SQM

Phase I

Development of
Staffing Quality Measures

Development of Staffing Quality Measures - Phase I

Final Report
July 25, 2005

Colorado Foundation for Medical Care

University of Colorado Health Sciences Center
- Division of Health Care Policy and Research

University of Missouri Sinclair School of Nursing

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Executive Summary

Introduction

The Centers for Medicare & Medicaid Services (CMS), the National Quality Forum, and the Institute of Medicine have all called for nursing home staffing measures that are rigorously defined, based on accurate data, and associated with quality of care. Although short-term modifications to the Online Survey Certification and Reporting System (OSCAR) are being implemented to improve the existing nurse staffing data, limitations exist in this system that cannot be overcome even with these interim modifications. OSCAR data lack the necessary information to generate measures other than staffing ratios (e.g., turnover/retention, tenure), that many argue are critical markers for nursing home quality. In addition, OSCAR data are limited to a two-week period, have been found to be inaccurate particularly for the lowest staffed facilities, and discrepancies exist in reporting certain elements. The purpose of this project was to investigate a wider array of staffing measures, and to assess alternative data sources that could be used for reporting staffing measures in the future. Early in the project, the decision was made to collect payroll data from several national corporations so that a large payroll record database could be constructed to test quality measures derived from payroll data. This report presents the methods and results from the initial analysis of staffing measures derived from payroll data, which examined measure properties across all facilities in which data were obtained.

Methods

An initial project task was to specify a set of staffing constructs (or attributes) that were considered to be associated with nursing home quality and meaningful to consumers and nursing home providers. The focus was not on precise definitions, rather identifying the constructs such as staffing ratios, staff turnover, presence of registered nurse (RN) staff, etc. These constructs were identified through a comprehensive literature review that served as the basis for a stakeholder meeting with 42 stakeholders including representatives from national organizations, nursing home corporations, and individual nursing facilities. Stakeholders addressed the following issues: 1) the aspects of nursing home staffing

most important to their constituencies; 2) how improvements could be made to the measures of staffing information currently presented on CMS's Nursing Home Compare; and 3) how staffing measures could be presented to the public. Following the stakeholder meeting, the nine-member technical expert panel (TEP) met and generated a list of constructs for the research team to pursue. In addition, the TEP was instrumental in the decision to pursue payroll data as the preferred data source for development of staffing measures because of its potential to generate the most accurate staffing measures with the lowest possible burden on nursing facilities.

Eight national nursing home corporations agreed to provide payroll data from their systems to support the development of staffing quality measures for this project. As a result, a database was constructed with payroll records from 1,453 facilities representing 48 states. Due to the receipt of annual census data from two corporations, staffing ratio measures could only be computed for 1,028 facilities. In total, over 11.6 million individual payroll records and 172,563 individual personnel records were received. Although data extraction specifications were sent to each corporation, construction of the database was complicated by the fact that no standards currently exist for job title categorization, duration of pay periods, and reporting of daily census data. Nevertheless, even with this lack of standardization, we were able to construct an identical set of measures for all facilities that provided the necessary data for the measures. Because this was the first time payroll data had been collected for computing staffing measures, unanticipated difficulties arose in constructing the database and associated measures. For example, we requested data for calendar year 2003; however, to compute turnover for the entire year of 2003, data from the first quarter of 2004 were necessary to determine if an employee was no longer being paid and thus employed by the facility. Through these analyses, we learned a great deal about payroll data systems and how to structure a data request that would eliminate many of the difficulties we encountered.

We were able to construct a wide array of measures pertaining to staffing ratios, staff mix, full-time employees, RN shift coverage, turnover/retention, and tenure. Many of these measures have never been calculated before or have not been calculated with the level of precision that we were able to obtain because prior studies lacked the raw data from which to construct the measures. However, other measures of interest to policy makers required data items that simply could not be provided by the corporations. These measures include: direct hands-on nursing care hours distinguished from indirect activities (e.g., documentation, reporting, phone calls, etc.), hours worked by contract agency staff (except

for one corporation), staffing ratios by shift or day of week, staffing levels by unit, and frequency of use of overtime for nursing staff. We are therefore unable to report these measures for the facilities in our database. However, we did receive data from one corporation that allowed us to investigate shift-level measures relating to coverage by RNs, though we could not calculate staffing ratios by shift because appropriate census data could not be obtained from that facility. Analysis of the data from the one corporation regarding the use of contract agency nursing staff is beyond the scope of this report.

Results

The analyses presented in this report were aimed at determining if equivalent measures could be computed across payroll systems, testing various measure definitions, and examining distributions of the measures and associations between measures. Highlights of these findings are presented below, organized by the different types of measures that were computed across all facilities.

Staffing ratio measures: The payroll data findings suggest that nurse staffing ratios can be captured most efficiently in three measures including CNA hours per resident day, all licensed nursing hours per resident day, and RN hours per resident day for direct care staff. Based on payroll data, hours per resident day averaged 1.97 for CNAs and 1.10 for licensed nursing staff including all RNs and LPNs in the facility (including management staff). One advantage of payroll data is that we were able to exclude nurse managers, such as directors of nursing (DONs) and assistant directors of nursing (ADONs) from some of the computations in order to calculate RN ratios that included only those RNs involved in resident care. This staffing ratio of 0.29 hours per resident day for RNs involved in resident care is considerably lower than estimates of RN time from other sources (that include DONs and ADONs), and yet is important to examine because these individuals have a different functional role than management staff. A substantial inverse correlation between RN and LPN hours per resident day ($r = -0.45$) suggests that considerable substitution occurs between these two types of licensed staff providing direct patient care. The finding that higher RN hours per resident day was associated with lower turnover in all types of nursing staff as well as all nursing home employees highlights the importance of RN direct care time. Payroll data provided the first opportunity to examine all nursing home employees, of which approximately two-thirds of the FTEs are nursing staff. Although staffing levels for all employees are highly correlated with nurse staffing levels ($r = 0.86$), the database provides an opportunity to identify and examine facilities that may substitute non-nursing staff time for CNAs.

Measures of percent of full-time employees: Payroll records provided a unique opportunity to examine the proportion of full-time employees relative to the proportion of part-time employees. Using a definition of greater than 35 hours per week, approximately 50% of nursing staff were full-time, and these full-time staff provided about 75% of all nursing hours. These proportions were relatively similar on average for all staff, with the exception of management, which had a higher proportion of full-time employees. An important finding in these analyses was that turnover rates for part-time employees were far greater than turnover rates for full-time employees, twice as high for several categories of staff. These findings suggest that facilities ought to specifically consider the needs of part-time employees when trying to reduce turnover and perhaps consider incentives to encourage staff to commit to full-time employment. Because of the high turnover for part-time staff and the wide distribution in percent of staff that are part-time ranging from approximately a third of staff in the top 10th percentile to three-quarters of staff in the bottom 10th percentile, further investigation of a measure of percent full-time employees seems warranted. Only a database derived from payroll records, however, can be used to uniformly compute such a measure.

RN shift coverage measures: Measures of RN shift coverage were examined for one corporation that provided shift-level data. A unique finding from this analysis was that RN coverage was greater on average than might be expected, with one RN available in three-quarters of daytime hours, two-thirds of evening hours, and almost half of nighttime hours (excluding DONs, ADONs, other nurse managers, and contract staff). However, these measures varied substantially with 10% of facilities having RN coverage less than 25% of evening hours and less than 10% of nighttime hours, whereas 10% of facilities had RN coverage about 90% of the time. An RN was covering the floor an average of 61% of the time for every 24-hour period, and this finding was consistent for both weekdays and weekends. Although 10% of facilities had less than 8 hours of coverage per 24-hour period, this analysis did not include coverage from contract nurses and management nurses who may have been covering these shifts. Because coverage was highly correlated across shifts and days, a single variable of RN coverage might be adequate for reporting purposes. These illuminating results are not available from any data source other than payroll data, and many extant payroll systems cannot readily extract these data at this time. However, payroll systems do contain the necessary data if each employee's work hours are submitted for each day they work and presumably could be extracted.

Turnover/Retention measures: Payroll data provided an opportunity to calculate turnover and retention using several methods, including the most traditional measure calculated as the rate of departures during a time period relative to the average number of positions. Rates of CNA turnover reported here (about 80%) were comparable to other findings for CNA turnover in previous studies (CMSO "Appropriateness of Minimum Nurse Staffing Ratios in Nursing Homes, Phase II", 2001). Unlike in previous studies, however, RN turnover was higher than CNA turnover at 88%. Several issues may explain this result including: the more current data available in this study during a time of nursing shortages; the more accurate nature of RN payroll data in contrast to other unaudited surveys; the exclusion of administrative nurses (e.g., DONs) who generally have lower turnover; and the possibility that corporations move nurses from one site to the next fairly frequently increasing RN turnover based on payroll data. Interestingly, the higher rate of RN turnover was not associated with an exceptionally high rate of very short-term employees (<60 days), i.e., "short-term turnover", a new turnover measure we were able to construct from payroll data. LPN turnover was lower than both CNA and RN turnover, with somewhat lower turnover in administrative nursing.

Using payroll data to compute turnover measures has multiple advantages relative to other methods. Use of personnel data were problematic because of variation in the way facilities defined termination of an employee, whereas we were able to use a uniform definition based on whether an employee received any salary for a period of 60 days or more. Personnel records also were not adequate for tracking an employee through multiple departures, rehires, or job classification changes. Finally, payroll data included employees who were employed by the facility during the time period of interest rather than measuring historically how many employees had terminated from personnel files. Nevertheless, even with payroll data the complexity of the turnover/retention construct requires that a precise measure definition is followed or the measures will not be comparable across facilities. If properly computed, turnover measures offer an important dimension of staffing for public reporting and quality improvement.

Tenure measures: To calculate tenure, only hire/rehire dates were used from the personnel data because facilities had different definitions of termination and held files open for varying periods after employees stopped working. Thus, payroll data were matched with the personnel data files and termination information was obtained from payroll records using a uniform definition. One-year and five-year tenure measures were calculated for both departed staff and employed staff. Of the employed staff,

about 60% of CNAs and two-thirds of licensed staff were employed at least one year, with figures in the 20%-30% range when looking at tenure of five years or more. DONs and ADONs had longer tenure: 80% at 1 year and 40% at 5 years. Although the numbers were much lower in total for departed staff, they followed the same trend. The correlation between these tenure measures and turnover measures ($r = -0.19$ for 1 year and $r = -0.12$ for 5 years) shows that these measures capture a different dimension of staffing than turnover; however, they are modestly associated with one another. The stronger associations between the employed staff tenure measures and turnover ($r = -0.46$ for 1 year and -0.25 for 5 years) suggest that employed staff measures may be more beneficial in characterizing current quality of care.

Conclusions And Recommendations

Strengths of payroll as a data source for staffing quality measures: These analyses demonstrated that payroll data can be used to generate uniformly defined quality measures that are not available from other data sources. Staffing measures that were unique because of payroll data included: RN staffing ratios for RNs providing direct resident care (non-management); staffing ratios for all employees; percent of staff that were full-time; turnover and retention measures defined in new ways (e.g., short-term turnover); and turnover and tenure measures with uniform termination definitions. Because payroll data originate from employees and are used to pay their salaries, there is an incentive for both the employers and employees to ensure accurate data, and therefore they are more accurate than reporting systems such as OSCAR where facilities calculate and report the required information. Payroll data are susceptible to audit and would be extremely difficult to alter based on incentives. By building on raw data elements in payroll records to construct the measures, variation in definitions and non-comparability between sites can be avoided. Thus, CMS should consider pursuing payroll data in generating staffing measures for public reporting, quality monitoring, research, and demonstrations.

Feasibility of using a payroll record database for computing nursing home staffing measures: Our major difficulties encountered in using payroll data resulted from lack of standards for data extraction and problems with our data specifications. For the most part, payroll systems collect the same raw information and are typically capable of extracting the set of data that is necessary to compute the various staffing measures included here. Although this project involved nursing homes affiliated with chains, survey findings from the continuation of the CMSO "Appropriateness of Minimum Nurse Staffing Ratios

in Nursing Homes, Phase II" (2001) study supported the ability to provide payroll data among nursing home facilities that were not affiliated with major nursing home chains. Furthermore, these 180 facilities from five states that varied in size and payroll systems reported that they would be able to report resident census, nursing hours by licensure type, distinguishing hours worked and hours paid, and provide the information necessary to calculate turnover and retention. Thus, reporting staffing data through standardized extraction from all systems likely offers the least burdensome and most accurate method that would not require survey agency audit.

Because of the exploratory nature of this study, we accepted payroll data in any format we could obtain it and encountered problems that could have been prevented by tighter specifications. If CMS were to use payroll data, a set of requirements or standards could be prepared based on our current knowledge from this study so that facilities extracted the same information in the same format rendering the calculations more uniform. For example, we collapsed 1,551 job classifications from facilities into 11 categories, which could be defined so that all payroll systems could map to the standard job categories while retaining whatever job classifications the nursing home or payroll company chose. The actual number of data elements required in the extract would be relatively modest for each employee payroll record. The experience gained in this analysis could be used to generate data requirements for payroll data extraction that would standardize the necessary data elements across facilities, corporations, and payroll companies. Because a requirement would standardize the extraction of payroll data without necessarily changing payroll systems, we believe that most systems could adapt without much burden. However, we recommend that a feasibility study be conducted of a payroll-based reporting system to examine the feasibility, burden, and costs associated with extracting payroll data from various nursing homes and companies according to uniform specifications, obtaining standardized contract staff data from invoices or other sources, and establishing and maintaining a payroll database.

Use of staffing quality measures developed from payroll data for public reporting and quality improvement: The findings from these analyses suggest that an array of measures are possible for examining nursing home staffing. Many of the staffing measures calculated from payroll data have never been generated precisely in a sample of over 1000 facilities because the necessary data were never available. This initial phase of the project has resulted in the identification and construction of many candidate measures that will need to be further analyzed in order to identify the optimal measures for public reporting. This essential work, planned for Phase II of this study, would address issues such as

comparisons among facilities, relationships between facility characteristics and staffing measures, the use of these measures in nursing homes that utilize alternative types of staffing models, and the association between various staffing measures and nursing home quality of care measures. Furthermore, the multiple dimensions of staffing (e.g., staffing ratios, turnover, tenure, proportion of full-time staff) suggest that an array of measures may be of interest for in-depth understanding of staffing problems and staffing improvement activities, even if a more parsimonious selection of measures is used for public reporting. One could envision a profile of staffing measures for facility use in quality improvement. Thus, we have a unique opportunity to build on the substantial investment made to produce this rich data file by conducting a more rigorous analysis than has been possible of staffing differences across corporations, regions, and facilities and of the association between staffing and quality of care.

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1 Introduction and Background

1.1 Background

Public reporting of nursing home staffing measures that are rigorously defined, based on accurate data, and associated with quality, has become a national priority. In the spring of 2003, the National Quality Forum Nursing Home Steering Committee recommended that a nurse staffing quality measure be included in the set of nursing home quality measures that are reported to the public. The Institute of Medicine (IOM) report entitled, "Keeping Patients Safe: Transforming the Work Environment of Nurses" (2004) cited evidence for a relationship between nurse staffing and quality of care. This report also included recommendations relating to the collection and reporting of staffing data. The Center for Medicaid and State Operations (CMSO) "Appropriateness of Minimum Nurse Staffing Ratios in Nursing Homes, Phase II" (2001) study indicated that critical nurse staffing ratios exist, below which, nursing home residents are at increased risk of quality problems; that these thresholds exist for each type of staff (registered nurses, total licensed staff, and certified nurses assistants); and that critical thresholds vary depending upon the case mix of the facility. A continuation of the CMSO study is addressing short-term modifications to the existing nurse staff reporting system, which utilizes data from the Online Survey and Certification and Reporting System (OSCAR), as well as recommendations for future options. The Development of Staffing Quality Measures – Phase I (SQM) project is proceeding concurrently with the CMSO project and is designed to expand on previous work by reviewing a range of staffing measures and data sources for longer-term use in public reporting of staffing quality measures for nursing homes. Specifically, the SQM project is intended to investigate staffing measures beyond ratios (e.g., turnover, staff mix) and to assess alternative data source options for future use.

Based upon extant literature and input from a technical expert panel (TEP) and stakeholders, the decision was made early in the project to test quality measures derived from payroll data. Following a brief summary of previous activities in the project, this report presents the methods and results from initial analysis of staffing measures derived from payroll data. These initial analyses focus on measure properties across all facilities from which data were obtained. Subsequent analyses in future reports will

address issues such as comparisons among facilities, relationships between facility characteristics and staffing measures, data involving contract staff, and the use of these measures in nursing homes that utilize alternative types of staffing models. In addition, subsequent work will involve validation of measures that pass initial screening criteria in terms of association with resident-level outcomes, and will discuss the need for and approaches to case-mix adjustment.

1.2 Project activities to date

The initial project step was to specify a set of constructs, or attributes, of staffing that were considered to be associated with nursing home quality and meaningful to consumers and nursing home providers. The focus was not on precise definitions, rather identifying constructs such as staffing ratios, staff turnover, presence of registered nurse (RN) staff, etc. To obtain a comprehensive list of staffing constructs, we conducted a thorough literature review of studies involving staffing in nursing homes (Development of Staffing Quality Measures – Phase I, Literature Review, University of Missouri Sinclair School of Nursing, January 2004). A meeting was then held with 42 stakeholders including representatives from national organizations, nursing home corporations, and individual nursing facilities. Stakeholders addressed the following issues: 1) the aspects of nursing home staffing most important to the stakeholders and their constituencies; 2) how improvements could be made to the measures of staffing information currently presented on Nursing Home Compare; and 3) how staffing measures could be presented to the public. The technical expert panel, composed of nine experts in the areas of staffing measurement, data sources, and methods, attended the stakeholder meeting and met following the stakeholder meeting to generate a list of measures for the research team to pursue. Details of the procedures followed and an enumeration of the measures recommended by the TEP are provided in the project report "Development of Staffing Quality Measures – Phase I, Data Collection Options for Staffing Data, June 30, 2004", included in Appendix A of this report.

In addition to discussing potential staffing measures, the TEP was asked to consider data sources that could be used in this project to measure staffing. As part of the discussion, information on data sources from the previously mentioned CMSO study was briefly presented to the TEP. After considerable discussion, payroll records received the highest endorsement by TEP members, with eight of the nine TEP members favoring the use of this data source in the SQM project. The discussion endorsed a focus on development and testing of staffing measures derived from payroll data because of the potential to

generate the most accurate measures of interest with the lowest possible burden on facilities. As a result, the project Statement of Work was modified to require the acquisition and analysis of nursing home payroll data instead of OSCAR and Medicaid claims data as originally planned.

We initiated a series of discussions with representatives from several national nursing home corporations regarding their payroll data systems and the feasibility of using those systems to extract the data elements needed to create staffing quality measures. These discussions led to an introductory pilot data collection activity, which informed the content and structure of a subsequent, formal payroll data abstraction. Corporations encountered numerous difficulties extracting information from their data systems, and many concessions were made to maximize the number of entities providing data. The data ultimately received contained various inconsistencies, some resolvable and some not resolvable. Corrections were made wherever possible; records with irresolvable data issues were deleted if the error was severe, otherwise the records were retained and implications for the interpretation of results were noted. These issues and their resolutions are described in detail in the project report "Development of Staffing Quality Measures – Phase I, Documentation of Nursing Home Staffing Database, November 30, 2004", included in Appendix B of this report.

1.3 Objectives of this report

The database created for this project is unique in that it provides a comparable set of measures generated from payroll data from a national sample of over 1400 facilities. The process of rendering the staffing measures comparable across different corporations was a significant undertaking, which is carefully documented in the methods section of this report. We present results on distributional statistics for the various measures, assessment of stability of measures over time, and correlations among measures. The report also tests variants of measures calculated over different intervals. We discuss advantages of the payroll data and problems in using it, and recommendations for how to request payroll data for future work or ultimately public reporting. With the considerable investment that was necessary to both acquire the data and build the analysis file, the continued analysis of this file will be more enlightening. Thus, conclusive results about which measures are optimal for public reporting cannot be provided until further analyses of the measures and their validity are conducted.

2 Methods - Measure Creation

2.1 Data acquisition

National nursing home corporations were invited to provide staffing information for their constituent nursing facilities. We requested payroll and personnel records for every employee who worked during calendar year 2003, as well as daily census records for 2003. The individual data items requested included facility and employee identifiers, employee job title, employee productive and non-productive hours paid by date, employee hire and termination dates, reason for termination, and daily census. For corporations providing payroll data at the shift level, clock-in and clock-out dates and times were requested. Using these items, we constructed measures of staffing ratios, staff mix, RN shift coverage, turnover, retention, and tenure.

Eight corporations provided these data for 1453 individual nursing homes. As shown in Figure 1, the facilities are nationally distributed, with at least one nursing home in almost every state and the District of Columbia. We received no data for nursing homes in Alaska or in New York. The state of New York places regulatory limitations on the types of nursing facilities it allows to operate within the state, which was reflected in our database.

In order to maximize the number of corporations and facilities providing data, certain modifications to the data specifications were allowed, provided that data integrity was maintained. Even with modification, however, not all corporations were able to provide all data items as specified. Table 1 shows the data received from each corporation and the number of facilities for which the different measures can be calculated. The number of facilities per corporation ranges from 11 to 360, depending on the type of measure considered. In total, over 11.6 million individual payroll records and 172,563 individual personnel records were received.

Various data problems and inconsistencies were identified as the data were reviewed prior to creating the new staffing measures. Some of these problems were due to the lack of a standard extract while others are inherent to payroll data. These problems and their resolutions are listed by data source in Table 2. One issue relevant to all data sources is the type of facility included in the database. This project was specifically designed to assess staffing in Medicare-certified and/or Medicaid-certified nursing facilities

Figure 1: Distribution of nursing facilities that provided payroll, census or personnel data, by state (n=1453)

Legend: 0 | 1-20 | 21-40 | 41-60 | 61-80 | More than 80
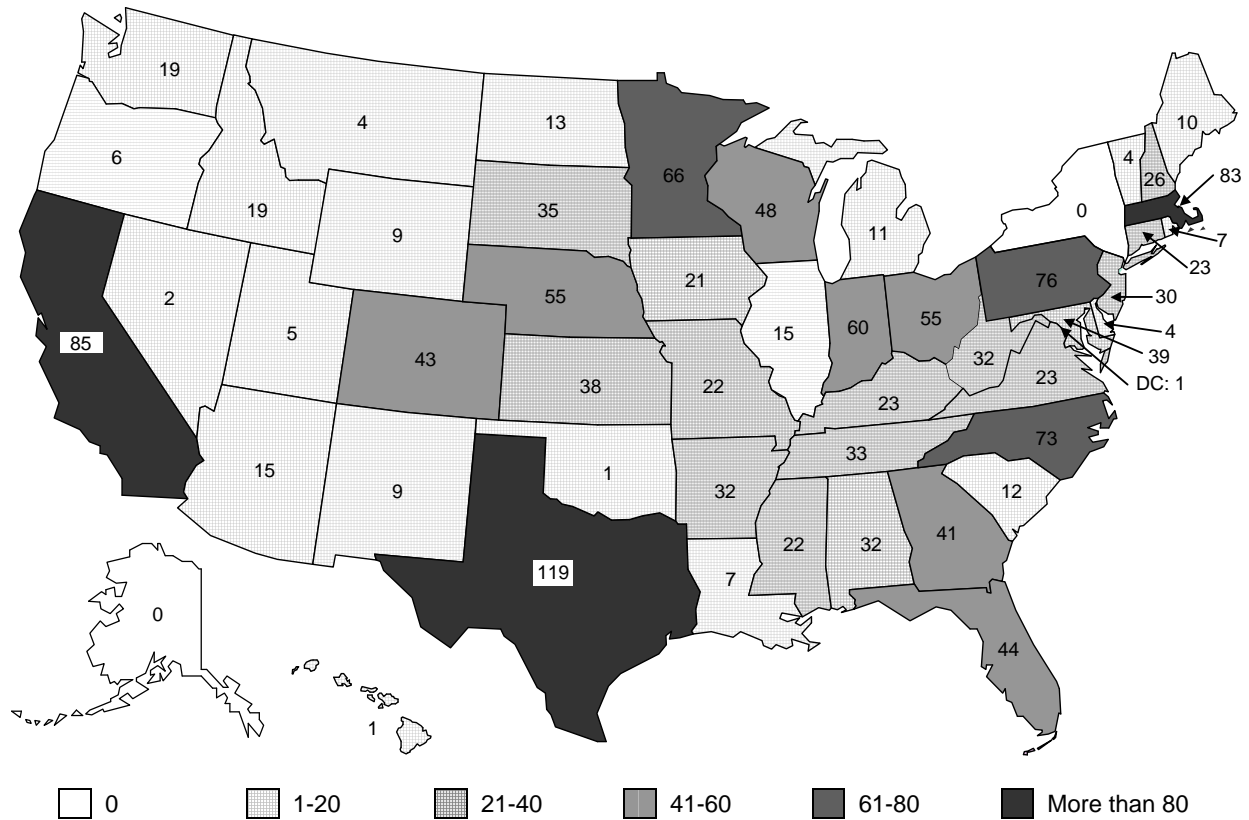
Table 1: Number of facilities per corporation for which different measures can be created

Corporation	Level of census data	Staffing ratios*	Staffing levels and turnover using payroll records only	Tenure using personnel records
1	Daily	345	360[§]	--
2	Yearly	--	144	144
3	Yearly	--	195	191
4	Daily	52	52	--
5	Daily	245	245	245
6	Monthly	279	342	--
7	Daily	76	84	84
8	Daily	31	31	11
Total		1028	1453	675

* Requires payroll data, and census data provided at the daily or monthly level for each facility
[§] Due to the structure of these data, staffing ratios were calculable, but turnover measures were not

Table 2: Data problems and decisions made

Problem Description	Decision
All data files	
Records without any facility identifiers	If facility identifiers could not be obtained from the corporation or found by cross-referencing other data files, these records were deleted
Facilities with Medicare provider number that indicates something other than a SNF	Facilities with non-SNF Medicare provider numbers were deleted
Job titles	
Job descriptions vary for the same job code	Used job description only
Job descriptions vary by facility (even within the same corporation)	Created a crosswalk of job codes across facilities and corporations
Missing job codes and descriptions	Cross referenced other payroll records or employee status records for the employee's job code/description. For 80 records where a job code/description could not be found for an employee, the record was classified into the "general" category.
Job title indicates more than one job category (e.g., RN/DON)	Classified into "highest" job category (e.g., DON)
Job title indicates non-SNF position (e.g., RN - ICF)	Left record as is
Payroll data	
Payroll hours exceed the number of hours expected for a given pay period	Excessive hours for a pay period = 12 hrs x Number of days in pay period (e.g., 168 hrs for 14-day pay period). Excessive productive hours (or total hours for corps that reported only total hours) were set to zero.
Negative hours reported for a pay period	Negative payroll hours were set to zero
Records with inconsistent or illogical dates	Records with inconsistent or illogical dates that could not be resolved were deleted
Payroll records missing for a significant portion of year	Facilities with 120 or more days missing (all staff) during the first 50 weeks of the year were deleted
Records show zero productive or zero total hours for the all staff job category	For any day, if all staff hours = 0, hours for all staff type categories were set to missing

Table 2: Data problems and decisions made (continued)

Problem Description	Decision
Payroll data (continued)	
Individual employee does not have a record for a specific pay period	We assumed the employee worked zero hours for the pay period
Data appears incomplete - sudden severe drop in hours for a given day	If daily total hours for the all staff job category drops to ≤15% of facility annual mean, then all hours were set to missing for that day for all job categories
Census data	
Data provided for non-Medicare/non-Medicaid facilities	Non-Medicare/Non-Medicaid facilities were not included in any analyses. Facilities with zero Medicare days and zero Medicaid days for the year were deleted.
Annual average daily census was submitted instead of actual daily census	These facilities were not used to calculate staffing ratios
Census data was negative or excessively low	Test for low census data (≤15% of facility annual mean), and if negative or low used mean substitution using the annual mean census
Monthly average daily census was submitted instead of actual daily census	For each month, average census was used for each day of the month

(NFs) and skilled nursing facilities (SNFs). Some corporations submitted data from other types of facilities, such as long-term care hospitals or assisted living facilities; these data were deleted. A second issue common to all data sources was the need for facility identifiers. Because different types of data were submitted in different data files, some measures required merging the data files for a given facility. This required that a facility identifier be present on each file; records without such facility identifiers were necessarily deleted. The remaining items in Table 2 are specific to different measure types and will be discussed in the pertinent sections below.

It should be mentioned that other measures that might be of interest to policy-makers required data items that simply could not be provided by the corporations. These measures include: direct hands-on nursing care hours distinguished from indirect activities (e.g., documentation, reporting, phone calls, etc.), hours worked by contract agency staff, staffing ratios by shift or day of week, staffing levels by unit, and frequency of use of overtime for nursing staff. We are therefore unable to report these measures for the

facilities in our database. However, we did receive limited data from one corporation that allowed us to investigate some shift-level measures, though we could not calculate staffing ratios by shift. We also received limited data from another corporation regarding the use of contract agency nursing staff; these data will be analyzed in a subsequent analytic phase following this report.

2.2 Job title categorization

Employees' job titles were requested so that staffing measures could be calculated by job category. The corporations provided 1551 individual job titles used by their facilities. These individual job titles were reviewed and collapsed into 11 common categories. Table 3 lists the categories and provides examples of the job titles they contain. Job titles that spanned more than one category were placed into the "higher level" category, under the assumption that an employee would spend the majority of his or her time at the higher level. For example, the job title "RN/DON" was placed in the Director of Nursing (DON) category because we assumed that most of the employee's time would be spent on DON-specific duties. Records with missing job titles were cross-referenced to other payroll or personnel records for that employee; 80 records remained with unknown job title and were classified into the "all others" category.

Table 3: Job title categories and examples

Job category	Examples of job titles
Administrator/Director	Administrator, Executive Director, Medical Director
DON	Director of Nursing
ADON	Assistant Director of Nursing
Other nursing administration	Case Manager, CNA Instructor, Infection Control Nurse, MDS Coordinator, Quality Improvement Coordinator, Wound Care Coordinator
Advance Practice Nurse	Clinical Nurse Specialist, Nurse Practitioner
RN	Registered Nurse
LPN	Licensed Practical Nurse, Licensed Vocational Nurse
CNA	Certified Nurse Aide, Certified Medication Aide, Restorative Aide
Non-certified nurses aide	Bath Aide, Caregiver, Nursing Assistant, Orderly, Personal Care Assistant
Other nursing	Nurse, Rehab Nurse, Restorative Nurse
All others	Bookkeeper, Cook, Customer Relations Director, IT Manager, Laundry Aide, Maintenance Technician, Physical Therapist, Social Worker, Unknown (missing) job titles

In some situations, an employee's job title suggested that he or she may work in a facility (or a unit within a facility) not referred to as a SNF or NF, e.g., "RN - ICF". We chose to retain these employee records in the database for several reasons. First, only a few certain facilities made this distinction in their employee job titles; most facilities' job titles simply indicated the employee's position, e.g., "RN". Employees at these latter facilities also may have worked in non-SNF/NF units, but the data do not make that distinction. Also, it may be that an employee with a title such as "RN - ICF" actually worked in several units within the building, but was given the ICF (intermediate care facility) unit title for other business concerns. The payroll records do not indicate how many hours the employee actually worked on the non-SNF/NF unit versus the SNF/NF itself. Furthermore, it is unclear if the facility census data included or excluded such units. Given that we can't make these distinctions uniformly across all facilities, we elected to include all staff titles and count as many staff as possible, though this may be a distortion of the true staffing picture. A standard set of job titles for reporting purposes would mitigate problems we encounter with allocating employees to specific job categories.

At the stakeholders meeting in March 2004, concerns were raised that traditional measures of nursing staff would not accurately reflect organizations with atypical or alternative staffing practices. Certain facilities may train clerical staff to perform non-nursing duties that often fall to nursing staff, such as responding to family complaints. This allows the facility to employ fewer nurses, but nursing staff are then able to devote more time to direct patient care. Other facilities operate under the philosophy that all employees are engaged in patient care, at least indirectly, and that these employees would be artificially excluded from counts of nursing staff. Other stakeholders argued that employees with advanced education or training should be counted separately from traditional nursing staff. On the other hand, several stakeholders maintained that nursing staff measures should be restricted to only nursing staff. The TEP members listened to these conflicting arguments and concluded that we should pursue the traditional measures of nursing staff such as registered nurse (RN), licensed practical nurse (LPN), and certified nurse assistant (CNA), but that we also include a measure of total staff that includes literally all employees. Recognizing that we can not report countless staffing measures for each possible different type of staff, including a measure for total staff seemed to be the best compromise. Alternative staffing model facilities are not currently well-represented in our database; we expect to obtain more data from such sites for future analysis.

The 11 job categories were further collapsed into three broader categories: 1) licensed nursing staff, which included DON, Assistant Director of Nursing (ADON), other nursing administration, advance practice nurse (APN), RN, and LPN; 2) all nursing staff, which included DON, ADON, other nursing administration, APN, RN, LPN, CNA, non-certified nurses aide, and other nursing; and 3) all staff, which included all job categories. Selected combinations of staff were also created, including RN+LPN, which simply combined the RN and LPN categories, and DON+ADON, which simply combined the DON and ADON categories.

2.3 Creation of staffing ratios, staff mix, and shift coverage measures

Payroll and census data were used to construct staffing ratios (hours per resident-day) by staff type and measures of staff mix (proportion of different types of staff, and percentage of hours worked by full-time employees). RN shift coverage (proportion of shift with at least one RN present) was constructed using raw time-clock payroll data from one corporation. All measures were calculated at monthly, quarterly, semi-annual, and annual time intervals. Payroll records that spanned two time intervals were prorated to appropriately distribute hours into each time interval. Missing, extraneous, and incomplete data were identified and modified or deleted as appropriate.

2.3.1 Cleaning pay period records and census data

Seven of the eight corporations provided payroll data by pay period and one corporation provided raw time-clock payroll data. It should be noted that much of the work devoted to cleaning up and standardizing the data could have been avoided or mitigated if data conforming to a standardized set of data elements could have been provided by each organization. For example if data elements such as pay period length, type of hours worked (e.g., productive versus non-productive), application of accounting adjustments to hours worked, etc. were the same for each corporation, cleaning and merging of the data would have been simplified.

Only payroll records for calendar year 2003 were retained. Pay periods that began in 2002 and ended in 2003 or that began in 2003 and ended in 2004 were prorated to remove hours outside calendar year 2003. For example, if an employee's payroll record indicated 35 hours in the pay period beginning December

30, 2002 and ending January 5, 2003, the hours were adjusted downward to 25 hours (35 x 5/7) because two days in that pay period fell outside calendar year 2003.

The payroll data were analyzed for gaps between pay periods as well as for overlapping pay periods. All employees that had missing pay periods were assumed to have zero hours during those pay periods. Pay periods with zero hours were inserted into the database for employees with missing pay periods. To maximize data submission, as mentioned previously, corporations were permitted to modify the data specifications resulting in issues unique to each corporation that required various assumptions and adjustments to the data. For example, some corporations did not provide a pay period begin date but only an end date for the pay period. For this situation when pay periods were standard (e.g., always 14 days) a begin date was easily calculated. When pay periods varied, a begin date was calculated based on various factors such as facility or corporation norms (e.g., the pay period always begins on Wednesday). Sometimes the end date of the previous pay period was used to determine the next pay period start date. Some pay periods were eliminated entirely because they overlapped with other pay periods or because they did not conform to the normal pay period end date, indicating that these records were for an atypical purpose such as bonus payments or accounting adjustments.

Payroll records were analyzed for negative and very high hours, which appeared to be the result of accounting adjustments presumably for special situations such as bonuses or terminations. All pay period records with negative hours were set to zero hours. A high hours outlier test was applied to all pay period records as well. If the per-day hours for the pay period exceeded twelve hours then the pay period record hours were set to zero. In a small number of cases (236), all pay periods for an employee were either negative or very high. When this occurred, all records for that employee were deleted.

Some corporations provided multiple records per pay period for each employee. For example, one corporation provided payroll data where it appeared each record was a type of hours (regular, overtime, vacation, etc.). In these situations, the multiple pay period records were summed to obtain all hours for a given pay period for each employee.

Most corporations provided bed census data split by payer type (Medicare, Medicaid, private pay, or other) as requested. Examination of the bed census data revealed that some facilities had zero Medicare-covered residents and zero Medicaid-covered residents for the entire year. These facilities were removed

from the database as we suspected they were not Medicare/Medicaid-certified facilities. Bed census data were provided for each facility at daily, monthly (i.e., the average daily census for each month), or annual (i.e., the average daily census for the year) levels depending on the corporation's ability to supply this information. One corporation provided monthly data that had very low and negative bed census data in the last quarter for some facilities. Two changes were made in the monthly census data in order to use this corporation's data. Mean substitution was applied to those months with negative or very low bed census values based on the remaining valid months using a 15% test of the mean. If the bed census for a particular month was less than 15% of the average bed census for all the other months, the low or negative bed census values were replaced with the mean bed census for that facility. Mean substitution was applied to 19 facilities for up to three months in the last quarter. In addition, the monthly bed census data was disaggregated to a daily time interval (the same monthly value was assigned to every day of the month). Yearly census data was not used to calculate any measures. Nearly all of the problems with bed census data would have been eliminated with an accurate, standardized daily bed census data element.

2.3.2 Prorating pay period data

Pay periods between corporations, within corporations, within facilities, and even for an individual employee varied in length. For maximum flexibility in creating subsequent measures, pay period hours were disaggregated to a daily level. For example, an employee with 35 hours for the pay period beginning on January 1, 2003 and ending on January 7, 2003 would be assigned five hours for each of the seven days in the pay period. If the pay period showed zero hours, then zero hours were assigned to each day in that pay period. Using daily hours, staffing measures for any time interval of interest could be constructed. Daily, weekly, monthly, quarterly, semi-annual, and annual time intervals were constructed for each measure, however only monthly, quarterly, semi-annual, and annual measures are provided in this report.

2.3.3 Aggregation of hours by job category to a facility level

Because some employees worked at multiple facilities or held multiple positions within a facility, identifiers were created that combined the facility ID, the employee ID, and the employee job category variables. Hours in a pay period for an employee with multiple responsibilities were then allocated to the proper facility and job categories. (Note that this is possible only for those facilities where employees

with multiple job categories or employed by multiple facilities have separate payroll records for these situations. Some corporations track the hours such employees work in various locations, but other corporations do not.) Using these unique identifiers, pay period hours for each employee were classified into a job category and their hours were aggregated to the facility level (summed across employees at that facility) by job category for each calendar day. The hours could then be used to create staffing measures for various time intervals and job categories.

2.3.4   Missing data

Missing data problems would be mostly eliminated with a standard extract but were present at a number of levels in the data we received. At the corporation level, some corporations had days (almost always for an entire pay period) for which there were no hours for any facility. Many of the corporations did not include hours for roughly the last two weeks in December. Some corporations had missing data for all facilities for one or more weeks during the year (this was mostly for one corporation where a data transfer error resulted in the loss of a month of data).

At the facility level, data were missing for sporadic time periods, and sometimes for nearly the entire year for a few facilities. There were also pay periods in which a significant drop in hours occurred, usually, but not always, in December, possibly reflecting incomplete data abstraction. Missing data in December appear to have been the result of corporations not providing all of the pay period records for pay periods that began in December 2003 but ended in January 2004. To distinguish facilities with suspected incomplete data from facilities with legitimate very low hours, a test was applied to hours for the all staff job category at the facility level. If the number of aggregated hours for the all staff job category fell below 15% of the average hours over the entire year for any given day, then the hours for that day were set to missing for all job categories. Because the payroll data were generally supplied by pay period, blocks of days, most often for seven or fourteen days, were affected. For example, if a facility's average daily all staff hours for the year was 500, then any days with hours less than 75 (15% of the mean) were set to missing. Based on the evaluation of the all staff category, the hours in other job categories were also set to missing for those corresponding days under the assumption that if the all staff hours were inaccurate, all other job categories were inaccurate as well. No adjustments to the data were made for high hour outliers at the job category level.

At the employee level, for days on which an employee had no payroll records, a missing value was generated for pay periods outside the first or last pay period record available for that employee. As discussed earlier, zero hours were assigned to any pay periods within the time frame of other payroll records. Missing pay period records could occur for several reasons. For example, an employee might begin working sometime after January 2003 or leave before the end of 2003 or there might be gaps in the employment history possibly reflecting a termination and re-hire. Payroll records could also be missing because they were not provided by the corporation.

2.3.5   Productive versus total hours, bed census interval and contributing facilities

Payroll and bed census data were provided in varying formats by each corporation which required substantial programming to insure quality measures were properly calculated. A standard extract would eliminate the work associated to tacking and calculating different types of hours and measures. Four corporations provided staff hours as separate variables for productive hours (hours actually worked) and non-productive hours (vacation, sick leave, etc). One corporation provided only total hours (the sum of productive and non-productive hours) and three corporations provided only productive hours. Bed census data were also provided for different time intervals with two corporations providing yearly data (a single value for each facility), one corporation providing monthly data (12 values for each facility), and four corporations provided daily census data (365 values for each facility).

In order to maximize the number of contributing facilities, staffing measures were calculated using the appropriate data that were available while minimizing interpolation of the data. For example, for those corporations that only provided productive hours, a multiplier could have been applied to convert the productive hours to total hours, however this was not done. Similarly, for those corporations that supplied yearly bed census data, the yearly data could have been used to calculate staffing ratios but this was not done. For the one corporation that supplied monthly bed census data, monthly bed census was used with modifications as previously described. Because staffing ratios require the use of bed census data, only those facilities with daily or monthly bed census data could be used. Staff mix measures do not use bed census data, therefore these measures were calculated for all facilities that provided either productive and/or total hours. Because corporations provided hours in different ways, the staff mix measures for productive hours versus total hours are created with different contributing facilities and corporations. For the set of staff mix measures that capture the proportion of hours worked by full-time

employees, a conversation factor of .931 was used to determine full-time status for those corporations that only supplied productive hours. One corporation did not supply payroll data at the employee level, therefore it was not possible to use that corporation's data to calculate the percentage of full-time staff measures. A total of 1079 facilities provided productive hours and of these, 748 facilities also provided monthly or daily bed census data. A total of 764 facilities provided total hours and of these, 625 facilities also provided monthly or daily bed census data.

2.3.6 Staffing ratios

In order to calculate staffing ratios, payroll data (hours worked and/or paid for) must be combined with census data. The census variable counts the number of residents present in the facility on a given day, and ranges from zero to the total number of beds in the facility. Productive hours are employee hours worked during a given time interval. Total hours are productive hours plus hours that are not worked but are part of the payroll system, such as sick leave, vacation, etc. The staffing ratios are calculated by dividing the total number of hours for any particular group of staff in a given time interval by the sum of the daily census figures during that same time interval.

Staffing ratios were calculated using both productive hours and total hours for each of seven job categories. The job categories were RN, LPN, CNA, RN+LPN, licensed nursing, all nursing, and all staff (See Table 3 for job category descriptions). Each of these 14 measures was calculated for monthly, quarterly, semi-annual and annual time intervals. Descriptive statistics that provide the number of contributing facilities, mean, standard deviation, minimum, and maximum for all staffing ratios at each time interval are provided in Appendix C. The calculation of each of these measures is the same except that the contributing employee hours change (productive versus total hours for each of the seven staffing groups) depending on the desired measure. Therefore, only the method for calculating the RN staffing ratio (RNHRD) will be provided in detail. The same methodology was used to calculate the staffing ratios for the other staff groups.

To calculate RNHRD a seven-step process was applied to the payroll and bed census data. A number of these steps would be eliminated with a more standard data extract. The first six steps are exactly the same for calculating the staff mix measures (Section 2.3.7). In Step 1, all payroll records provided by each corporation were evaluated for integrity at whatever structure was supplied by each corporation.

Transformations were applied to each corporation's data independently because each corporation had unique issues that needed to be addressed, such as extraneous payroll records, missing pay period start or end dates and records that fell entirely outside calendar year 2003. All payroll records were deleted or modified as appropriate. Of the original 210,588 unique employee IDs, all associated payroll records for 3334 employees were deleted, resulting in 207,254 employees being represented for all corporations after completing Step 1.

Step 2 brought all payroll records to a pay period level with valid pay periods and hours sorted by facility ID, employee ID, job category and pay period start date. Some corporations had multiple records for different types of hours, while other corporations had separate variables for different types of hours but only one record for each pay period. Using facility, employee and job category identifiers to sort the pay periods resulted in some employee's pay periods being split between different facilities and/or job categories. In effect, employees that worked at multiple facilities or multiple job categories were treated as if they were two or more separate employees, potentially affecting the full-time versus part-time designation of the employee. (See Section 2.3.8 for additional discussion). An employee's pay period begin and end dates were adjusted, if appropriate, and separate variables for productive, total, full-time productive and full-time total hours were created depending on the structure of the data provided by the corporation. Pay period start and end dates were evaluated to determine if there were overlapping pay periods or missing pay periods. If pay periods overlapped (a rare occurrence) the earlier pay period end date was adjusted so that the overlap was eliminated, consequently reducing the length of the pay period (hours were not adjusted). If there were missing pay periods between an employee's first and last pay period, a pay period record was created that had zero hours for this pay period. Four major adjustments relative to pay period hours were performed. Hours for pay periods that were partially outside calendar year 2003 were prorated (reduced) by dividing the pay period hours by the number of days in the pay period and multiplying by the number of days that were in calendar year 2003. Separate variables for all staff productive hours, full-time staff productive hours, all staff total hours and full-time staff total hours were created. Pay periods that had negative hours were set to zero hours. Excessively high hour pay periods were identified by dividing the pay period hours by the number of days in the pay period. If the result was greater than 12, hours for these records were set to zero. If employees had zero hours for all pay periods, all of their pay period records were deleted. Of the 207,254 unique employee IDs, 236 employees were deleted, resulting in 207,018 employees being represented for all corporations. No further deletion of payroll records was done.

Step 3 disaggregated hours for each pay period to daily time intervals and summed all hours for all employees into the same job category for each facility. Variables (365) for each calendar day for year 2003 were assigned a fraction of the hours for each type of hour. For example, if an employee worked 35 productive hours during a pay period that started on January 1st and ended on January 7th, then five hours were assigned to each of those seven days. All staff productive hours, full-time staff productive hours, all staff total hours, and full-time staff total hours were all kept in separate variables. (See Section 2.3.8 for details on full-time hours.) All records were then sorted by facility and job category. Hours were then summed across each job category resulting in the total number of hours for all employees in one of the seven job categories for each calendar day.

Step 4 created separate files for each of four types of hours (all staff productive hours, full-time staff productive hours, all staff total hours, and full-time staff total hours) and summed all hours for each job category to a facility level. Each of the resulting files contained 365 variables representing each day of the year for each of the seven job categories plus the facility identifier resulting in 2556 variables. Each corporation's data were processed in separate files because of different data structures. One corporation provided data that had already been aggregated to staff groups rather than at an employee level and therefore was included at this step after initial clean up of the payroll records.

Step 5 disaggregated bed census data to a daily time interval for one corporation, modified the bed census data (negative or very low values) using mean substitution and then merged the daily bed census data with the hours data at a facility level. Some facilities were lost during the merge process because some facilities had bed census data but no hours data, while other facilities had hours data but no bed census data. For all corporations there were 1374 facilities with valid bed census data (yearly, monthly, daily) and 1,436 with valid hours data. After merging there were 1357 facilities that could potentially be used for calculating the various staffing measures, however because yearly bed census data was not used, only 1022 facilities were available for calculating the staffing ratio measures.

Step 6 evaluated the hours for very low, zero, and missing hours for the all staff job category and then used this evaluation to set to missing hours for the remaining six staffing groups and the bed census data where appropriate. Data from each corporation were processed separately, as were the four types of hours and each of the seven staffing groups. Using the evaluation of low, zero and missing hours from

the all staff group, a matrix of binary indicators was created for valid hours on any given day for each facility. The binary indicator determined if there were missing data for that facility on that day (0) or if there were valid data for that facility on that day (1). This matrix was then used to set to missing all hours for each job category and also for the bed census data for each day and each facility. For a given facility, selected days were set to missing for all job categories. All other days had valid hours or bed census data that were either zero or positive. For example, if seven days were missing in December for a particular facility, then any measures that were calculated for December would only use the valid 24 days, because hours and bed census for invalid days would be set to missing. Facilities with more than 120 days of missing data in the first 50 weeks of the year were then deleted. Four facilities were deleted at this point leaving 1353 facilities for calculating various staffing measures.

Step 7 calculated RNHRD for various time intervals by summing RN hours for every day for various time intervals and then dividing the summed RN hours by the sum of daily bed census for the same time interval. RNHRD can be created for any time interval, however because data were provided by pay periods that were generally one to two weeks in length, time intervals of less than two weeks may not be reliable. The following staffing ratios were calculated for both productive and total hours:

- RN hours per resident day (monthly, quarterly, semi-annual, annual)
- LPN hours per resident day (monthly, quarterly, semi-annual, annual)
- CNA hours per resident day (monthly, quarterly, semi-annual, annual)
- RN+LPN hours per resident day (monthly, quarterly, semi-annual, annual)
- Licensed nursing hours per resident day (monthly, quarterly, semi-annual, annual)
- All nursing hours per resident day (monthly, quarterly, semi-annual, annual)
- All staff hours per resident day (monthly, quarterly, semi-annual, annual)

Because staffing ratios were calculated for both productive and total hours, an assessment of the relative differences between them was performed. Mean productive and mean total hours per resident-day were calculated (by job category), and the ratio between them was calculated as well. The ratio of the two forms of staffing ratios can be used to convert values from one form to the other.

2.3.7 Staff mix

In order to calculate staff mix, payroll hours by job category were needed. Productive hours (hours actually worked) and total hours (productive hours plus hours for sick leave, vacation and other accounting adjustments) were calculated for seven job categories and summed to a facility level for each corporation following the six steps previously described for staffing ratios (Section 2.3.6). To calculate staff mix, hours for different staff categories within the same time interval were divided which yielded a proportion.

Steps 1 through 6 (See Section 2.3.6)
Step 7 calculated the RN to LPN proportion by summing the RN hours for every day for a particular time interval and then dividing the summed RN hours by the sum of LPN hours for every day in the same time interval. The RN to LPN proportion can be created for any time interval one day or longer, however because hours data were provided for pay periods that were generally one to two weeks in length, time intervals of less than two weeks may not be reliable. The following staff mix measures were calculated for both productive and total hours:

- RN to LPN proportion (monthly, quarterly, semi-annual, annual)
- RN+LPN to CNA proportion (monthly, quarterly, semi-annual, annual)
- RN to all nursing proportion (monthly, quarterly, semi-annual, annual)
- RN+LPN to all nursing proportion (monthly, quarterly, semi-annual, annual)
- CNA to all nursing proportion (monthly, quarterly, semi-annual, annual)
- Licensed nursing to all nursing proportion (monthly, quarterly, semi-annual, annual)

2.3.8 Full-time versus part-time, and hours worked by full-time employees

In order to calculate the percentage of hours worked by full-time employees, each employee must be classified as full time or part-time. We chose to make all hours for an employee full-time or part-time rather than selected hours during different time periods. For example, an employee who worked part-time from January through March and then full-time from April through December would be considered a full-time employee for the entire year because more than half of the pay periods were worked at a full-time status. As discussed previously, a seven-step process was applied to the data to calculate various staffing measures. In Step 2, variables were created for each of the four types of hours (all staff

productive hours, full-time staff productive hours, all staff total hours, and full-time staff total hours). An evaluation of the full-time status for each employee was made at the pay period level. A unique employee was determined using facility, employee and job category identifiers, therefore it was possible for employees that worked at more than one facility and/or job category to be "split" into two or more unique employees, both of which would have a full-time status indicator that might be the same or different.

Full-time status was determined by evaluating the full-time status for each pay period for a unique employee. For those corporations that provided total hours, if the per day total hours were equal to or greater than five (35 hours per week), then full-time status was assigned for that pay period. For those corporations that only provided productive hours, a conversion factor of .931 (calculated as the median ratio of productive to total hours for those corporations that provided both types of hours - see Section 3.1.1 for more discussion) was used to reduce the per-day lower limit test to 4.655 hours (32.585 hours per week). If the total number of pay periods for a given employee had a status of full-time for 50% or more pay periods, then that employee was given a full-time status. The percentage of hours worked by full-time employees was calculated using a seven-step process.

Steps 1 through 6 (Same as Steps 1 through 6 previously described in Section 2.3.6 for staffing ratios). Step 7 calculated the licensed nursing full-time percentage by summing the all licensed nursing full-time hours for every day for a particular time interval and then divided those summed all licensed nursing full-time hours by the sum of all licensed nursing all hours (includes both full-time and part-time hours for the all licensed nursing job category) for every day in the same time interval. The licensed nursing full-time percentage can be created for any time interval one day or longer, however because hours data were provided for pay periods that were generally one to two weeks in length, time intervals of less than two weeks may not be reliable. The following measures were calculated for both productive and total hours:

- Licensed nursing percent of hours worked by full-time employees (monthly, quarterly, semi-annual, annual)
- All nursing percent of hours worked by full-time employees (monthly, quarterly, semi-annual, annual)
- All staff percent of hours worked by full-time employees (monthly, quarterly, semi-annual, annual)

2.3.9 Shift coverage using raw time-clock payroll data

Unfortunately, the one corporation (representing 194 facilities) that provided raw time-clock payroll data was only able to provide annual census data, therefore it was not possible to calculate shift-level staffing ratios. However other measures that do not require census information were created at the shift level for these facilities. We calculated the proportion of the shift for which at least one RN was present separately for day, evening, night, 24-hour, weekday, weekend, holiday and non-holiday shifts. The day shift was defined as 7:00AM to 3:00PM, evening shift was defined as 3:00PM to 11:00PM, night shift was defined as 11:00PM to 7:00AM, and a 24-hour shift was defined as 11:00PM to 11:00PM. The night and 24-hour shifts span two contiguous days. For the holiday shift, the following 2003 holidays were used: New Years Day (1/1), Easter (4/20), Memorial Day (5/26), July 4th (7/4), Labor Day (9/1), Thanksgiving Day (11/27), Christmas Eve (12/24), Christmas Day (12/25) and New Year's Eve (12/31). This measure can take on any value from zero to one and could also be thought of as the percent of coverage during a shift. For example, if an RN comes on duty at 6:00AM on May 1st and remains on duty until 4:00PM, then the RN day shift coverage would be one or 100% for the facility on May 1st. If two RNs come on duty and leave at the same time the RN day shift coverage would still be one; multiple RN coverage does not change the measure. If an RN comes on duty at 4:00AM on May 2nd and goes off duty at 10:00AM, and a new RN comes on duty at 11:00AM that same day and then goes off duty at 5:00PM, the RN day shift coverage would be 0.875 or 87.5% because out of the eight possible hours of coverage there was one hour (between 10:00AM and 11:00AM) during which no RN was present.

To calculate shift coverage, the raw time-clock payroll data were used to determine the time frames at least one RN worked during a given shift. In Step 1, time-clock punch-in and punch-out times were validated. Records with missing punch times or days outside of calendar year 2003 were deleted. Only those punch times for the RN job category were retained.

Step 2 adjusted punch times to eliminate overlaps (a rare occurrence) and then allocated coverage for a unique employee into a given shift based on the punch times. Because raw punch times were provided, a unique employee could - and most often did - have two or more punch time records for one or more shifts. The punch time data reflected breaks in work such as a half hour lunch break. On the rare occasion that an employee punched back in before they punched out, the earlier punch end time was

modified to eliminate any overlap. Once multiple punch times for each employee were combined, coverage was then allocated to day, evening and night shifts as appropriate. The night shift runs across two calendar days with one hour in the previous day and the remaining seven hours in the next day. The coverage allocated to the night shift was for contiguous hours. This required that the coverage worked on the previous day be added to the coverage worked on the next day to get the coverage for that one night shift.

Step 3 evaluated RN coverage at a facility level to determine the continuous coverage for that facility by all RN staff. Punch times for all RN staff on duty at the same facility were evaluated for gaps in coverage. For example, beginning at 11:00PM on May 1st through May 2nd at 11:00PM for facility X, four RNs worked at various times through these three shifts. RN-A came on duty prior to 11:00PM on May 1st and then worked until 6:00AM the next morning providing coverage for all but one hour of the night shift. RN-B came on duty at 5:00AM on May 2nd and therefore overlapped RN-A by one hour. RN-B worked until 5:00PM covering the entire day shift, the last hour of the night shift, and two hours of the evening shift for May 2nd. RN-C came on duty at 2:00PM and worked until 7:00PM and therefore provided coverage for two hours of the evening shift. RN-D came on duty 6:00PM and worked until midnight providing coverage for the remaining four hours of the evening shift. For this example, all shifts had 100% coverage. If RN punch-in and punch-out times for multiple staff did not fully overlap (or end and start at the same time), then gaps of coverage would occur and the coverage would be less than 100%.

Step 4 calculated the RN coverage proportion by calculating the total hours covered for a particular shift on a particular day for all RN staff and then dividing by eight. The maximum possible coverage is 100%, but this was rarely achieved because the raw time-clock data included breaks. Because multiple coverage by more than one RN at any given time was more the exception than the rule, lunch and other breaks were usually not covered. This resulted in a loss of coverage even if there was overlap of RN staff at the beginning or end of the RN staff work periods.

Step 5 used the daily day, evening and night shift coverage proportions to calculate the coverage for the 24-hour, weekday, weekend, holiday and non-holiday shifts for various time intervals. Day, evening, and night shift coverage proportion was calculated for each day. To calculate shift coverage for different time intervals, the coverage proportions for a given time interval were summed and then divided by the number of days in that time interval. The 24-hour shift was calculated by summing the coverage

proportions for the three shifts on that day and dividing by three. The 24-hour shift coverage proportions were then used to calculate weekends, weekdays, holidays, and non-holidays for various time intervals. The holiday, non-holiday coverage was only calculated for an annual time interval. The following shift coverage measures were calculated for productive hours:

- Day shift RN coverage (monthly, quarterly, semi-annual, annual)
- Evening shift RN coverage (monthly, quarterly, semi-annual, annual)
- Night shift RN coverage (monthly, quarterly, semi-annual, annual)
- 24-hour period RN coverage (monthly, quarterly, semi-annual, annual)
- Weekday shift RN coverage (monthly, quarterly, semi-annual, annual)
- Weekend shift RN coverage (monthly, quarterly, semi-annual, annual)
- Holiday shift RN coverage (annual)
- Non-holiday shift RN coverage (annual)

2.4 Creation of turnover, retention, and tenure measures

2.4.1   Identification of data source for computing turnover, retention, and turnover measures

Two potential data sources were considered for computing staff turnover, retention, and tenure measures: personnel data and payroll data. As described previously, corporations were asked to provide personnel data (hire dates, termination dates, rehire dates, etc.) in addition to payroll and census data. Personnel data were received from five corporations and due to limitations with acquiring historical data from corporate data systems, the personnel data that were submitted contained records with inaccurate job descriptions; missing or inaccurate hire, termination, and rehire dates; and little if any information to identify transfers between facilities within a corporation. For example, several corporations were able to provide only the most recent termination date for an employee. Therefore, if an employee departed from a facility more than once during 2003, only the most recent departure would be included in turnover calculations based on personnel data. These issues impacted the utility of the personnel data for computing staffing turnover, retention, and tenure measures. As many of these issues are inherent in the human resources software applications, a more standardized data extract would not correct many of these problems. Therefore, given that personnel data were difficult to obtain and contained incomplete or inaccurate information, a preliminary examination of the feasibility of using payroll data to compute these measures was undertaken. Furthermore, the ability to use the same data source (i.e., payroll data)

to compute all measures of nursing home staffing will decrease data collection/submission burden for nursing home facilities.

2.4.2   Creating employee status records based on payroll data

To examine the feasibility of using payroll data for computing turnover, retention, and tenure, employee departures based on payroll data and personnel data were compared for one corporation (245 facilities). In order to conduct this analysis, employee personnel records were created using payroll data. Records were created for each employee within a facility; therefore, if an employee worked at multiple facilities, a unique record (reflecting an employment episode) was created for each facility. In Step 1, each corporation's payroll data were examined for issues related to data quality and integrity based on the unique characteristics of the corporation's data structure. Payroll records with missing Medicare provider numbers, missing employee IDs, missing job categories, and invalid or missing pay period start and end dates were deleted. In addition, payroll records for pay periods that occurred prior to or after calendar year 2003 were removed. In Step 2, for corporations that provided multiple records per pay period for each employee, one record per employee pay period was retained. It is important to note that individual payroll records, not employees, were deleted in Steps 1 and 2. As mentioned previously, many of these problems would be eliminated or substantially mitigated with a standardized extract. In the third step the number of days elapsed (referred to as a "gap") between employee pay periods was calculated. For example, if an employee has two payroll records, the first with a pay period start date of 1/1/2003 and a pay period end date of 1/6/2003 and the second record with a pay period start date of 1/13/2003, then the gap between pay period 1 and pay period 2 would be seven days.

In Step 4, employee personnel records were created from the payroll data using the employee's first and last payroll records for calendar year (CY) 2003, unless a gap of at least 60 days occurred in the payroll history. When a gap of 60 days or more appeared in the payroll data, a new personnel record was created using the first pay period following the payroll gap and the last pay period in CY 2003 or the last pay period preceding the next payroll gap. For example, a CNA with contiguous payroll data from January 1, 2003 through March 1, 2003 and contiguous payroll data from June 1, 2003 through December 15, 2003 would have two personnel records for CY 2003. The first record would show an employment start date of January 1, 2003 and an employment end date of March 1, 2003 and the second employee record would have an employment start date of June 1, 2003, since the gap between March 1, 2003 and

June 1, 2003 is greater than 60 days. For the purposes of computing retention and turnover measures this employee would be considered a departed and rehired employee.

The decision to use 60 days as the cutoff for a departure was based on a review of the distributions for the pay period gap variable created in Step 3. Ninety percent of the gaps in payroll records were 15 days or less. Of those records that had a gap greater than 15 days, the average number of days elapsed between pay periods was 57 days, with a minimum value of 16 days and a maximum value of 337 days.

In Step 5, employees that were deleted from the personnel file when they had only one payroll record and the total hours worked for that record was zero or missing. For the test corporation no employees were deleted at this step. Across all facilities 381 employees were deleted as a result of this exclusion. In the final step, pay period start dates prior to calendar year (CY) 2003 were set to 1/1/2003 and pay period end dates after CY 2003 were set to 12/31/2003. This step was necessary to account for those pay periods (and therefore corresponding pay period start and end dates) that spanned years.

Each personnel record created from the payroll data contained the employee ID, facility Medicare provider number, job category, calendar year start date (equal to the pay period start date of the first pay period the employee worked during CY 2003 or the first pay period after a gap) and calendar year end date (equal to the pay period end date of the last pay period worked during CY 2003 or the pay period end date for the last record preceding a gap). When using payroll data for computing retention and turnover measures, CY start dates are analogous with employee hire dates. However, CY end dates are considered equivalent to termination dates only when a gap of at least 60 days in the payroll data can be established. As a result, to identify a departure, a minimum of 60 days of payroll data beyond the end date of the reporting period is required for the computation of turnover measures.

Personnel records based on payroll data were created independently for each specific job category (e.g., CNA, RN, LPN) and for each combined staffing group (licensed nursing, all nursing, all staff). For example, if an employee worked as an RN from January 1, 2003 through February 15, 2003 and worked as a DON from February 16, 2003 through December 31, 2003, the following personnel records would be created:
- a record as an RN with a CY start date of 1/1/2003 and a CY end date 2/15/2003,
- a record as a DON with a CY start date of 2/16/2003 and a CY end date 12/31/2003,

- a record as licensed staff with a CY start date of 1/1/2003 and a CY end date 12/31/2003,

- a record as nursing staff with a CY start date of 1/1/2003 and a CY end date 12/31/2003, and

- a record as all staff with a CY start date of 1/1/2003 and a CY end date 12/31/2003.

When examining retention and turnover for the RN position, this employee would be counted as an RN departure, even though the employee was promoted within the facility to a DON position. However, this method allows for recognition of facilities that promote internally, as this individual would not be considered a departure in the all licensed, all nursing, or all staff categories. Therefore this approach allows for an examination of both position level and employee level turnover and retention.

2.4.3 Comparison of departures and departure dates between personnel and payroll data

A comparison of employee end dates was conducted to examine the comparability of personnel data and payroll data for computing retention, turnover, and tenure measures. Employee end date was selected because it is a necessary component for all three measures. For payroll data, employees with end dates prior to 10/1/2003 were considered a departure, and for personnel data, termination dates in calendar year 2003 were considered a departure.

In this comparison, 42.8% of the employees in the payroll data had an end date prior to the end of the year compared to 40.1% of the employees in the personnel data who had a termination data in 2003. In addition to examining turnover rates, an employee level comparison of departures was conducted between the two data sources. Sixteen percent of the employees with departure (termination) dates in the personnel file did not have matching departure dates (CY end date) based on payroll data. Departure dates within 15 days of each other were considered a match. Furthermore, 14.6% of the employees with departures in 2003 based on payroll data did not have a departure (termination) date based on personnel data. Missing or mismatched departure dates were the result of:

- missing termination dates in the personnel data when employees had several terminations in CY 2003 (as described previously personnel data for most of the corporations only reports the most recent termination date),

- employees that departed and were rehired within a 60-day period (and therefore the employee did not have a gap in the payroll data that qualified as a departure), and

- a gap of more than 15 days between the last payroll record for the employee and the termination date in the employee status file suggesting that termination dates reported in the personnel file may not be related to the actual last day worked.

Overall departure dates are fairly similar between the two data sources, suggesting that payroll data can be used to construct departure dates that represent the overall rate of departures across all employees. Furthermore, use of payroll data will permit measures of retention, turnover, and tenure to be computed with greater specificity and precision. For example, using payroll data turnover within positions can be more precisely measured (e.g., when an RN is promoted to a DON) as well as turnover, retention, and tenure across facilities when employees work at multiple facilities concurrently (most of the corporations that provided data for this project did not provide information on transfers or concurrent work episodes in the personnel data). Retention and turnover measures based on payroll data are biased toward under-representing very brief departures from a facility but are a more reliable source than personnel data for detecting multiple terminations (provided the termination is 60 days or more) within a report period. As payroll data were easier to acquire than personnel data and were determined to be a feasible source for creating personnel records, measures of turnover, retention, and tenure will be calculated based on payroll data.

2.4.4   Measures of employee turnover and retention

Based on a review of the literature (as described in Section 1.2 above) and communication with the corporations participating in this project, multiple definitions for turnover, retention, and tenure measures were considered. Three approaches to measuring turnover were explored including cohort turnover, position turnover, and short-term employees. Cohort turnover was defined as the percent of staff employed at the beginning of the reporting period that departed prior to the end of the reporting period. Position turnover was defined as the percent of staff that departed during the reporting period based on the average number of positions at the facility during the reporting period. Although it is anticipated that these two measures of staff turnover will be highly correlated, they are distinct measures. The cohort measure is an indication of employee (versus position) turnover and is not sensitive to multiple individuals filling the same position over and over ("churn"). The position turnover measure reflects both turnover across positions and repeated turnover within a given position but provides an overall turnover rate that does not differentiate these two types of turnover. The final turnover measure,

short-term employees, was defined as the percent of employees who departed within 60 days from their start date. In addition to measures examining turnover, a cohort retention measure was computed and is defined as the percent of staff employed at the beginning of the report period that were still employed at the end of the report period. The cohort retention measure is the inverse of the cohort turnover measure.

Each of the tenure and retention measures was calculated separately for CNAs, LPNs, RNs, RNs+LPNs, DONs+ADONs, all licensed staff, all nursing staff, and all staff. As the number of employees categorized into the DON and administrator groups was small (one DON/facility), proportional measures were not computed. Therefore, two additional turnover measures were generated: the number of DONs who departed during the report period and the number of nursing home administrators who departed during the report period. The short-term measures were computed for all staff groups including DONs and administrators.

2.4.5   Measures of employee tenure

Albeit the payroll data were determined to be a feasible and preferable data source for calculating measures of retention and turnover, these data did not contain employee hire dates necessary for computing tenure measures. Therefore employee hire/rehire dates from the five corporations that provided personnel data were matched to the payroll records created in Section 2.4.2 above to compute the tenure measures. During the process, personnel data from one corporation were excluded due to problems with mismatched employee IDs between the two files. Therefore the tenure measures are based on data from four corporations (663 facilities).

Five tenure measures were created for each facility including, tenure to date (TTD), percent of departed employees whose tenure was greater than 1 year, percent of departed employees whose tenure was greater than 5 years, percent of employed staff whose TTD was greater than 1 year, and percent of employed staff whose TTD was greater than 5 years. The term tenure is used for departed employees because their tenure is a known quantity. For current employees, the term tenure to date is used to denote the fact that the true tenure for these employees is unknown at this time. Tenure is defined as CY end date - hire (or rehire) date, and tenure to date is defined as the report period end date (i.e., 9/30/2003) - hire (or rehire) date.

2.4.6 Full-time versus part-time

As described in Section 2.3.8 employees were classified as full-time or part-time based on the average number of hours worked for each pay period for the entire calendar year 2003. Full-time designations were used to create measures of the proportion of staff in each job category that were classified as full-time. In addition, turnover, retention, and tenure measures were calculated separately for full-time and part-time employees.

2.4.7 Exclusions for turnover, retention, and tenure measures

One corporation was unable to provide Medicare provider numbers and therefore exclusions based on Medicare provider number as described in Table 2 of Section 2.1 could not be conducted, which would not have been a problem with a standard data extract. However, an examination of the staff composition within these facilities revealed that 19 facilities did not have CNAs (with the exception of CNAs for medication administration) or RNs, and LPNs were employed on an intermittent basis, if at all. Some of these facilities were staffed entirely by corporate positions (e.g., CEOs, vice-presidents) or by other staff groups (e.g., resident assistants, housekeeping, cooks). It was determined that these facilities did not appear to be Medicare/Medicaid nursing facilities and were excluded from all measures. Twenty-two facilities were excluded from the turnover, retention, and tenure measures because these facilities had less than five months of data or the average number of employees across all job categories was less than 10 employees.

Facilities were excluded on a measure-by-measure basis for the retention and turnover measures when the number of months with active employees for the staff group in question was less than 5 months. For example, if a facility employed RNs for only two months during the nine-month reporting period, this facility would be excluded from the RN turnover and retention measures. Therefore sample sizes vary across all measures based on staff composition within facilities.

2.5 Assessment of appropriate measurement intervals

2.5.1 Staffing ratios

To thoroughly investigate the properties of the staffing ratio measures (hours per resident-day), the measures were calculated over multiple time periods, ranging from weekly to annually. For each facility, the mean hours per resident-day was calculated for each of the different periods; for example, each facility had 12 monthly mean values for January through December. Next, for each facility, the standard deviation (SD) and the coefficient of variation (CV) expressed as a percentage (CV=SD/mean x 100%) were calculated; for example, the SD and the CV of the facility's 12 individual mean monthly values was determined. Last, the individual facility SDs and CVs were averaged to assess the overall variability of the measure across all facilities; for example, the means of the 748 individual facility monthly SDs and CVs were calculated. These steps were repeated for the weekly, quarterly, semi-annual and annual staffing ratio measures. By comparing the variation of the measure when calculated over different time periods, one can assess whether staffing ratios measured over shorter time periods are too variable relative to longer periods, or whether staffing ratios measured over a shorter time period provide sufficient additional precision to be worth the expense of calculating them more frequently.

2.5.2 Turnover and retention

Each measure of employee turnover and retention was calculated at five time intervals: three quarterly intervals (Q1-Q3, 2003), semi-annually (January - June 2003) and at a nine-month (January - September 2003) interval. As described in Section 2.4.2., when using payroll data to compute retention and turnover measures two months of data beyond the end date of the reporting period are necessary to identify employee departures (i.e., gaps in the payroll data of 60 days or more). The data requested for this project were for calendar year 2003 only, and therefore CY end dates after October 31, 2003 could not be definitively counted as departures or retentions. Therefore, for this developmental work nine-month measures were created in lieu of annual measures; however, it is recommended that adequate data be obtained in the future to compute turnover and retention measures based on annual data.

For cohort measures, quarterly measures included all employees with a calendar year start date on or before the seventh day of the respective quarter. For measures based on average number of positions, the

average number of employees for each quarter was defined as the number of employees with calendar year start dates equal to or prior to the last day of each month in the quarter and calendar year end dates greater than the end of each month of the quarter divided by the number of months with valid data in the quarter. For example, if data were not available for the first month of the quarter (e.g., no staff were employed), the average would be based on two months of data. For both types of measures (cohort and position average), the numerator (departures) was defined as the number of employees with a calendar year end date in the respective quarter. Retention, for quarterly measures, was defined as the number of employees with calendar year end dates greater than the respective quarter.

Semi-annual and nine-month cohort measures derived from payroll data included all employees with a calendar year start date prior to 2/1/2003. For measures based on monthly averages, the number of employees was defined as the number of employees for each month with calendar year start dates equal to or prior to the last day of each month and calendar year end dates greater than the end of each month divided by the number of months with valid data. For the semi-annual cohort and position turnover measures, the numerator (departures) was defined as the number of employees with calendar year end dates prior to 7/1/2003 and retention was defined as the number of employees with calendar year end dates after 6/30/2003. For the nine-month cohort and position turnover measures, the numerator (departures) was defined as the number of employees with calendar year end dates prior to 10/1/2003 and retention was defined as the number of employees with calendar year end dates after 9/30/2003.

2.6 Simple statistics

The distributions of all measures (and the component variables used to create them) outlined above were examined to understand the measure behavior. The distributional statistics included mean, median, standard deviation, minimum and maximum values, and 10th, 90th, and 99th percentiles. To assess relationships between the many measures, Pearson's correlations were calculated between all measures.

3 Results - Measure Analyses

As described in the methods section, the results presented below are presented without removal of outliers and with no imputation conducted for missing values. Obviously erroneous data were eliminated, either by deleting inappropriate records or by setting incorrect values to missing, but no further editing or trimming of data was performed. Rules for the appropriate handling of missing, incomplete, or outlier data will be investigated and determined during Phase II of this project.

3.1 Distributional statistics

3.1.1   Staffing ratios

Table 4 presents distributional statistics for facility-level staffing ratios and the component variables used in the creation of the staffing ratios. Hours worked per day by staff category and daily resident census are shown in addition to staffing ratios. Seven of eight corporations (1079 facilities) provided productive hours (e.g., excluding paid time off), while five corporations provided total hours (764 facilities). Although all eight corporations provided census data, the data did not include all facilities within those corporations.

For all staff types, the distributions of productive and total hours are somewhat skewed, though less so for total hours than for productive hours. For productive hours, the 10th percentile is generally approximately half the median, while the 90th percentile is generally approximately twice the median, indicating that many facilities staff significantly higher than average. This is further evidenced by the observation that the mean is consistently higher than the median. The skew is present for total hours also, but to a lesser degree. There is also somewhat less variation in the distribution of total hours than productive hours.

On average, a facility's CNA staff work a combined 190.5 hours per day and account for approximately 62% of nursing care provided to residents within nursing facilities. Nursing care, in turn, represents approximately 65% of total hours worked by all employees (305.7 versus 470.3) within a facility. RNs hours were the most variable across facilities, with the highest coefficient of variation (standard deviation/mean x 100) of 67.5, indicating that RN staffing practices are extremely variable from facility to

facility. A similar pattern of results exists for total hours as for productive hours. The mean daily census is approximately 100 residents, and ranges from 17 to 344.

Table 4: Distributional statistics of staffing ratios and their components

Measure	n	Mean	Standard deviation	Minimum	10th Percentile	Median	90th Percentile	99th Percentile	Maximum
Productive hours by position									
CNA	1079	190.5	86.9	0.5	98.9	178.5	299.5	460.8	988.4
LPN	1079	62.0	37.8	1.5	21.9	55.1	109.6	180.5	322.4
RN	1079	28.9	19.5	0.0	9.5	24.6	54.7	93.3	184.6
RN+LPN	1079	90.9	45.8	15.5	39.5	85.0	148.7	232.7	378.0
Licensed nursing	1079	106.9	51.7	21.1	48.8	101.1	170.3	263.9	473.7
All nursing	1079	305.7	134.5	68.1	155.6	290.5	475.0	695.8	1468.5
All staff	1079	470.3	206.9	125.9	244.0	445.7	717.3	1185.0	2388.1
Total hours by position									
CNA	764	222.2	84.1	0.5	127.3	212.2	332.5	463.1	603.1
LPN	764	78.8	39.2	1.2	35.9	70.9	129.5	200.9	262.2
RN	764	32.1	21.5	0.0	9.3	28.0	60.1	97.6	196.0
RN+LPN	764	110.9	46.2	1.2	58.7	105.6	172.4	256.4	364.5
Licensed nursing	764	129.6	51.2	6.9	70.4	121.7	196.1	282.7	422.0
All nursing	764	364.1	132.0	90.5	208.0	347.4	533.1	719.4	1025.0
All staff	764	571.4	199.2	95.8	341.8	547.7	829.8	1131.8	1668.8
Resident-days (census)	1374	99.6	43.1	16.6	51.0	94.6	151.9	242.6	344.3
Staffing ratios* by position									
CNA	748	1.97	0.41	0.01	1.62	1.94	2.36	3.49	4.51
LPN	748	0.65	0.22	0.04	0.37	0.66	0.91	1.22	1.73
RN	748	0.29	0.16	0.00	0.11	0.27	0.52	0.73	1.06
RN+LPN	748	0.94	0.21	0.09	0.71	0.93	1.18	1.54	2.08
Licensed nursing	748	1.10	0.23	0.17	0.87	1.09	1.36	1.78	2.23
All nursing	748	3.11	0.49	0.53	2.72	3.06	3.58	4.77	5.89
All staff	748	4.69	0.89	0.82	3.86	4.59	5.62	7.45	9.90

* Staffing ratio = productive hours per resident-day

For most staff types, the distribution of staffing ratios (productive hours per resident-day) is relatively tight. This indicates that although there is much variability in hours worked, hours worked *per resident-day* adjusts for daily variation in resident census. The coefficients of variation for these measures are markedly lower than for their components. CNAs provide 1.97 hours of care per resident-day, again representing approximately 63% of all nursing care. RN staffing ratios remain the most variable of the staff types, ranging from 0 to 1.06 hours per resident-day, with an average of 0.29 hours per resident-day.

As discussed previously, not all corporations were able to provide both productive and non-productive hours from their payroll systems; some corporations provided a single combined value for total hours, and some provided only productive hours. Staffing ratio measures were constructed for both productive and total hours, however the analyses were conducted (and are presented in this report) for productive hours because more facilities reported productive hours than total hours. Because most studies of hours per resident-day have used total hours, it was necessary to assess the relative differences between staffing ratios calculated using productive versus using total hours.

Three corporations (351 individual nursing facilities) provided both productive and non-productive hours. Staffing ratios were calculated using productive hours only, and using the summed productive and non-productive hours as total hours. Table 5 presents the mean hours per resident-day using both measures for each staff type, as well as the ratio between them. The mean productive hours staffing ratios for this subset of facilities are similar to the mean productive hours staffing ratios shown in Table 4.

Table 5: Comparison of staffing ratios calculated using productive hours versus total hours

Staff type	n	Mean productive hours staffing ratio	Mean total hours staffing ratio	Mean ratio of productive to total
CNA	351	1.944	2.095	0.928
LPN	351	0.680	0.733	0.927
RN	351	0.303	0.325	0.932
RN+LPN	351	0.983	1.058	0.929
Licensed nursing	351	1.111	1.198	0.927
All nursing	351	3.129	3.374	0.927
All staff	351	4.974	5.377	0.925

As expected, the mean total hours staffing ratios are somewhat larger than the mean productive hours staffing ratios. For all staff types, the ratio between productive and total hours per resident-day is 0.93, showing that productive hours are 93% of total hours. For readers accustomed to seeing staffing ratios calculated using total hours, the figures presented in this report can be multiplied by 1.075 to approximate the results that would have been obtained had total hours been used instead of productive hours. (Note that Table 5 presents mean values; the conversion factor described in Section 2.3.8 used median values. The mean and median ratios were strikingly similar, thus Table 5 shows only the mean values.)

3.1.2   Staff mix

Distributional statistics for staff mix measures are shown in Table 6, and include ratios of hours worked by different staff and the percentage of work performed by full-time employees. Six measures of staff type ratios are provided, some of which show significant variability. The ratio of RN hours to LPN hours, for example, has a mean of 0.72 and a median of 0.46. This fairly large discrepancy in these two measures of central tendency is explained in part by the maximum value of 44.84. This very large value is caused by a facility that utilizes LPNs very infrequently, and instead relies on RNs and CNAs to provide the bulk of the care. A similar result occurs in the ratio of RN+LPN to CNA hours. One particular facility uses extremely few CNAs, relying instead on non-certified aides to provide this level work; this results in an extremely low denominator, which in turn results in an extremely high ratio value. These facilities are very unusual, which can be seen by the fact that, in both examples, the 99th percentile is much closer to the 90th percentile than to the maximum value. Nevertheless, such occurrences do have significant effects on the mean values. It is interesting to note that as a proportion of all nursing hours, RNs represent between 0 and 30% of productive hours, with a mean of 10%, and CNAs represent between 0 and 95% of productive hours, with a mean of 63%. Licensed staff typically comprises 35% of all nursing productive hours provided.

The second group of measures shown in Table 6 are percentages of hours provided by full-time employees. For licensed nursing staff, 70% of the productive hours per day were provided by full-time licensed nursing staff. This figure decreases to 65% when considering all nursing staff. As apparent from the minimum and maximum values of these measures, some facilities rely completely on part-time staff, and others rely almost completely on full-time staff.

Table 6: Distributional statistics of staff mix measures

Measure	n*	Mean	Standard deviation	Minimum	10th Percentile	Median	90th Percentile	99th Percentile	Maximum
Staff mix									
RN to LPN hours	1079	0.72	1.56	0.00	0.15	0.46	1.37	4.33	44.84
RN+LPN to CNA hours	1079	0.62	4.43	0.02	0.33	0.47	0.63	1.00	145.96
RN to All nursing hours	1079	0.10	0.05	0.00	0.04	0.09	0.16	0.22	0.30
RN+LPN to All nursing hours	1079	0.29	0.06	0.02	0.22	0.30	0.36	0.43	0.53
CNA to All nursing hours	1079	0.63	0.07	0.00	0.54	0.63	0.71	0.78	0.95
Licensed to All nursing hours	1079	0.35	0.06	0.05	0.28	0.35	0.41	0.47	0.57
% of hours provided by full-time employees									
Licensed nursing	734	70.0%	18.2%	0.0%	42.5%	75.1%	88.9%	95.8%	98.4%
All nursing	734	65.3%	16.4%	0.0%	42.3%	68.2%	83.8%	94.2%	97.6%
All staff	734	66.8%	15.7%	7.1%	43.0%	70.8%	83.0%	91.8%	95.1%

* One corporation provided payroll data aggregated by department; determination of individual employee full-time vs. part-time status was therefore not possible

3.1.3 Shift coverage

For the one corporation (representing 194 facilities) that provided payroll data by shift, an assessment was conducted of the percentage of each shift for which at least one RN was present. As shown in Table 7, the night shift had the lowest RN coverage (48.2%) and the day shift had the highest RN coverage (73.3%). When measured over a 24-hour period, an RN was present 60.9% of the time on average. RN coverage was equivalent for weekdays versus weekends, at approximately 61%. There is significant variation in these measures; 10% of facilities cover less than 41% of day shifts with at least one RN, and 10% of facilities cover more than 97.7% of day shifts with at least one RN; these differences are even greater for the evening and night shifts. Recall that these measures do not include RN administrative staff such as DONs, nor do they include contract agency RNs. Therefore these measures cannot be used to assess compliance with RN staffing regulations.

3.1.4 Turnover and retention

Distributional statistics for the four measures of staff turnover and retention as well as distributions of facility staff are presented in Table 8. On average, CNAs account for 38% of nursing home staff, LPNs account for 16% and RNs account for 6%. The distribution for CNAs is fairly tight and symmetric while the distribution for RNs is somewhat skewed with the 90th percentile being twice the median. Furthermore, staff distribution percentages for LPNs and RNs contain maximum values that are 3.5 to 5 times greater than the median. The minimum value for LPNs is 2% and for RNs is 0, suggesting that facilities' staffing distributions differ markedly from each other. On average, nursing staff account for 61% of all nursing home employees, and the distribution for the all nursing job category is fairly tight and symmetric.

Both measures of staff turnover (cohort and position) are higher for RNs than all other staff groups and retention rates for RNs are lower. The mean percentages for CNA and RN short-term employees are nearly identical; however the variability among RNs is much greater than for CNAs. Turnover rates are lowest among the DON/ADON and LPN staff groups, and DONs and LPNs have a lower percentage of short-term employees compared to RNs and CNAs. Across all three turnover measures, turnover rates are higher for CNAs and RNs than for LPNs.

Table 7: Distributional statistics of RN shift coverage measures

Measure	n	Mean	Standard deviation	Minimum	10th Percentile	Median	90th Percentile	99th Percentile	Maximum
Day	194	73.3%	23.4%	2.0%	41.0%	78.9%	97.7%	100.0%	100.0%
Evening	194	61.2%	27.1%	3.5%	23.6%	63.7%	95.2%	99.8%	100.0%
Night	194	48.2%	30.9%	0.5%	8.8%	46.9%	93.9%	99.7%	99.9%
24-hours (11pm-11pm)	194	60.9%	21.6%	16.4%	34.8%	59.9%	91.2%	99.4%	99.6%
Weekday	194	60.8%	22.6%	10.7%	32.9%	60.5%	92.3%	99.3%	99.6%
Weekend	194	61.1%	20.7%	19.3%	34.8%	60.6%	91.2%	99.6%	99.7%

Table 8: Distributional statistics of turnover, retention, and short-term measures and their components

Measure	n	Mean	Standard deviation	Minimum	10th Percentile	Median	90th Percentile	99th Percentile	Maximum
Facility staff distribution									
% CNA	1045	38.1%	6.1%	7.6%	31.1%	38.8%	44.6%	49.7%	68.5%
% LPN	1045	16.2%	6.0%	2.0%	9.0%	16.0%	23.5%	31.4%	80.5%
% RN	1045	6.1%	3.3%	0.0%	2.5%	5.5%	10.7%	15.6%	23.2%
% RN+LPN	1045	22.3%	5.9%	6.0%	15.9%	21.8%	28.7%	37.3%	103.7%
% DON	1045	1.0%	0.4%	0.0%	0.6%	0.9%	1.5%	2.3%	4.8%
% DON+ADON	1045	1.4%	0.7%	0.0%	0.7%	1.3%	2.3%	3.4%	5.2%
% Licensed nursing	1045	21.4%	4.4%	8.9%	16.6%	21.1%	26.5%	34.4%	68.9%
% All nursing	1045	60.9%	6.6%	29.7%	53.9%	60.8%	68.0%	80.0%	100.0%
% Administrator	1045	1.0%	0.4%	0.0%	0.6%	0.9%	1.5%	2.4%	4.5%
Cohort turnover									
CNA	1043	39.2%	13.5%	8.7%	21.9%	38.6%	57.1%	71.6%	100.0%
LPN	1042	32.8%	17.6%	0.0%	11.1%	33.3%	57.1%	75.0%	100.0%
RN	1032	41.2%	25.5%	0.0%	0.0%	40.0%	75.0%	100.0%	100.0%
RN+LPN	1043	35.7%	15.6%	0.0%	16.7%	34.8%	57.1%	75.0%	83.3%
DON+ADON	1014	32.1%	39.6%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
Licensed nursing	1043	32.5%	15.1%	0.0%	14.3%	30.8%	53.3%	71.4%	86.7%
All nursing	1043	37.0%	11.9%	8.3%	22.5%	36.1%	52.7%	67.2%	85.7%
All staff	1043	33.2%	10.0%	9.1%	21.0%	32.4%	46.4%	57.7%	75.3%
Cohort retention									
CNA	1043	60.8%	13.5%	0.0%	42.9%	61.4%	78.1%	88.1%	91.3%
LPN	1042	67.2%	17.6%	0.0%	42.9%	66.7%	88.9%	100.0%	100.0%
RN	1032	58.8%	25.5%	0.0%	25.0%	60.0%	100.0%	100.0%	100.0%
RN+LPN	1043	64.3%	15.6%	16.7%	42.9%	65.2%	83.3%	100.0%	100.0%
DON+ADON	1014	67.9%	39.6%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
Licensed nursing	1043	67.5%	15.1%	13.3%	46.7%	69.2%	85.7%	95.5%	100.0%
All nursing	1043	63.0%	11.9%	14.3%	47.3%	63.9%	77.5%	87.1%	91.7%
All staff	1043	66.8%	10.0%	24.7%	53.6%	67.6%	79.0%	86.0%	90.9%

Table 8: Distributional statistics of turnover, retention, and short-term measures and their components (continued)

Measure	n	Mean	Standard deviation	Minimum	10th Percentile	Median	90th Percentile	99th Percentile	Maximum
Position turnover									
CNA	1045	79.6%	44.5%	13.3%	36.7%	70.8%	128.1%	236.8%	658.2%
LPN	1045	46.2%	30.2%	0.0%	14.2%	40.9%	83.2%	144.8%	228.8%
RN	1037	87.8%	68.9%	0.0%	22.5%	72.0%	173.7%	313.0%	533.3%
RN+LPN	1045	54.9%	30.4%	0.0%	22.2%	49.2%	94.5%	154.2%	240.7%
DON+ADON	1030	51.7%	69.2%	0.0%	0.0%	0.0%	150.0%	276.9%	500.0%
Licensed nursing	1045	58.0%	33.5%	0.0%	23.0%	50.2%	103.9%	165.6%	245.5%
All nursing	1045	70.8%	32.5%	11.1%	36.9%	64.1%	112.3%	182.4%	262.9%
All staff	1045	61.3%	26.0%	15.4%	33.9%	56.3%	94.6%	142.6%	212.6%
Short-term									
CNA	1045	21.8%	9.8%	2.8%	10.9%	20.5%	34.6%	51.2%	92.1%
LPN	1045	16.9%	11.1%	0.0%	0.0%	16.0%	31.3%	48.3%	57.1%
RN	1043	21.3%	16.0%	0.0%	0.0%	20.0%	42.9%	66.7%	100.0%
RN+LPN	1045	18.6%	9.8%	0.0%	7.1%	17.6%	32.0%	45.3%	52.6%
DON	1032	7.8%	18.0%	0.0%	0.0%	0.0%	50.0%	66.7%	100.0%
DON+ADON	1035	9.5%	17.6%	0.0%	0.0%	0.0%	40.0%	66.7%	75.0%
Licensed nursing	1045	16.2%	9.2%	0.0%	5.6%	15.1%	28.6%	42.3%	50.4%
All nursing	1045	20.0%	8.2%	2.3%	10.6%	18.8%	31.0%	45.1%	52.1%
Administrator	1015	6.3%	16.8%	0.0%	0.0%	0.0%	33.3%	66.7%	100.0%
All staff	1045	18.0%	7.2%	2.5%	9.7%	17.0%	28.1%	39.5%	47.5%

The distributions for all of the CNA turnover and retention measures are less variable than those presented for the other job categories, with the exception of the all nursing and all staff groups. The RN measures are characterized by high variability suggesting that facilities differ considerably in their ability to retain RNs. Cohort turnover rates for RNs range from 0-100% and position turnover rates range from 0-533.3%.

3.1.5 Tenure

Presented in Table 9 are the five measures of employee tenure. Across all staff actually employed at the end of the reporting period, the average tenure to date is 3.7 years. Average tenure is higher for administrators (5.7 years) and DONs/ADONS (6.2 years) compared to all other staff groups. On average, LPN tenure (4.3 years) is higher than CNA and RN tenure (3.3 and 3.6, respectively). LPN tenure is more variable than tenure for CNAs and RNs, with a few very long stay LPNs (maximum tenure of 21.3 years) accounting for a portion of the increased variance. Across all nursing staff tenure on average is 3.4 years. Tenure for administrators and DONs/ADONs are the most skewed across facilities.

Measures related to departed employees are characterized by shorter tenure than those for currently employed staff. For currently employed staff the percent with TTD greater than one year is 60.7% for CNAs, 65.9% for LPNs, and 65.4% for RNs. The distributions for CNAs, LPNs, and RNs for the measure of current staff with tenure greater than one year are fairly symmetric and tight, as are the distributions for the analogous measure for departed employees. Distributions for the percent of departed employees with tenure greater than five years are considerably skewed, with a median for LPNs and RNs of 0 and a mean of 14.3 and 16.4, respectively. Distributions for administrators and DONs across all four measures are asymmetrical and demonstrate little variability. Since the average tenure to date is 5.7 years for administrators and 6.2 years for DONs/ADONs and these staff groups comprise a very small percentage of overall staff, proportional measures of tenure are not recommended for these staff groups.

Table 9: Distributional statistics of staff tenure measures

Measure	n	Mean	Standard deviation	Minimum	10th Percentile	Median	90th Percentile	99th Percentile	Maximum
Tenure to date, years (employed staff)									
CNA	663	3.3	1.6	0.2	1.5	2.9	5.3	8.7	11.9
LPN	663	4.3	2.9	0.5	1.6	3.7	7.8	15.9	21.3
RN	662	3.6	2.4	0.2	1.1	2.9	6.8	11.4	13.8
RN+LPN	663	3.9	2.3	0.5	1.6	3.3	7.0	12.1	15.6
DON	654	6.5	6.5	0.0	1.1	3.9	16.2	29.0	38.5
DON+ADON	656	6.2	5.8	0.2	1.1	4.1	14.9	25.8	38.5
Licensed nursing	663	4.1	2.3	0.5	1.7	3.7	7.3	11.0	14.9
All nursing	663	3.4	1.6	0.5	1.6	3.1	5.3	7.8	11.1
Administrator	636	5.7	5.8	0.0	1.1	3.7	13.0	28.0	34.5
All staff	663	3.7	1.5	0.6	1.9	3.5	5.8	7.8	11.5
Tenure > 1 year (departed)									
CNA	663	38.6%	19.9%	0.0%	13.3%	37.2%	65.6%	88.9%	100.0%
LPN	634	47.8%	29.9%	0.0%	7.1%	48.3%	100.0%	100.0%	100.0%
RN	619	49.6%	33.6%	0.0%	0.0%	50.0%	100.0%	100.0%	100.0%
RN+LPN	661	49.3%	25.9%	0.0%	17.6%	50.0%	87.5%	100.0%	100.0%
DON	196	72.2%	42.4%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
DON+ADON	260	70.1%	41.9%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
Licensed nursing	660	48.5%	25.2%	0.0%	18.2%	45.5%	85.7%	100.0%	100.0%
All nursing	663	38.1%	17.0%	0.0%	16.9%	37.0%	60.0%	80.4%	100.0%
Administrator	159	76.4%	39.6%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
All staff	663	39.3%	15.0%	0.0%	20.0%	38.9%	59.6%	75.5%	86.4%
TTD > 1 year (employed)									
CNA	663	60.7%	15.0%	0.0%	41.1%	60.3%	79.5%	93.0%	96.0%
LPN	663	65.9%	19.0%	0.0%	41.0%	66.7%	88.9%	100.0%	100.0%
RN	661	65.4%	23.1%	0.0%	33.3%	66.7%	100.0%	100.0%	100.0%
RN+LPN	663	66.0%	16.7%	6.5%	42.9%	67.6%	85.7%	100.0%	100.0%
DON	641	83.2%	36.2%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
DON+ADON	647	81.6%	34.6%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
Licensed nursing	663	67.7%	16.3%	6.3%	44.9%	69.8%	87.0%	100.0%	100.0%
All nursing	663	61.6%	13.4%	4.7%	43.4%	62.0%	79.1%	87.6%	94.1%
Administrator	622	82.0%	37.3%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
All staff	663	65.1%	11.4%	3.0%	50.0%	66.7%	78.6%	88.1%	93.2%

Table 9: Distributional statistics of staff tenure measures (continued)

Measure	n	Mean	Standard deviation	Minimum	10th Percentile	Median	90th Percentile	99th Percentile	Maximum
Tenure > 5 years (departed)									
CNA	663	8.8%	9.9%	0.0%	0.0%	5.9%	22.2%	45.5%	62.5%
LPN	634	14.3%	23.1%	0.0%	0.0%	0.0%	50.0%	100.0%	100.0%
RN	619	16.4%	26.3%	0.0%	0.0%	0.0%	50.0%	100.0%	100.0%
RN+LPN	661	15.9%	20.5%	0.0%	0.0%	9.1%	50.0%	100.0%	100.0%
DON	196	26.1%	42.6%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
DON+ADON	260	27.3%	41.6%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
Licensed nursing	660	14.8%	19.4%	0.0%	0.0%	8.8%	41.6%	100.0%	100.0%
All nursing	663	8.7%	8.1%	0.0%	0.0%	6.7%	20.0%	35.7%	46.7%
Administrator	159	27.9%	42.9%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
All staff	663	8.5%	6.7%	0.0%	1.0%	7.1%	17.6%	30.4%	39.3%
TTD > 5 years (employed)									
CNA	663	21.8%	13.5%	0.0%	1.3%	21.1%	39.4%	58.1%	83.3%
LPN	663	28.4%	20.9%	0.0%	0.0%	25.6%	55.6%	83.3%	100.0%
RN	661	24.5%	22.6%	0.0%	0.0%	22.2%	55.6%	83.3%	100.0%
RN+LPN	663	26.9%	18.2%	0.0%	0.0%	26.1%	50.0%	73.3%	91.7%
DON	641	41.2%	48.7%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
DON+ADON	647	40.3%	45.4%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
Licensed nursing	663	28.3%	18.3%	0.0%	3.6%	27.0%	53.3%	75.0%	84.6%
All nursing	663	23.2%	13.3%	0.0%	2.5%	23.4%	40.5%	56.0%	74.3%
Administrator	622	37.0%	47.3%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
All Staff	663	25.8%	13.0%	0.0%	4.2%	26.9%	40.9%	54.8%	74.5%

3.2 Correlations

3.2.1 Staffing ratios

Pearson's correlation statistics for the facility-level staffing ratios are shown in Table 10. Almost all associations are positive (and statistically significant at p<0.001), demonstrating that as the hours per resident-day of one staff type increases, increases are also seen in the other staff types. Such associations suggest that staffing ratios may be determined by facility-wide factors that influence staff levels throughout the organization. The single - and important - exception to this finding is the negative relationship between RN and LPN hours per resident-day. The correlation between these two measures is -0.446 - a strong inverse association indicating that LPN hours increase as RN hours decrease, suggesting some type of labor substitution may be occurring.

Table 10: Pearson's correlation statistics between staffing ratios (n=748)*

	CNA	LPN	RN	RN+LPN	Licensed nursing	All nursing	All staff
CNA	1.0	-0.018*	0.133	0.084*	0.135	0.835	0.695
LPN	-0.018*	1.0	-0.446	0.718	0.695	0.318	0.250
RN	0.133	-0.446	1.0	0.302	0.241	0.221	0.296
RN+LPN	0.084*	0.718	0.302	1.0	0.927	0.510	0.496
Licensed nursing	0.135	0.695	0.241	0.927	1.0	0.578	0.506
All nursing	0.835	0.318	0.221	0.510	0.578	1.0	0.858
All staff	0.695	0.250	0.296	0.496	0.506	0.858	1.0

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* p-values for all correlations are <0.001 except: CNA with LPN p-value=0.618, CNA with RN+LPN p-value=0.022

3.2.2 Shift coverage

Correlations among the RN shift coverage measures are presented in Table 11. These associations are all positive and all statistically significant at p<0.0001 for the 194 facilities for which these measures were calculated. Associations between the day, evening, and night shift coverage measures are relatively modest. Associations of these measures with 24-hour period coverage, however, are greater, with the strongest relationships found with the night and evening shift. This finding suggests that it is more difficult to provide RN coverage during the evening and night shifts, and that facilities that do so are

more likely to provide 24-hour RN coverage. There is a strong relationship between weekday and weekend RN coverage, although 24-hour RN coverage is more strongly associated with weekday than weekend coverage.

Table 11: Pearson's correlation statistics between RN shift coverage measures (n=194)*

	Day	Evening	Night	24 Hours	Weekday	Weekend
Day	1.0	0.435	0.343	0.707	0.720	0.614
Evening	0.435	1.0	0.546	0.836	0.817	0.822
Night	0.343	0.546	1.0	0.829	0.820	0.789
24 Hours	0.707	0.836	0.829	1.0	0.993	0.942
Weekday	0.720	0.817	0.820	0.993	1.0	0.894
Weekend	0.614	0.822	0.789	0.942	0.894	1.0

* p-values for all correlations are <0.0001

3.2.3   RN turnover, retention, and tenure measures

To examine the associations and potential redundancy of the turnover, retention, and tenure measures, correlations between measures within each staffing group were examined using Pearson's correlation statistics. A similar pattern of association between measures exists within each staffing group, and therefore correlations for the RN group are presented in Table 12 as an illustrative example of the pattern of associations. All but one of the correlations presented in Table 12 are significant at $p<0.005$ and associations are in the expected direction. For example, the retention and tenure measures are negatively correlated with the turnover measures but positively related to each other. Correlations of tenure measures for departed employees with measures of turnover and retention are weak, whereas tenure measures for currently employed staff are more strongly associated with retention and turnover. This finding suggests that tenure measures for departed versus current staff may be related to very different aspects of nursing home staffing.

In addition to examining the associations between the measures, the potential redundancy of measures was examined. Redundancy between two measures would exist when a large proportion of variance is shared by both measures and can be determined by calculating the coefficient of determination (r^2*100).

Table 12: Pearson's correlation statistics for RN turnover, retention, and tenure measures

	Cohort turnover	Cohort retention	Position turnover	Short-term	Tenure	TTD > 1 year (employed)	TTD > 5 years (employed)	Tenure > 1 year (departed)	Tenure > 5 years (departed)
Cohort turnover	1.0	-1.0	0.761	0.479	-0.404	-0.558	-0.302	-0.166	-0.141
Cohort retention	-1.0	1.0	-0.761	-0.479	0.404	0.558	0.302	0.166	0.141
Position turnover	0.761	-.761	1.0	0.775	-0.329	-0.456	-0.250	-0.189	-0.121
Short-term	0.479	-0.479	0.775	1.0	-0.158	-0.233	-0.141	-0.116	-0.002
Tenure	-0.404	0.404	-0.329	-0.158	1.0	0.561	0.778	0.499	0.612
TTD > 1 year (employed)	-0.558	0.558	-0.456	-0.233	0.561	1.0	0.485	0.359	0.285
TTD > 5 years (employed)	-0.302	0.302	-0.250	-0.141	0.778	0.485	1.0	0.285	0.390
Tenure > 1 year (departed)	-0.166	0.166	-0.189	-0.116	0.499	0.359	0.285	1.0	0.533
Tenure > 5 years (departed)	-0.141	0.141	-0.121	-0.002	0.612	0.285	0.390	0.533	1.0

One of the strongest associations between RN measures is the correlation between RN cohort turnover and position turnover of 0.761. Although there is a strong association between these two measures, only 57.9% of the variance is shared between these two measures, suggesting that the measures are somewhat independent of each other.

3.2.4   Position turnover and tenure to date by job categories

Correlations between the various job categories for the position turnover measure are presented in Table 13 and correlations between job categories for the average tenure to date measure are presented in Table 14. All correlations are significant at $p<0.005$. For both the position turnover and average tenure to date measures, correlation coefficients are higher between CNA and LPN job categories than between CNA and RN or CNA and DON job categories. Associations between RNs and LPNs on each of the measures are moderately related. The magnitude of the correlations (and therefore amount of shared variance) increases when associations are examined between CNAs and RN+LPN or CNAs and all licensed staff. Associations between overlapping job categories (CNAs with all nursing) are very high due to the non-independence of the two staffing groups (i.e., CNAs comprise the majority of the all nursing group). Associations between administrators and all other job categories on the TTD measure are weak (range 0.11 to 0.22) and associations between DONs (and DONs+ADONs) and all other staffing groups with the exception of administrators are modest. These findings suggest that measures of turnover and tenure among the various staff groups are related but are not redundant measures.

Table 13: Pearson's correlation statistics for position turnover by job category

	CNA	LPN	RN	RN+LPN	DON+ADON	Licensed nursing	All nursing	All staff
CNA	1.0	0.391	0.277	0.404	0.137	0.418	0.826	0.756
LPN	0.391	1.0	0.426	0.881	0.298	0.837	0.628	0.617
RN	0.277	0.426	1.0	0.720	0.294	0.676	0.471	0.447
RN+LPN	0.404	0.881	0.720	1.0	0.343	0.923	0.664	0.639
DON+ADON	0.137	0.298	0.294	0.343	1.0	0.464	0.306	0.333
Licensed nursing	0.418	0.837	0.676	0.923	0.464	1.0	0.711	0.693
All nursing	0.826	0.628	0.471	0.664	0.306	0.711	1.0	0.930
All staff	0.756	0.617	0.447	0.639	0.333	0.693	0.930	1.0

Table 14: Pearson's correlation statistics for average tenure to date by job category

	CNA	LPN	RN	RN+LPN	DON	DON+ADON	All licensed	All nursing	Administrator	All staff
CNA	1.0	0.608	0.521	0.641	0.246	0.283	0.647	0.934	0.107	0.880
LPN	0.608	1.0	0.564	0.905	0.327	0.364	0.888	0.765	0.174	0.740
RN	0.521	0.564	1.0	0.863	0.343	0.367	0.800	0.682	0.199	0.665
RN+LPN	0.641	0.905	0.863	1.0	0.375	0.410	0.956	0.820	0.209	0.797
DON	0.246	0.327	0.343	0.375	1.0	0.925	0.479	0.374	0.156	0.379
DON+ADON	0.283	0.364	0.367	0.410	0.925	1.0	0.516	0.413	0.183	0.417
All licensed	0.647	0.888	0.800	0.956	0.479	0.516	1.0	0.841	0.216	0.825
All nursing	0.934	0.765	0.682	0.820	0.374	0.413	0.841	1.0	0.153	0.948
Administrator	0.107	0.174	0.199	0.209	0.156	0.183	0.216	0.153	1.0	0.181
All staff	0.880	0.740	0.665	0.797	0.379	0.417	0.825	0.948	0.181	1.0

3.2.5   RN staffing ratio and cohort turnover and short-term

Associations between RN staffing ratio and cohort turnover by staff type and short-term by staff type are shown in Table 15. RN staffing ratios are negatively correlated with both cohort turnover and short-term measures for all staff categories. Higher levels of RN staffing are associated with lower turnover, most strongly for RNs as expected, but also for CNAs and all nursing staff. Higher RN staffing is also associated with lower percentages of short-term staff, again most strongly for RNs as expected, but also for CNAs, LPNs, and all nursing staff.

Table 15: Pearson's correlation statistics between RN staffing ratio and cohort turnover and short-term measures

	RN staffing ratio (n=402)		RN staffing ratio (n=403)
Cohort turnover		Short-term	
CNA	-0.154**	CNA	-0.168***
LPN	-0.091^{ns}	LPN	-0.125*
RN	-0.240****	RN	-0.188***
RN+LPN	-0.143**	RN+LPN	-0.166***
Licensed nursing	-0.117*	Licensed nursing	-0.159**
All nursing	-0.151**	All nursing	-0.208****
All staff	-0.138**	All staff	-0.232****

^{ns} p-value>0.05, * p-value<0.05, ** p-value<0.01, *** p-value<0.001, **** p-value<0.0001

3.3 Determination of appropriate measurement intervals

3.3.1   Staffing ratios

The average facility standard deviations (SD) and coefficients of variation (CV) of the staffing ratios for each time period and for each staff type are shown in Table 16. The mean annual values are also provided for comparison. Nursing facilities that did not provide productive hours or that provided only a single average daily census are excluded. Because the CV represents the ratio of the SD to the mean (CV=SD/mean x 100% when expressed as a percentage), CVs can be compared across measures with very different means; SDs, on the other hand, are not directly comparable unless the measures have similar means. For example, a CV of 10% (or 0.10) indicates that the standard deviation is 10% of the mean,

Table 16: Variability of staffing ratios by measurement period*

Staff type	Annual mean	Variance measure[†]	Week	Month	Quarter	Semi-annual	Annual
CNA	1.967	SD	0.111	0.095	0.077	0.057	0
CNA	1.967	CV	5.936%	5.055%	4.096%	3.137%	0
LPN	0.648	SD	0.066	0.059	0.051	0.042	0
LPN	0.648	CV	11.338%	10.241%	8.809%	7.196%	0
RN	0.293	SD	0.048	0.044	0.038	0.031	0
RN	0.293	CV	20.705%	18.904%	16.467%	13.510%	0
RN+LPN	0.941	SD	0.072	0.064	0.053	0.042	0
RN+LPN	0.941	CV	7.855%	6.951%	5.819%	4.621%	0
Licensed nursing	1.104	SD	0.079	0.069	0.057	0.044	0
Licensed nursing	1.104	CV	7.248%	6.366%	5.250%	4.140%	0
All nursing	3.107	SD	0.144	0.121	0.097	0.073	0
All nursing	3.107	CV	4.581%	3.874%	3.092a5	2.329%	0
All staff	4.684	SD	0.200	0.167	0.131	0.102	0
All staff	4.684	CV	4.222%	3.551%	2.800%	2.173%	0

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* n=748. Facilities that did not provide productive hours or that provided only a single average daily census are excluded.
[†] SD=Standard deviation, CV=Coefficient of variation. Values presented are the mean of all facilities' within-facility SD and CV for each time period.

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regardless of what the mean and standard deviation are. Smaller CV values indicate a tighter measure distribution. When a measure is normally distributed, 68% of observations fall within 1 SD of the mean, and 95% of observations fall within 2 SDs of the mean. Using this fact to approximate the distribution of facility-level staffing ratios, a CV of 10% indicates that on average a facility staffs within 10% (1 x CV) of its typical level 68% (1 SD) of the time, and within 20% (2 x CV) of its typical level 95% (2 SDs) of the time. The mean facility CV for staffing ratios ranges from 20.7% for RN weekly hours per resident-day to 2.2% for semi-annual all employee hours per resident-day (the annual CV and SD are 0 by definition because there is only one year of data), indicating that the within-facility variation in staffing ratios is quite small. Across all time periods, RN staffing ratios are much more variable than any other category of staff, and LPN staffing ratios are the next most variable.

For each staff type, the average within-facility variation steadily decreases as the time period lengthens. This is not entirely unexpected; however there were many facilities whose CVs do not follow this pattern. For example, the CV for RN hours per resident-day shows some other pattern in 438 of the 748 (59%) facilities. The semi-annual CV can be larger than the quarter CV when facilities experience increases or decreases in staffing during the year such that staffing ratios in the first half of the year are very different from staffing ratios in the second half of the year. Such changes in staffing can occur when facilities engage in recruiting efforts to add staff, or when tight labor markets result in the steady drain of staff away from facilities. Any weekly or monthly variation is overwhelmed by the very large differences between the beginning and end of the year. Nonetheless, on average, variation decreases over longer measurement periods.

When the average CVs for each time period are graphed (not shown), the result is a steady decline in variation. There are no major jumps or drops that might suggest that shorter time periods are excessively volatile, nor are there any indications of a threshold beyond which no additional precision is gained. In the absence of a compelling statistical argument, the determination of the optimal measurement period must be based instead on practical considerations. Measures developed for this project are intended to be used in a future public reporting system, and therefore the resources required to calculate and update them are an important consideration. Although a small time period would allow more current data to be reported, it is simply too great a burden to impose on the system. Nursing Home Compare is currently updated quarterly, which suggests that the staffing ratio measures should be calculated on a quarterly basis as well. These analyses were therefore focused on quarterly staffing ratios, and the results presented in the bulk of this paper show staffing ratios at the quarterly level.

3.3.2 Turnover and retention

As described in Section 2.5.2, each of the staff turnover and retention measures was calculated at three quarterly intervals, semi-annually, and at a nine-month interval. Findings for the CNA turnover and retention measures are presented in Table 17. These data show that as the time interval for the measures increases, turnover rates increase and retention rates decrease. This finding is expected as the denominator for each measure is relatively unchanged when the interval is increased but the numerator increases over time. Therefore to allow for the opportunity for turnover to occur, the nine-month measure will be used (because a 12-month measure is not available) for all subsequent analyses.

Table 17: Descriptive statistics for CNA turnover and retention measures at various time intervals

Measure	n	Mean	Standard deviation
Cohort turnover			
January-March (Q1)	1042	17.6%	9.3%
April-June (Q2)	1043	18.3%	10.1%
July-September (Q3)	1045	20.1%	10.4%
January-June	1042	30.7%	12.5%
January-September	1043	39.2%	13.5%
Cohort retention			
January-March (Q1)	1042	82.4%	9.3%
April-June (Q2)	1043	81.7%	10.1%
July-September (Q3)	1043	80.1%	9.8%
January-June	1042	69.3%	12.5%
January-September	1043	60.8%	13.5%
Position turnover			
January-March (Q1)	1043	25.4%	15.6%
April-June (Q2)	1044	26.3%	18.4%
July-September (Q3)	1045	28.9%	34.5%
January-June	1045	51.5%	30.2%
January-September	1045	79.6%	44.5%

3.4 Differences between full-time and part-time employees

The percentage of staff that are full-time employees is shown in Table 18. For all staff types, with the exception of administrators and DONs/ADONs, on average approximately 40-50% of the staff are part-time employees as defined previously in Section 2.3.8. Notably, on average across all facilities just over half of the employees that comprise the all nursing job category are classified as full-time employees. Variability (SD=25.0%) in the proportion of full-time to part-time staff is greater in the RN job category compared to the CNA (SD=17.5%) and LPN (SD=19.4%) job categories. On average, the percent of administrators that are full-time is 80% and the percent of DONs/ADONs that are full-time is 90%.

As the proportion of full-time to part-time staff is fairly equal, particularly for RNs and CNAs, an examination of turnover, short-term, and tenure measures by full-time status was conducted. Descriptive statistics for selected measures are presented in Table 19 separately for full-time and part-time staff.

Table 18: Distributional statistics of full-time staff percentages

Measure	n	Mean	Standard deviation	Minimum	10th Percentile	Median	90th Percentile	99th Percentile	Maximum
% of staff that are full-time employees									
CNA	1045	51.4%	17.5%	6.3%	28.1%	51.4%	74.4%	91.0%	95.8%
LPN	1045	57.9%	19.4%	0.0%	32.4%	58.8%	81.8%	100.0%	100.0%
RN	1039	47.9%	25.0%	0.0%	14.3%	50.0%	80.0%	100.0%	100.0%
RN+LPN	1045	54.4%	17.1%	0.0%	31.6%	55.2%	75.0%	90.9%	100.0%
DON	910	90.5%	27.2%	0.0%	50.0%	100.0%	100.0%	100.0%	100.0%
DON+ADON	943	89.5%	26.8%	0.0%	50.0%	100.0%	100.0%	100.0%	100.0%
Licensed nursing	1045	57.7%	16.4%	0.0%	36.7%	59.5%	77.5%	90.0%	100.0%
All nursing	1045	52.8%	15.2%	3.1%	33.3%	53.3%	72.4%	88.7%	92.2%
Administrator	992	80.1%	39.0%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
All staff	1045	53.3%	14.1%	5.9%	33.3%	54.9%	70.8%	82.2%	88.1%

Table 19: Descriptive statistics for turnover and tenure measures for full-time versus part-time employees

Measure	Full-time			Part-time		
	n	Mean	Standard deviation	n	Mean	Standard deviation
Position turnover						
CNA	1038	37.4%	26.7%	1045	139.8%	81.6%
LPN	1029	26.4%	24.8%	1015	89.0%	70.8%
RN	942	57.8%	63.2%	968	112.5%	89.3%
Licensed nursing	1039	32.0%	24.1%	1044	112.5%	80.7%
All nursing	1039	33.5%	18.3%	1045	126.4%	65.6%
Short-term						
CNA	1038	9.5%	7.8%	1045	31.6%	14.2%
LPN	1031	7.6%	9.8%	1035	27.6%	19.6%
RN	994	14.2%	20.0%	1023	27.1%	23.0%
Licensed nursing	1039	6.9%	7.1%	1045	26.9%	16.2%
All nursing	1039	8.0%	5.5%	1045	30.2%	12.5%
Length of employment, years (tenure)						
CNA	659	4.6	2.4	663	2.3	1.6
LPN	653	5.3	3.8	657	3.2	3.0
RN	636	4.1	3.3	657	3.0	2.7
Licensed nursing	659	5.0	3.0	663	3.2	2.4
All nursing	659	4.6	2.2	663	2.4	1.6
TTD > 1 year (employed)						
CNA	659	72.9%	15.8%	663	47.8%	20.1%
LPN	653	74.1%	21.8%	656	54.4%	28.3%
RN	610	72.5%	29.1%	633	57.7%	31.6%
Licensed nursing	659	75.3%	17.2%	663	56.3%	23.4%
All nursing	659	72.8%	13.6%	663	49.3%	18.3%

Distributional statistics for all turnover, short-term, and tenure measures by full-time and part-time status are presented in Appendix D.

The differences between full-time and part-time staff are notable across all measures and all job categories. Position turnover rates and percent of short-term employees across all job categories are two to four times higher for part-time employees than full-time employees. Average TTD across all job categories is one and one-half to two times longer for full-time employees compared to part-time employees. The percent of current staff whose TTD is greater than one year is one to one and one-half times greater for full-time staff than part-time staff. The magnitude of the differences and the consistency of the finding suggest that full-time and part-time employees have very different employment histories.

4 Discussion

4.1 Summary of findings

The project activities leading up to this report resulted in: 1) a decision to test the use of payroll data for measuring staffing characteristics in nursing homes; and 2) a proposed list of staffing measures to be compared and validated. With respect to the first objective, the analyses provided compelling evidence that payroll records are not only feasible as a data source for staffing, but also preferable to other data sources. Not that working with payroll records is without complexities; however, the analyses suggest these can be overcome with improvements in standardization and data transfer, and that such improvements are within reach of most payroll systems. The second study objective involved programming, examining, and comparing numerous staffing measures and variants of these measures, many of which were never previously calculated because of data limitations. Although an evaluation of how these measures discriminate between facilities and validation of the measures with respect to outcomes is beyond the scope of this report, these initial analyses suggest some of the strengths and limitations of particular measures and variants of measure definitions.

4.2 Data sources

The three data sources that are currently available for reporting staffing measures for nursing homes include OSCAR, Medicaid cost reports, and payroll records. OSCAR data, which are used as a source of staffing measures currently reported by CMS, have several known limitations (Appendix A; pages 6,7). First, they can be used only to report number of staff hours worked per resident day and lack the necessary information to report measures of turnover/retention or tenure. Second, the data, which are collected during the state survey, report information corresponding to a two-week period that does not necessarily represent a quarter, six months, or a year of staffing. Third, and potentially most important, earlier studies have suggested that OSCAR data lack accuracy for facility-level reporting, and are particularly inaccurate for CNAs and for staffing at the lowest staffed facilities. Confusion also exists in reporting facility census for facilities that have both certified and uncertified beds, resulting in an undercount of the total facility census and an inflation of the hours per resident day figures. Although improved edit checks will be implemented for OSCAR data, data cleaning can only go so far without eliminating substantial numbers of cases that may have the most egregious staffing problems. (CMS

Survey and Certification Letter S&C-05-24, "Changes to Staffing Data on the Nursing Home Compare Web Site", April 14, 2005, http://www.cms.hhs.gov/medicaid/survey-cert/sc0524.pdf).

Medicaid cost reports provide a more accurate alternative because the data are desk audited and used for facility reimbursement. Medicaid cost reports, however, provide other impediments for public reporting (Appendix A; page 8). First, Medicaid cost reports do not currently contain measures of turnover or retention, nor the data needed to calculate current turnover, except in the case of three states. Second, Medicaid cost reports in some states do not even contain staffing measures and in other states the cost reports data are not available in electronic format. Third, Medicaid cost reports are not available for facilities that only treat Medicare and/or private pay residents. Fourth, Medicaid cost reports provide staffing for 12-month periods only, allowing calculation of only annual average staffing levels. Finally, the delays in submitting and processing cost reports because they include comprehensive cost information would make them impractical for reporting staffing data.

In theory, payroll records provide an ideal source of data for generating nursing home staffing measures and reporting them. First, payroll hours for each individual staff member are input into the systems, so almost any staffing measure (including turnover/retention measures) can be calculated from these building blocks. Second, although each payroll system may define staffing measures differently, definitions can be rendered comparable because all systems begin with the same basic data of staff hours for each staff member. Third, hours are reported by staff and used to pay salaries so their accuracy is confirmed by both the staff member and the facility. They are also susceptible to audit, so are unlikely to be altered. Fourth, they are provided for every pay period so variants of each measure can be calculated corresponding to a week, month, quarter, year, or any other time period.

Generally, all of these theoretical benefits proved true. Using the data we received, we were able to generate the full range of measures recommended by the TEP. The data were sufficiently basic that uniform definitions could be used across all sites. In fact, a level of precision was possible that never has been possible with other data sources, such as separating full-time and part-time staff, distinguishing RNs who work on the floor from RNs who are DONs or ADONs, and separating productive work hours (i.e., excluding vacations and holidays) from total hours, though not all corporate data systems were designed to make these distinctions. We were able to generate staffing measures corresponding to

different time periods and compare findings from one time period to the next. The accuracy of the information was supported by the minimal number of outlier cases that were identified.

Nevertheless, use of payroll data in this study was complicated for several reasons. The payroll systems were all different and a substantial learning curve was required to understand how each one dealt with different reporting issues. The variable transformations had to be coded differently for each payroll system because each system captured different data elements and utilized different file structures. Resident census data, which is not part of the payroll system, was not available from all facilities in a manner that could be transmitted. And most importantly, payroll data do not include information on contract staff, who are probably used differentially across facilities. Arguably, most of these issues could be resolved with more standardized reporting and the involvement of appropriate nursing home and corporate staff if payroll record reporting were a requirement, or if recommended standards were disseminated.

4.3 Measures

A broad array of measures were recommended for examination by the TEP (Appendix A; page 4,5), all of which we were able to generate from payroll records. Measures relating to advance practice nurses, while calculated, were not presented in this report because only one Clinical Nurse Specialist and one Nurse Practitioner were identified from all corporations' payroll records (advance practice nurses are often covered by physicians' offices, not nursing homes). In addition, variants of almost every measure were calculated based on different definitions or time periods. In these analyses, we did not impute missing data so corporations were only included when they had complete data that were necessary for computing a value. For example, when a corporation did not include daily census data we did not base the measures on disaggregated annual census data; rather we left the facilities out of the computations that required census data. In the future, daily variability in census and seasonal variation will be examined in order to more accurately impute missing census data. A standard data extract would mitigate the need for and impact of missing data. A discussion of preliminary findings related to each type of measure is provided below.

Staffing ratios: Measures of hours per resident day are clearly candidates for public reporting and should be studied further. Relative to values from 1999 Medicaid cost report data, the payroll average

values were slightly lower for CNAs and LPNs and considerably lower for RNs, with less overall variability (CMSO "Appropriateness of Minimum Nurse Staffing Ratios in Nursing Homes, Phase II", 2001). ADONs, DONs, and other nursing administrators were not included in the payroll RN level, which probably explains the RN difference because cost reports do not discriminate RN roles. However, for licensed nursing, where all nurses were included in the payroll value, the values were comparable. The substantial inverse correlation between RN and LPN hours per resident day demonstrated the substitution that occurs between these two types of licensed staff providing direct patient care, suggesting that examining LPN levels alone makes little sense. With the very high correlation between all licensed nursing and RN+LPN, only one of these variables will require reporting. A facility's nursing staff ratio profile can therefore be captured largely in three measures including CNA, RN, and all licensed nursing hours per resident day.

This study represents the first opportunity to examine all nursing home employees, of which approximately two-thirds of the FTE are nursing, and overall staffing levels are therefore highly correlated with nursing staffing levels. Also of note was the finding that higher direct care RN hours per resident day were associated with lower turnover in all types of nursing staff and all employees - a profile we might expect in better-staffed facilities. Thus, the tighter definition of different nurse staff categories and the more comprehensive information on facility staffing offered new measurement opportunities and insights.

Staff mix: Ratios of RN hours, RN+LPN hours, CNA hours, and licensed hours to total nursing hours are potential measures for public reporting, although more complicated in concept than staffing levels. The ratios of RN to LPN hours and RN+LPN to CNA hours are extremely difficult to interpret and have substantial outlier values, making it difficult to determine the implications. Using all nursing hours in the denominator, however, results in measures demonstrating that about two-thirds of nursing hours are provided by CNAs and about 10% are provided by direct care RNs (not DONs or management). These measures vary across facilities but without extreme outliers, except at the low end, which probably reflects facilities with high contract staff use. The RN+LPN variable was once again highly correlated with the licensed hours variable suggesting that only one of these is necessary. Thus, a facility staff mix profile might be apparent from CNA hours to total nursing hours, RN hours to total nursing hours, and licensed hours to total nursing hours.

Percent full-time employees: Payroll records provide a unique opportunity to examine full-time relative to part-time employees. Using a definition of greater than 35 hours per week, around 50% of nursing staff were full-time, and these full-time staff provided about 75% of all nursing hours. These proportions were relatively similar on average for all types of nursing staff and all staff, with the exception of management, which had a higher rate of full-time employees. An important finding in these analyses was that turnover rates for part-time employees were far greater than turnover rates for full-time employees, twice as high for several categories of staff. To some extent, facilities with higher rates of part-time employees had higher turnover; however, this is also one of several factors contributing to high turnover. Nevertheless, these findings suggest that facilities ought to specifically consider the needs of part-time employees when trying to reduce turnover and perhaps consider incentives to encourage staff to commit to full-time employment. The Veteran's Administration, for example, provides a considerable salary bonus for clinicians that are full-time. The measures relating to the percent of staff that are full-time rather than the percent of hours provided by full-time staff are more comprehensible, and from these findings the number of staff who are part-time may be more critical.

RN shift coverage: Shift-level data were available from only one nursing home corporation's payroll system. These unique findings from payroll data showed that RN coverage was greater on average than might be expected, with one RN available in three-quarters of daytime hours, two-thirds of evening hours, and almost half of nighttime hours, excluding DONs, ADONs, other nurse managers, or contract staff. However, these measures varied substantially with 10% of facilities having RN coverage less than 25% of evening hours and less than 10% of nighttime hours, whereas others had virtually 100% coverage by RNs around the clock. An RN was covering the floor an average of 61% out of every 24-hour period, which was consistent on both weekdays and weekends. Although 10% of facilities had less than 8 hours coverage per 24-hour period, this excludes coverage from contract nurses and management nurses. Because coverage was highly correlated across shifts and days, a single variable of RN coverage might ultimately be adequate for reporting. These illuminating results are not readily available from any other data source.

Turnover/Retention: Payroll data were preferable to personnel data for generating measures related to turnover and retention because payroll data included individuals who were employed in the facility during the time period of interest; they tracked an employee through multiple departures, rehires, or job classification changes which were difficult from personnel records; and they were not susceptible to

variation in facility definitions of termination. Payroll data provided an opportunity to calculate

turnover and retention by following a cohort from a single point and determining what proportion of

these employees departed before a later interval such as nine months (termed "cohort turnover").

Retention was the inverse of this turnover measure (termed "cohort retention"). The more traditional

measure of turnover, which was also calculated from payroll data, provided a rate of departures during a

time period relative to the average number of positions (termed "position turnover").

Rates of CNA position turnover reported here (about 80%) were comparable to other findings for CNA

turnover in previous studies (CMSO "Appropriateness of Minimum Nurse Staffing Ratios in Nursing

Homes, Phase II", 2001). Unlike in previous studies, however, RN position turnover was higher than

CNA turnover at 88%. Several issues may explain this result including: the more current data available in

this study in a time of nursing crisis; the more accurate nature of RN payroll data in contrast to other

unaudited surveys; the exclusion of administrative nurses (e.g., DONs), who generally have lower

turnover, from our RN turnover measure; and the possibility that corporations move nurses from one

site to the next more frequently increasing RN turnover. Interestingly, the higher rate of turnover in RNs

was not associated with an exceptionally high rate of very short-term employees (<60 days) that turn over

frequently, which is the payroll data "short-term turnover" measure. LPN turnover was lower than both

CNA and RN turnover, with somewhat lower turnover in administrative nursing.

The complexity of the turnover/retention construct is apparent from the associations among these

measures, many of which cannot be calculated without payroll records or a similar data source.

Although several types of turnover/retention measures are reasonably well correlated, they provide

unique information (with the exception of the cohort retention measure that is the inverse of the cohort

turnover measure). These correlations suggest that all the different staffing measures may not be

warranted for public reporting; however, further investigation of the various measures is essential at this

stage and the more complete measure profile may prove informative for in-depth understanding of

staffing issues and development of approaches to improve staffing in a specific facility. Turnover based

on a single measure is correlated moderately across the various types of staff, except for staff categories

that are highly overlapping where correlations are high. Therefore, relationships between outcomes and

all variants of these turnover measures for different staff types will be extremely important to investigate

in the upcoming analyses.

Tenure measures: Tenure measures could not be calculated solely from the payroll data and therefore hire/rehire dates from the personnel data files were matched to the employee records created from the payroll data. As stated previously, personnel data have unique problems because facilities have different definitions of termination and hold files open for varying periods after an employee stops working. Therefore, only hire/rehire dates were used from the personnel data to calculate tenure. One-year and five-year tenure measures were calculated for both departed staff and employed staff. Of the employed staff, about 60% of CNAs and two-thirds of licensed staff were employed at least one year, with figures in the 20%-30% range when looking at tenure of five years or more. DONs and ADONs had longer tenure. Although the number is much lower in total for departed staff, they followed the same trend. The modest correlation between these tenure measures and turnover measures show that these measures provide a different dimension of staffing than turnover; however, they are associated with one another. The stronger associations between the employed staff tenure measures and turnover suggest that employed staff measures may be more beneficial in characterizing current quality of care.

Reporting periods: As expected, the analysis of different reporting periods for staffing level measures demonstrated that there was less variability with greater stability in estimates that corresponded to longer time intervals. The coefficient of variation improved considerably when staffing levels were computed quarterly instead of weekly or monthly, supporting the use of quarterly measures. Medicare's Nursing Home Compare website (http://www.medicare.gov/nhcompare) also reports nursing home quality measures using a quarterly schedule. Six-month measures provided further reductions in variation, although not as great, and the tradeoff is they would include an unnecessarily longer window to which the staffing levels apply. For turnover/retention measures, longer time intervals provide a more complete picture of turnover rates. Although the study calculated turnover at three-, six-, and nine-months, we would recommend a twelve-month turnover rate with the addition of a quarter and deletion of the first quarter every three months. In order to have 12 months of turnover data, 15 months of data are necessary from the facility to determine the disposition of the last individuals three months after admission.

4.4 Recommendations

The following recommendations result from the staffing measure development activities conducted to date:

1. The data file that was constructed using payroll data includes an array of measures and variants that should be further analyzed to examine how these measures are associated with other facility characteristics, and to test the validity of these measures in relation to resident outcomes. Substantial resources were invested in file development and a great deal can be learned about staffing measurement from this rich dataset.

2. CMS should consider pursuing payroll data for public reporting, quality monitoring, research and demonstrations. These data are more accurate because they originate from employees, are used to pay salary by facilities, and susceptible to audit, rendering them unlikely to be influenced by incentives.

3. To facilitate future uses of payroll data across facilities, corporations and payroll companies, CMS could prepare payroll data requirements that could be distributed as soon as possible. The experience gained in this analysis could be used to generate such a requirement. Even without mandating the requirements at the present time, payroll systems undergoing evolution could begin to accommodate the eventual CMS standards.

4. The array of measures developed in this study should be honed slightly in accord with these findings and then compared and contrasted. Ultimately, the process can lead to a manageable set of staffing measures that could be used for public reporting and a larger measure set that could be used by facilities for in-depth understanding of staffing problems and staffing improvement activities.

DEVELOPMENT OF STAFFING QUALITY MEASURES PHASE I

FINAL REPORT APPENDICES

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Appendix A: Development of Staffing Quality Measures – Phase I, Data Collection Options for Staffing Data, June 30, 2004

Development of Staffing Quality Measures Phase I

Data Collection Options for Staffing Data
Final Report: June 30, 2004

Submitted on June 30, 2004 to:
Dr. Jean Scott, CMS, Government Task Leader
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DATA COLLECTION OPTIONS FOR STAFFING DATA

A. INTRODUCTION

Public reporting of nursing home staffing measures that are rigorously defined, based on accurate data, and associated with quality, has become a national priority. In the spring of 2003, the National Quality Forum Nursing Home Steering Committee recommended that a nurse staffing quality measure be included in the set of nursing home quality measures that are reported to the public. The Institute of Medicine (IOM) report entitled, "Keeping Patients Safe: Transforming the Work Environment of Nurses" (2004) cited evidence for a relationship between nurse staffing and quality of care.   This report also included recommendations relating to the collection and reporting of staffing data. The Center for Medicaid and State Operations (CMSO) "Appropriateness of Minimum Nurse Staffing Ratios in Nursing Homes, Phase II" (2001) study indicated that critical nurse staffing ratios exist, below which, nursing home residents are at increased risk of quality problems; that these thresholds exist for each type of staff (registered nurses, total licensed staff, and certified nurses assistants); and that critical thresholds vary depending upon the case mix of the facility. A continuation of the CMSO study is addressing short-term modifications to the existing nurse staff reporting system, which utilizes data from the Online Survey and Certification and Reporting System (OSCAR), as well as recommendations for future options. The Development of Staffing Quality Measures – Phase I (SQM) project is proceeding concurrently with the CMSO project and is designed to expand on previous work by reviewing a range of staffing measures and data sources for longer-term use in public reporting of staffing quality measures for nursing homes. Specifically, the SQM project is intended to investigate staffing measures other than ratios (e.g., turnover, staff mix) and to assess alternative data source options for future use.

Design of staffing measures for public reporting requires initial specification of constructs, or attributes, of staffing that most closely relate to nursing home quality and are meaningful to consumers and nursing home providers. Based on these constructs, specific quality measures that could be reported can be defined. Once quality measures have been defined, data source options can be considered. Potential staffing measures for public reporting can then be compared and contrasted with respect to feasibility and validity. Finally, the need for and approach to case mix adjustment can be determined for the proposed measures.

Activities under the SQM contract are following these defined steps. The project team first completed a literature review to identify potential quality measures for public reporting. Stakeholder input was then received to identify staffing constructs that stakeholders consider essential to measuring quality of nursing home care and most important from the perspectives of consumers and providers. Technical expert panel (TEP) members, who received the literature review and attended the stakeholder session,

helped the project team prioritize the quality measures for further study in subsequent stages of the project.

Data source considerations were also addressed in these initial steps of the project. Limitations of the OSCAR dataset were identified, particularly in view of the recommended measures, suggesting the need for consideration of alternative data sources. The CMSO study demonstrated relationships between staffing and quality of care using Medicaid cost report data, and more recently has also been considering other data source options. Based on the work conducted in the SQM project to date, the TEP, the SQM project team, and the Centers for Medicare & Medicaid Services (CMS) concluded that staffing quality measures could best be defined using payroll records instead of OSCAR data. Payroll records are considered to be an appropriate data source because facilities must collect these data accurately in order to pay their employees. Relatively little is known about using payroll data for measuring staffing in nursing homes. Thus, rather than repeating analyses using OSCAR and/or Medicaid cost report data, this project is emphasizing the use of staffing data from payroll records, provided it is possible to collect payroll data from an adequate sample of facilities within project timelines.

The contract will compare and contrast the statistical properties of several different staffing quality measures and assess the strength of their relationships with an array of outcome measures. This will first require obtaining staffing data from a sufficiently large sample of providers and assuring data comparability across sites. Following descriptive results of staffing measures at both the resident and the facility level, analyses will examine associations between staffing measures and quality, taking case mix into consideration. This data collection options report represents the completion of quality measure identification and review of data collection options. The report is divided into three sections. The first section identifies the potential staffing quality measures. The second section discusses evaluation of data collection options. The final section provides a strategy for the next steps in the project.

B. OVERVIEW OF STAFFING MEASURES IDENTIFIED FOR FURTHER STUDY

Discussion of data collection options for staffing data first requires specification of staffing measures or the constructs, or attributes, of staffing that will be measured. For example, if interest is on registered nurse (RN) hours per resident day[1], the staffing data collection instrument needs to precisely track RN hours and daily census, but information on other types of staff or by shift would not be necessary. If a staffing measure of interest is the availability of an RN on all shifts, then data by shift would also be required. Alternatively, if there is interest in certified nurses aide (CNA) turnover, then the data

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1 Hours per resident day for a given staff type is defined as the total number of hours worked by that staff over a given period divided by the total number of resident days in that period. It is a measure of the hours worked (or paid), but not a measure of the amount of patient care that is delivered. None of the available data sources—including payroll records-- separately track patient care hours vs. time spent on other tasks.

source would also need to include dates of hire and termination dates for CNAs. The SQM project team is not advocating a narrow staffing data collection approach at this stage; however, without first specifying the range of potential staffing measures we wish to investigate, it is impossible to evaluate the various data collection options. This section of the report therefore focuses on the measures providing a basis for judging the adequacy of various data collection options.

As previously mentioned, a multi-faceted method was used to identify potential quality measures including a comprehensive literature review, stakeholder input, and review by a technical expert panel. The literature review consisted of an electronic literature search of articles related to staffing measures, data sources, quality measures and risk adjustment published from 1975 to 2003 in the English language. This electronic search yielded ninety-six citations of which the team performed a manual review, eliminating all but fifty-one articles of sufficient quality to glean information about staffing measures. The literature review also involved study of relevant CMS and General Accounting Office (GAO) documents that were not identified electronically. The findings of the review were summarized in a series of detailed tables and a summary of main points (Development of Staffing Quality Measures – Phase I - Literature Review, University of Missouri Sinclair School of Nursing, January, 2004; submitted to CMS).

On March 2, 2004, a stakeholder meeting was held at CMS to obtain information pertaining to: 1) the aspects of nursing home staffing most important to the stakeholders and their constituencies, 2) how improvements could be made to the measures of staffing information currently presented on Nursing Home Compare, and 3) how staffing measures could be presented to the public. Forty-two stakeholders attended the meeting, including twenty-seven national organizations, nine nursing home corporations (both for-profit and not-for-profit), and six nursing facilities (both for-profit and not-for profit). Members of the technical expert panel also attended the stakeholder meeting to inform subsequent TEP discussions. Thus, recommendations of the stakeholders were strongly considered throughout the TEP meeting the following day and during subsequent project work. A summary of the stakeholder meeting, including their comments and written statements, was prepared (Development of Staffing Quality Measures – Phase I - Stakeholder Meeting Report, Colorado Foundation for Medical Care and the University of Colorado Health Sciences Center, April, 2004; submitted to CMS).

The TEP meeting was held March 3, 2004 with nine experts in the areas of staffing measurement, data sources, and methods (Development of Staffing Quality Measures – Phase I - Technical Expert Panel Meeting Report, Colorado Foundation for Medical Care and the University of Colorado Health Sciences Center, April, 2004; submitted to CMS). Prior to the meeting, panel members were sent the literature review and asked to complete a set of rating sheets to evaluate each measure in terms of whether or not to pursue the measure in further analyses. The list of measures for evaluation was drawn from the literature, but TEP members were asked to add to the list during their review and throughout the stakeholder meeting. The review sheets were submitted to the SQM project team and synthesized in preparation for the TEP meeting discussion. At the end of the discussion, TEP members were again asked to rate each of the quality measures

with "0" representing "do not pursue the measure further, "1" representing "pursue secondarily", and "2" representing "pursue with high priority".

A summary of the TEP recommended staffing measures for public reporting is provided in Table 1. Enumerated in this table are measures that received an average score across raters that was higher than 1.0. When two measures are the inverse of one another (e.g., % of RNs remaining for cost report period vs. % of RNs leaving during cost report period), only one of the two measures is listed. The measures include staffing hours per day by type of staff, which was considered essential staffing level information. In addition, both stakeholders and panel members discussed the importance of examining a measure relating to whether an RN was in the facility twenty-four hours a day, seven days a week; however, the TEP acknowledged this measure requires staffing data by shift. Both staffing level and staff mix information raised the concern about whether these were direct care (bedside) staff, or non-direct care staff, which was generally agreed to be both difficult to distinguish and could potentially be gamed.

The area of turnover and retention received substantial support for further study. These staffing measures require information about specific staff members who were hired and terminated during different time periods. In developing measures related to turnover/retention, the TEP supported study of different time periods to determine when such a measure became fairly stable. The need to distinguish specific types of staff was also considered important. In addition, turnover in directors of nursing (DONs) and administrators was suggested for further study. Some argued that not only was rapid turnover of administration a problem, but that the team should study whether DONs and administrators who held positions for too long might hamper progress in improvements of nursing home quality.

Table 1: Potential Staffing Measures for Public Reporting
Staffing Levels
RN hours per resident day
LPN hours per resident day
Licensed (RN+LPN) hours per resident day
CNA hours per resident day
Total nursing hours per resident day
RN in facility 24 hours, 7 days per week

Table 1: Potential Staffing Measures for Public Reporting
STAFF MIX
Ratio RN to total nursing hours
TURNOVER/RETENTION
#RNs employed at year end minus beginning
#CNAs employed at year end minus beginning
#Total nursing staff employed at year end minus beginning

#Total nursing staff voluntary terminations

%RN remaining for entire cost report period
%Licensed (RN+LPN) remaining for entire cost report period
%CNAs remaining for entire cost report period
%Total nursing staff remaining for entire cost report period

#DONs leaving in the past year
#Administrators leaving in past year

ADVANCED PRACTICE NURSE/PHYSICIAN ASSISTANT
GNP
Clinical Specialist (e.g., wound care nurse)
PA

TOTAL STAFF FTES
Total staff hours per resident day

A great deal of interest was expressed in more highly trained staff and substitution of different types of staff in nursing homes. Despite the difficulties in distinguishing whether advanced practice nurses and physician assistants provide mostly primary care in conjunction with physicians, it was argued that research is needed to determine whether staffing measures should publicly report the presence of advanced practice nurses and physician assistants. Although this may not occur in the majority of nursing homes today, substantial evidence has been accumulated over an extended period of time regarding the quality benefits accrued by having advanced trained nurses in nursing homes. Any staffing system put in place today must take into consideration innovations in staffing that continue to grow. Some stakeholders argued that they have substituted certain types of specialized nurses for traditional nursing staff. In addition, other facilities argued that therapy staff, activity staff, and other types of staff might be substituted for CNA time. Thus, a measure of total staff hours per resident day was also proposed for further study.

C. IMPLICATIONS FOR DATA COLLECTION OPTIONS

OSCAR System

The CMS OSCAR system provides staffing data for all certified nursing homes in the United States and is the source of the staffing measures reported on the CMS Nursing Home Compare web site. OSCAR data, which are collected from the facility by the state survey and certification agencies at the time of the facility's survey, report the number of staff hours worked in the preceding two week period by staff category. Combined with

information on resident census, it is possible to calculate measures of hours per resident day. While the OSCAR system contains information on all of the staff categories that could conceivably be included in a public reporting system[2], it has a number of significant limitations, which diminish its potential value as a data source for a public reporting system. These limitations are related to the scope of the staffing measures available, the limited time period represented, and the accuracy and reliability of OSCAR-based staffing measures.

A major limitation of OSCAR is that the system does not contain any data related to staff turnover or retention. As previously noted, measures of turnover/retention were supported by our TEP and stakeholders, and a relationship between staff retention and quality was found in the CMSO study. To the degree that aspects of staffing other than hours worked are important, a reporting system that is based on OSCAR will be inherently limited. The data in OSCAR also do not permit calculation of other staffing measures that may be desirable, such as hours by shift or weekday/weekend staffing levels.

The second limitation is that the OSCAR system contains staffing data for only a two-week time period (for each survey cycle). Analyses from the "Appropriateness of Minimum Nurse Staffing Ratios in Nursing Homes, Phase I" CMSO staffing study indicated that there was considerable variation in facility staffing levels across time. In that analysis, researchers compared staffing measures from OSCAR to payroll records for a sample of approximately one hundred nursing homes in Ohio. Payroll data were collected for two time periods—the period covered by the OSCAR data and a period about six months earlier. The correlation in staffing measures between the two periods was relatively low (between 0.5 and 0.75 depending on the measure used). Thus, inferences about staffing levels in a single two-week period were not a reliable indicator of staffing levels in other periods. While the ideal reporting period for a public reporting system is less apparent than it might seem[3], it is clear that data from a two-week period may misrepresent facility staffing levels for other periods during the year.

A third limitation is the accuracy and validity of staffing data from OSCAR. The OSCAR data are based on self-reported information from nursing home facilities and are not subject to any audit or data quality check. CMS performs only minimal edits before the measures are posted on Nursing Home Compare.

The most comprehensive analysis of the accuracy of OSCAR staffing measures is the comparison between OSCAR and Ohio payroll records that was performed for the CMSO Phase I staffing study. Researchers compared OSCAR staffing measures to staffing measures derived from payroll data, which are widely held to be the standard for staffing information. This is the only data collection effort that captured information on the

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2 OSCAR contains information on the number of hours worked for 38 separate staff types, including nursing staff (RNs, LPNs, nurse aides, nurse aides in training, medication aides); administrators, dietary service, physicians, therapists (separately by type), housekeeping staff, mental health, lab, and X-ray staff.
3 For the CMSO Phase II staffing study, case studies were conducted in 17 nursing homes in three states. These case studies found that when staffing fell below a critical level even for one day, there was an increased risk of an adverse outcome, suggesting that a public reporting system that reports annual rates could mask important variation in staffing levels during the year.

OSCAR staffing categories for an identical time period as OSCAR, using an independently collected and not self-reported facility data source. Analyses showed considerable difference in staffing levels between OSCAR and payroll data for some facilities, suggesting that the OSCAR data are not very accurate. The correlation coefficient for a measure of total hours per resident day was less than 0.5. There was greater consistency in RN and LPN staffing figures than for nurse aides. Correlations were particularly low for the lowest staffed facilities. In addition, several nursing homes were classified into different staffing quartiles depending on which data source was used.

Accurate staffing level measures require both an accurate count of nursing hours worked and the total number of residents in the facility. For some facilities, there is ambiguity about how the number of residents is recorded in OSCAR. The OSCAR form asks facilities to report resident census in certified beds but not the total resident census (including non-certified beds); however, the staffing information collected in OSCAR covers the entire facility, including both certified and non-certified beds. Facilities with non-certified beds seem to differ with respect to whether they report total resident census or only the census for residents in certified beds. Thus, for some facilities, the numerator and denominator in a calculation of total hours per resident day cover different units of observation.

In about eighty-five percent of nursing homes, the number of total beds and certified beds are identical. But for fifteen percent of homes the total bed count exceeds the certified bed count, and, for about six percent of homes the difference is considerable. In these facilities, there is an undercount of the total facility census—the denominator in a calculation of total hours per resident day is too low. As a result, the calculated hours per resident day is inflated. Changes to processing OSCAR data (e.g., imputing total resident census for facilities that report census for non-certified beds) or to the OSCAR form (e.g., asking for total resident census) could improve the reliability of OSCAR data by calculating (or at least attempting to calculate if imputation is used) staffing measures for which resident census includes all facility residents.

Medicaid Cost Reports

In many states, Medicaid-certified nursing facilities report information on nursing hours as part of their Medicaid Cost Reports. Because the cost reports are desk audited and associated with facility reimbursement, the Medicaid cost report data are considered to be more accurate than OSCAR. Medicaid Cost Reports, however, are not practical to use as a data source for a public reporting system:

- *Medicaid Cost Reports are not available for all states.* Staffing measures are not reported in the Medicaid Cost Reports of some states, particularly those with flat-rate reimbursement systems. In other states, the Cost Reports do contain information on nursing hours, but the Cost Report data are not available in an electronic format. For example, researchers working on the Phase II CMS Staffing Study were not able to identify any southern state for which appropriate Cost Report data were available.

- *Medicaid Cost Reports are not available for all facilities.* Medicaid Cost Reports are only available for Medicaid-certified facilities. Many hospital-based and sub-acute facilities do not file Medicaid Cost Reports since they serve only Medicare and private pay patients.

- *Medicaid Cost Reports for most states do not contain measures of turnover and retention.* Only three Medicaid Cost Reports (California, Kansas, and Texas) contain information on turnover and only California reports staff retention. Given the importance placed by the TEP on measures of turnover and retention, this is a significant limitation of Cost Report data.

- *Staffing categories and definitions used in Cost Reports vary across states.* States include different staffing categories on their Cost Reports, particularly with respect to non-nursing staff and vary with respect to how agency hours are recorded. Also, some states report hours worked and others report hours paid (which also includes sick time, holidays, and vacation).

- *Medicaid Cost Reports don't allow analysis of variance in staffing levels during the year.* Medicaid Cost Reports report staffing for a 12-month period, allowing calculation of average staffing levels across the entire year. They do not allow analysis of the variance in staffing levels through the year.

Payroll Records

All nursing homes must generate information on hours worked for each non-exempt employee to generate their payroll. The CMSO reports "Appropriateness of Minimum Nurse Staffing Ratios in Nursing Homes Phase I" (2000) and "Phase II" (2001) examined nursing home payroll records as a source of accurate, verifiable staffing information. Results of the studies indicated there is variability in the types of payroll reporting systems used by nursing facilities and in the staffing information captured in those systems. However, many of the staffing measures in Table 1 could be calculated from data that are captured in the payroll systems of most facilities; and could potentially be captured in the systems of other facilities with minimal changes to their system. Specifically, most facility payroll systems could generate information on hours worked (or hours paid[4]) by staff type and information on employee start and termination dates, allowing for calculation of measures of turnover and staff retention. Because payroll-based measures are subject to audit and are reviewed by individual employees for accuracy, their validity is enhanced.

Use of payroll records is not without its potential limitations. First, payroll records do not typically track information on resident census. If payroll records are used for a public

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4 Hours paid includes pay for vacation, sick time, and holidays; hours worked does not include these.

reporting system, then some other method would be necessary to collect resident census information for the same time period.

Second, payroll records do not typically include contract agency staff. For this information, it would be necessary to use contract agency invoices, which are not easily collected and vary in terms of the level of detail and time periods covered. Fortunately, contract agency staff represent a small percentage of total staff hours. For example, in Missouri, only 1.2% of total staff hours were from contract agencies based on 2001 cost report data (Rantz 2004, Unpublished Data). For 90% of the states' facilities, contract staff were less than 2% of total staff. Based on Medicaid Cost Reports in California for 2000, an average of 1.2% of RN, 0.9% of LPN, and 1 % of CNA staff were from staffing agencies (White 2004a, Unpublished Data). Eighty-one (81%) of nursing homes reported using no agency staff in a 12-month period and 3.7% used more than 10% agency staff. An on-site survey of 38 nursing homes found that 50% reported using some agency staff (White 2004b, Unpublished Data). Thus, the SQM project will not include agency staff because of difficulties inherent in collecting these data on a large scale, except from cost reports, and the overall low rate of agency staff use.

A third limitation of payroll data is that many systems do not appear to report staffing data by shift. However, this issue will be explored further in this contract because payroll information is initially collected by day and shift for each staff person. All three of these limitations are also true of OSCAR, so the basic conclusion holds that payroll records are preferable as a data source for public reporting.

Most facilities collect data on non-exempt employees' hours via some type of time recording device – using either paper time cards or an electronic system. Electronic systems collect time punches and store them for later transfer, with the more advanced models allowing management to transfer collected information to a computer for calculation and eventual payroll processing. Electronic systems utilize swipe badges, or in some cases, biometrics recognition systems (e.g., hand recognition) and may be integrated with schedules as well as with payroll software.

Processing and generation of payroll reports varies across facilities. There are typically three processing options: 1) using a completely in-house system, 2) outsourcing the work to a payroll service, or 3) using some combination of an in-house processing and outsourcing. In-house methods include manual processes or use of payroll software programs. Systems calculate employee payroll obligations, payroll deductions, and payroll tax obligations; checks are written or generated, and payroll-related information is recorded or updated to the general ledger. Payroll service vendors provide payroll functions that range from basic calculation of employee payroll and tax obligations, production of checks and preparation of management reports to optional services such as filing payroll taxes, preparing W-2s, 401k processing and union reporting. Nationwide, there are 2,370 payroll services firms, almost 70 percent of which have 20 or fewer employees. There are about 130 payroll service companies with 500 or more employees.

CMSO STUDIES ON PAYROLL

The data collection effort conducted for the Phase I CMSO report generally revealed that payroll records were an accessible and accurate source for nurse staffing level data. All of the variables identified in the study were available and easily identified at each of the facilities in the Ohio sample. Employees and temporary staff were identified by department, staff type (Director of Nursing, administrative nurses, RNs, LPN/LVNs and Certified Nursing Assistants), and hours worked. Average daily census data were also collected. The records were found to be available for the previous six to twelve months and generally took no more than 30-40 minutes to extract per facility. Facilities in this study did not view the process as intrusive or particularly burdensome.

The CMSO Phase I study involved only one state and referenced a limited number of payroll variables. The Phase II study attempted to collect and verify additional staffing variables from facilities in four states. Staffing information from thirty-eight facilities in four states (California, Maryland, Minnesota and Texas) was provided by facilities and reviewed by researchers during on-site visits. A data collection instrument was developed to capture staffing hours differentiated by staff type, shift worked, unit worked, care provided for Medicare or non-Medicare beneficiaries, day of the week, and type of care (direct care or administrative). Census information, volunteer hours and staff turnover and stability measures were also collected. A further goal was to examine and describe facility payroll processes including the types of records available and procedures involved in maintaining and modifying those records. Findings showed:

- Total nurse staffing hours by licensure type per pay period is currently available at most facilities in payroll and contract agency invoice records. In addition, this information was verifiable with mixed levels of effort.
- Other staffing variables (shift, unit, day of the week, and direct care vs. administrative care) are available in facility internal records, but not feasible to verify. Temporary staffing agency invoices typically contain information on shift and date worked, but this information is not included in facility payroll systems and thus not practical to include in a public reporting system.
- Information on hours by unit is available, but is dependent on staff to manually update; hence, the accuracy is questionable.
- Hours caring for Medicare vs. non-Medicare residents does not appear to be tracked by payroll systems or facility internal records for the majority of facilities studied.
- Census information was reportedly available in facility internal records.
- Technology for creating and modifying payroll and contract agency invoices is available and could be used to make information on shift and weekday vs. weekend hours available.

The tool presented to facilities was lengthy and requested information on a large number of variables. Despite pre-testing, researchers were not prepared for the variability seen in both payroll and invoice processing systems, and staff encountered significant difficulty utilizing facility documents to verify staffing information provided by the nursing

facilities. Even for variables noted to be most readily available – that of total staffing hours by licensure type - the process of removing unproductive hours to determine the hours worked was a tedious process. The verification process was far from what had been envisioned (i.e., simply comparing a number with the payroll record or invoice to a number reported by the facility on the tool).

Facilities were nearly evenly split between those that utilized an outside payroll processing service and those that processed payroll in-house. Many of the facilities that processed payroll in-house reported using automated systems and were able to generate the same staffing variables as those that utilized an outside service. Responses to the Phase II survey indicated the use of many different payroll processing companies and software packages. Because of the multiple processing systems and variation in available information identified among sampled facilities, it became clear that more detail on payroll reporting systems was needed.

Payroll data, although promising as a source for accurate, auditable staffing information, will require further study to determine the level of variation in payroll systems and the feasibility of using payroll data as it is generated by nursing homes. Additional study is required to provide:

- Information on how payroll is processed, (e.g., the number of facilities that use an outside payroll processing company completely, those that use a vendor to supplement their own internal processes, types of services these vendors provide and software packages in use;)
- Information on the availability of specific staffing data, e.g., staffing hours paid, staffing hours worked by licensure type, by unit, by shift or by day of the week, temporary staffing hours; and
- Information on the burden to facilities to report specific staffing variables.

TEP Ratings on Data Sources

Following TEP discussion and rating of staffing measures, TEP members also rated data sources. As with staffing measures, they initially rated data sources based on the literature review and their knowledge, and subsequently rated them at the conclusion of the meeting after the stakeholder discussion and TEP discussion. The information pertaining to data sources from the previously mentioned CMSO study was briefly presented at the TEP meeting. The data source that received the highest rating from TEP members was payroll records, with eight of the nine TEP members providing a rating of "2" (pursue with the highest priority). The discussion strongly endorsed that the project focus on development and testing of quality measures based on payroll data because of the potential to generate the most accurate measures of interest with the lowest possible burden on sites. Other ideas related to payroll data were that provider groups may be willing to share payroll data for the study, and ultimately incentives might be put in place for use of standardized definitions in payroll data once specifications are clear.

The two other data collection sources that were rated higher than "1.0" (pursue secondarily) by the TEP included the two approaches proposed in the CMSO study. The

short run solution of edits to the OSCAR system was preferred over continuing to use OSCAR data on Nursing Home Compare without changes. There was absolutely no support for continuing to use the OSCAR system with no changes; all nine TEP members rated this as "0" (do not pursue further). Creation of a new data collection form to be submitted by facilities to CMS was supported by the TEP, but less so than the approach of using payroll records.

D. STRATEGY FOR NEXT STEPS OF THE PROJECT

At the stakeholders and TEP meetings, a number of individuals expressed willingness to assist with the project by making their corporations nursing home data available for the initial phase of developing quality measures for staffing. Additionally, CFMC had existing working relationships with certain nursing home corporations from past collaborations, and individual TEP members suggested other facilities that might be able to provide detailed staffing data. These facilities were contacted and asked to participate in the project. With each organization, the project team discussed in detail what type of data would be requested from them and what type of data they could readily provide. For a few facilities, the effort required to abstract the data or to complete the necessary data use agreements was more than they could comfortably accommodate; other facilities encountered difficulties at the corporate level. Discussions with these facilities were not continued.

Initial discussions were conducted with twelve nursing home corporations, representing 1965 individual nursing homes. We asked that data be provided for one month or one payroll period for only one nursing home. We requested staffing data in its most unaggregated form with raw time-clock data recording clock-in and clock-out times being preferred. Data at this detail would allow us to calculate hours per resident day separately by provider, by shift, and by weekend vs. weekday. We requested census data for the same time period as the payroll data, separately by payer source. In order to test turnover and retention measures, we also asked for dates of hire and termination for staff that worked during the same time period. Finally, we requested information about the use of contract labor in order to calculate hours per resident day for agency nursing staff, however no facility was able to provide this information. We have received adequate data from five corporations for five nursing homes. Data from at least three additional corporations may be forthcoming.

A second request for payroll, census, and employment data will be sent to the participating nursing home corporations, requesting data from each of their individual nursing home providers and covering all of calendar year 2003. Additional facilities that did not participate in the initial data collection effort will also be contacted (with an emphasis on non-profit homes) to assess the feasibility of obtaining similar data. We have also contacted Wellspring to assess their interest in participating in the project. Once

payroll data are obtained, the raw data will be used to test the generation of all of the proposed staffing measures discussed in Section B. This may require different transformations of raw data from different payroll systems in order to yield the same staffing measure. A file can then be created with the facility as the unit of analysis, including all staffing measures plus an array of facility characteristics available through a match with OSCAR data. Selected measures may be limited to sites with the capability to collect data in a specific manner, i.e., not all sites will be able to provide information on staffing by shift.

Analyses of staffing measures will begin by examining distributions of facilities for each measure in terms of extreme values, measures of central tendency, and measures of variability. Staffing levels obtained from payroll data will be compared with staffing levels on the Nursing Home Compare site for all sampled facilities, as well as for the facilities with the lowest staffing levels according to the payroll data. Subsequent to these analyses, the relationship between staffing measures and an array of quality measures will be investigated. Quality measures will be similar to those used in prior studies based on both Minimum Data Set (MDS) and claims information, but without acquisition of primary data. However, it should be noted that the TEP strongly recommended acquisition of primary data for ultimate validation of staffing quality measures. The different measures will be compared based on these analyses and the most suitable measures will be recommended for public reporting.

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Appendix B: Development of Staffing Quality Measures – Phase I, Documentation of Nursing Home Staffing Database, November 30, 2004

Development of Staffing Quality Measures
Phase I

Documentation of Nursing Home Staffing Database
Final Report: November 30, 2004

Submitted on November 24, 2004 to:
Dr. Jean Scott, CMS, Government Task Leader
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Prepared by:
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Table of Contents

DOCUMENTATION OF NURSING HOME STAFFING DATABASE

1.   INTRODUCTION

In the fall of 2003, the Centers for Medicare & Medicaid Services (CMS) contracted with the Colorado Foundation for Medical Care (CFMC) to develop a set of nursing home staffing quality measures for use in a public reporting system. The University of Colorado Health Sciences Center, Abt Associates, and the University of Missouri joined CFMC in this effort. The Development of Staffing Quality Measures – Phase I (SQM) project is designed to build on previous work conducted by CMS's Center for Medicaid and State Operations (described in the 2001 report "Appropriateness of Minimum Nurse Staffing Ratios in Nursing Homes, Phase II") by investigating a range of nursing home staffing measures beyond basic staffing levels and assessing options for collection of relevant staffing data.

Representatives from nursing home corporations, national health care associations, and consumer advocacy groups identified which aspects of nursing home staffing were most important to them, and voiced their concerns regarding the accuracy and usefulness of any measure used for public reporting at a stakeholder's meeting in March 2004. A technical expert panel (TEP) meeting was scheduled such that members of the (TEP) also attended the stakeholder session to inform subsequent TEP discussions. The TEP met separately to review issues raised at the stakeholder meeting. During the subsequent meeting the TEP recommended specific quality measures and data sources for further study.

An important consideration raised by the TEP was the source of data to be used to calculate staffing measures. Limitations of the Online Survey and Certification and Reporting System (OSCAR) data files and Medicaid cost reports were identified, particularly in view of the recommended measures, suggesting the need to identify alternative sources for these data. It was concluded that staffing quality measures might be better defined using nursing home payroll records. Payroll records were considered an appropriate data source because facilities must collect these data accurately in order to pay their employees, although relatively little is known about using them to measure nursing home staffing.

The project analytic team identified and invited nursing home corporations to participate in the project, requested payroll records, discussed the details of the data request with corporate representatives, reviewed the data received, and resolved data issues with the representatives. This Documentation of Nursing Home Staffing Database report describes the data acquisition and findings from a preliminary review of the data. A technical documentation will be prepared once the database is finalized.

This report is divided into four sections. The first section presents steps taken to obtain payroll data from participating nursing home corporations. The second section discusses the obstacles encountered by the corporations in efforts to provide data for the project. The third section describes the data received and presents some of the data issues identified and analysis activities. The final section presents a general plan for the remainder of the project.

2. DATA ACQUISITION

Identification of Nursing Home Providers

National nursing home corporations were invited to contribute data in support of the project. The nursing home corporations were identified in a variety of ways. TEP members recommended corporations with more sophisticated data management systems that likely would be capable of extracting the necessary data. Representatives of some national nursing home corporations attending the stakeholders meeting volunteered to contribute data from their corporation. In addition, nursing home corporations that had collaborated with CFMC on previous projects were contacted and invited to participate in the project.

It should be noted that participating corporations were not reimbursed for their participation in the project. All participating corporations recognized the importance of the project and wanted to make contributions to support the development of the most accurate staffing measures possible.

Pilot Data Collection

Twelve nursing home corporations were identified as potential participants, and initial contacts were made to invite the corporations to participate in the study. Ten corporations expressed readiness to participate. The SQM data project team requested sample files from each of these corporations to assess the feasibility of obtaining the desired data. Each corporation was asked to provide a file from one facility for any one-month period, in the format currently used by the corporation, consisting of the following information:
- raw payroll data for all job categories (preferably shift-level data)
- date of hire for all employees reflected in the payroll records for the same time period
- daily resident census data for the same time period
- hours of contract labor for the same time period

Several issues were explored in detail in the course of these early discussions with the nursing home corporations, including, but not limited to, the capacity of their various data systems to integrate information needed for the project, the level of detail available for each of the data types within each corporation (e.g., shift-level payroll data versus pay period payroll data; daily resident census versus weekly or monthly averages), the availability of contract labor data, as well as the feasibility of extracting these data for all facilities in the corporation later in the project. Five corporations submitted pilot data during the pilot data acquisition phase of the project.

Formal Data Request

The project analysts developed a standardized file format for a formal data request (Appendix) that was based on the pilot data submissions and subsequent discussions with the corporations. Due to the wide range of measures that would be investigated for the project, it was decided to pursue data for calendar year 2003 for all facilities within each corporation. A data specification

document outlined the request for abstraction of shift-level or pay period payroll data, daily resident census data by payer source, and hire/termination dates for all staff that worked at least one day during CY 2003. Because tracking of contract labor was decentralized in most of the corporations, these data were eliminated from the formal data request.

The project team sent a data specification document electronically and in hard copy to each of the ten corporations that originally expressed interest in participating in the project. Conference calls were conducted between the SQM data team and nine of the corporations to review the data specifications, discuss payroll system conventions and processes, and answer any questions from the corporations. Corporations unable to provide the requested data were encouraged to discuss possible modifications to the request with the SQM data team. Corporations were asked to submit their data within four weeks of the request. SQM data team members conducted follow-up phone calls to address questions or concerns from the corporations, to offer support as able to the corporations' data collection processes, and to facilitate timely submission of data. One additional non-profit organization was invited to join the project late in the data collection process and has reviewed the data specifications and is committed to submitting their data as soon as possible.

To date, data have been received from eight nursing home corporations; however, data from two of the corporations arrived too late to be described in this report. One corporation was unable to participate in this data collection phase due to turnover in key data management positions. A second corporation did not respond to attempts at communication on behalf of the SQM data team and consequently was dropped from the participation list. This report, therefore, describes the data for six corporations representing 829 individual nursing homes.

Data Use Agreements

CFMC implemented a data use agreement (DUA) with each nursing home corporation. The DUA outlined the management of the data to insure confidentiality, limited its use to the SQM team for the purpose of this project, and guaranteed the return or destruction of the data once the project is completed.

3. OBSTACLES ENCOUNTERED IN THE PROVISION OF A LARGE DATA SET

Numerous discussions were held with each of the nursing home corporations as they progressed through their data collection. During these conversations, it became apparent that although the SQM data team had tailored the formal data request to the requirements of most organizations' data systems, multiple obstacles still needed to be resolved. The barriers listed in Table 3.1 generally fall into three broad categories: personnel, operational, or technical.

Table 3.1: Obstacles encountered in the provision of a large data set

Personnel

- Extensive request required a large amount of resources
- Insufficient staff or resources to devote to the task
- Staff assigned to abstract data not authorized to access all necessary data files

Operational

- Payroll services provided by contract company; data not readily available to nursing home corporation
- Certain health care services converted to contract staff and no longer in payroll records
- Acquisitions and divestments result in incomplete data for a designated calendar year
- Facilities within a corporation operate differently with respect to such key concepts as pay periods and shifts
- Corporate administration, at times, has summarized data rather than individual facility data

Technical

- Database structure incompatible with our data request; unable to calculate requested data
- Data not retained in retrospective historical files; only hard copy reports available at times
- Data request too large for corporate data system to accommodate
- Different computer systems used in different facilities or in different time periods within the same facility

The project enjoyed the strong support of corporate leadership. Not only did leadership teams graciously volunteer to participate in this project and provide their corporations' data, they connected the team with the appropriate personnel within their corporations to accomplish the data acquisition. In spite of this, the biggest obstacle encountered by most corporations, was the availability of appropriate staff to dedicate to a task of this magnitude. The data we requested typically resided in multiple data systems and required significant programming resources to obtain, select, and merge the necessary components. In busy organizations, a project such as this is an optional activity and understandably is secondary to corporate-related tasks. In some instances, corporate reorganizations and personnel changes meant that appropriate information systems staff needed to complete the electronic data abstractions were no longer available. In other instances, the structure of the corporate database was such that, although the data were available, abstracting a years worth of data was extremely time-consuming and inefficient. For example, for one corporation, obtaining information about individual facilities required separate data abstractions for each facility. For some corporations, the resource expenditure was too great, and they withdrew from the project. For others, the project team was able to devise strategies to reduce the burden of the data abstraction, such as permitting modifications to the data specifications. Most of the organizations met the challenges with persistence and were able

to provide their data. Nonetheless, this was a difficult and time-consuming activity for every corporation involved.

Another common difficulty involved the selection of the specific staff members designated to complete this task. For at least three corporations, a single person was assigned to generate these data. These individuals did not always have access to all the necessary data systems. This was particularly true for the employee status file, which required access to the human resources data systems to obtain dates of hire and termination. Corporations that assigned a team of individuals to abstract the data files, each within his or her own area of expertise and authorization, were much more successful in this undertaking.

Other difficulties encountered by nursing home corporations were operational in manner. The most complex issue involved corporations that outsource their payroll services to an external vendor. Corporations that use external vendors can elect to have access to their employees' payroll data files, but this request typically requires an additional fee.

Another type of contracting relationship proved problematic as well. One corporation was not able to provide payroll or employee data for certain staff positions because those services were consistently provided by contract agency staff. Although this did not affect the number of nursing staff members, it will impact measures of total staff hours, and will be an issue for any facility that contracts specific services on a regular basis. For almost all corporations, providing detailed information on contract staff was not feasible.

Some of the difficulties due to operational issues were related to the project's request of asking nursing home corporations to provide information for each nursing home under their ownership. Market consolidation and changes in corporate holdings resulted in only partial data for facilities that were acquired or divested over the course of the year. In addition, individual nursing homes under the same corporate umbrella used different pay period timeframes (7-day, 14-day, bi-monthly) or different shift definitions (traditional 8-hour shifts versus 12-hour shifts), which made it difficult for all nursing homes owned by a corporation to be included in the compiled data files sent to us. Lastly, although the level of data detail that the SQM project required is likely available from individual facilities, some corporations retained data in a summarized format necessary for their specific business purposes. Many of these issues would be eliminated if individual nursing homes provided their own data, rather than having the corporations provide them.

The third type of difficulty nursing home corporations encountered was of a technical nature. The most frequent issue was that the structure of the corporate database did not allow for the calculation of the requested data. For example, one corporation owned facilities that contained assisted living units, but the staffing for these units was not stored separately; therefore the staffing hours for the nursing home could not be isolated. This corporation was unable to complete our request. A problem for some corporations was that census data was not stored by payer by day; only monthly or in some cases yearly averages were available. In some instances, the data systems did not retain a termination date for employees that were re-hired at a later

date. For almost all corporations, payroll data were structured by pay period, and shift-level measures could not be constructed from available data. These and other examples of data issues and potential solutions and/or implications are discussed in more detail in Section 4.

Other technical difficulties were experienced less commonly, but were still significant barriers for obtaining data for this project from the corporations. For at least two corporations, the data we requested would have been available at the time it was collected (2003), but the data were no longer readily available in the corporate information system. Accessing the archived data files was far beyond the scope of what the project would request from the corporations. One corporation had printed reports containing the necessary historical data, but manual entry into an electronic format was highly impractical for either the team or the corporation. The sheer size of the request was the cause of difficulties for certain corporate data systems; administrators either had to run abstraction programs multiple times or had to consolidate information. This only added to the overall burden of compiling our requested data. Lastly, several corporations indicated that the data collection systems at some facilities were recently upgraded or converted from one payroll software to another. This resulted in very different data files for different nursing homes or for the same nursing home for different parts of the year. Abstracting these data would be difficult and time-consuming, and therefore, such facilities were frequently excluded from the data files sent to us.

It should be noted that these varying difficulties are inter-related. For example, archived data could be restored if sufficient time and resources were available within the project timelines. If corporate staff with appropriate clearance levels for the variety of files were brought in to abstract the data, access issues disappear. Some of the technical problems may be surmountable by corporate information systems experts. The necessary data may indeed reside in the corporate systems, but it may require someone familiar with the intricacies of the system to abstract it.

4. SUMMARY OF DATA RECEIVED AND DATA LIMITATIONS

As previously described, payroll, census, and employee status data (hire and termination dates, job titles, etc.) from six nursing home corporations have been received. The project data team has conducted preliminary analyses in preparation for staffing measure development. The number of facilities with payroll and census data ranged from 31 to 279 facilities per corporation. Table 4.1 provides the number of facilities and records for each type of data file requested and received from the six corporations.

Table 4.1: Summary of staffing data received from six corporations

Data file type	Number of facilities	Number of records
Payroll	829	3,814,081
Census - Daily	406	148,190
- Monthly	279	279
- Annual	144	144
Employee status	477	143,026

Payroll (in the form of pay period data) and census data were received for 829 facilities and employee status data were received for 477 facilities. Four corporations provided employee status data and four corporations provided census data by day. Two other corporations provided monthly or annual census data. Collectively, these data represent nursing home facilities in 39 states; no facilities were located in the District of Columbia or in U.S. territories. The distribution of facilities by state is presented in Table 4.2.

Table 4.2: Distribution of nursing homes by state (total=829)

State	Nursing homes	State	Nursing homes
Alabama	17	Montana	2
Alaska	6	Nebraska	7
Arizona	0	Nevada	2
Arkansas	0	New Hampshire	26
California	54	New Jersey	29
Colorado	36	New Mexico	0
Connecticut	24	New York	0
Delaware	4	North Carolina	61
Florida	33	North Dakota	0
Georgia	25	Ohio	46
Hawaii	0	Oklahoma	0
Idaho	16	Oregon	2
Illinois	6	Pennsylvania	35
Indiana	32	Rhode Island	7
Iowa	0	South Carolina	12
Kansas	0	South Dakota	0
Kentucky	14	Tennessee	30
Louisiana	1	Texas	93
Maine	10	Utah	5
Maryland	33	Vermont	4

Table 4.2:   Distribution of nursing homes by state (total=829) (continued)

State	Nursing homes	State	Nursing homes
Massachusetts	64	Virginia	8
Michigan	9	Washington	15
Minnesota	0	West Virginia	25
Mississippi	9	Wisconsin	17
Missouri	3	Wyoming	7

After a preliminary review of the data files, several data problems were identified and classified into one of two categories 1) resolvable data problems and 2) irresolvable data problems. Resolvable data problems are problems that can be addressed either through communication with the corporations (e.g., identification and correction of data) or through data management methods (e.g., deleting invalid data, data substitution). Resolvable data problems tend to affect individual records versus all records from an entire facility or corporation. Irresolvable data problems are problems that cannot be corrected (the problem is inherent in the manner in which the data were received) and likely will impact the calculation of staffing measures in a meaningful manner. Irresolvable data problems tend to impact data in a more systematic and far-reaching manner (e.g., the reporting of combined productive and non-productive hours for an entire facility or corporation). Table 4.3 enumerates the resolvable data problems that have been identified including proposed resolutions and implications. A brief review and discussion of the most significant problems follows Table 4.3.

Table 4.3: Resolvable data problems with proposed resolutions and implications

Problem Description	Proposed Resolution	Implication
Payroll data		
Payroll hours exceed the number of hours expected for a given pay period (e.g., >160 hours for a two week pay period)	Determine the appropriate threshold for excessive hours for each pay period interval (e.g., 7 days, 14 days) and remove records that exceed the threshold from all subsequent analyses	Decreased precision in staffing measures
Negative hours reported for a pay period	Records with a negative number of payroll hours for a specific pay period will not be included in any analyses	Decreased precision in staffing measures
Records provided without any facility identifiers	If facility identifiers cannot be obtained from the corporation or found by cross-referencing other data files, there records will not be included in subsequent analyses	Under-representation of the number of staffing hours for a given pay period
Records with inconsistent or illogical dates	Records with inconsistent or illogical dates that cannot be resolved will not be included in subsequent analyses	Under-representation of the number of staffing hours for a given pay period
Facilities with data missing for an entire pay period	If a specific pay period is missing for an entire facility, the annual average number of hours by job category will be substituted	Decreased staffing measure variability
Variable length pay periods (range from 1 day to >14 days)	Variable length pay periods will increase the complexity of linking pay periods to each other and matching payroll data to census data when census data are not provided on a daily basis	Customized data transformations for all staffing measures will have to be conducted for each corporation and potentially for individual facilities within corporations

Table 4.3: Resolvable data problems with proposed resolutions and implications (continued)

Problem Description	Proposed Resolution	Implication
Payroll data		
Job descriptions vary for the same job code	Reconcile inconsistencies with job codes and descriptions before creating a crosswalk of job codes across facilities and corporations	
Job descriptions vary by facility (even within the same corporation)	Create a crosswalk of job codes across facilities and corporations	Potential loss of detailed job descriptions
Missing job codes and descriptions	Cross reference other payroll records or employee status records for the employee's job code/description; if a job code/description cannot be found for an employee, the record will not be used in analyses conducted by job category	If the record cannot be used then an under-representation of the number of staffing hours for a given pay period may result
Census data		
Data provided for non-Medicare/non-Medicaid facilities	Non-Medicare/Non-Medicaid facilities will not be included in any analyses	
Employee status data		
Employee information provided without any facility identifiers	If facility identifiers cannot be obtained from the corporation or by cross-referencing other files, these records will not be included in any analyses	Decreased precision in retention and turnover measures

Payroll records with an invalid number of hours - One of the most significant record level issues identified in the payroll data is records with higher than expected or negative payroll hours for a given pay period. The magnitude and origin of the problem varies by corporation. For some corporations higher than expected hours reflect employee payouts such as vacation pay or bonus pay. For other corporations excessive hours result from reporting discrepancies that were subsequently corrected outside of the payroll database. Many corporations use negative hours to correct errors that occurred in previous pay periods, however information on the actual pay period the correction applies to is not available. As the nature (and in turn the implications) of reporting excessive and negative hours varies by corporation (and to some degree within a corporation), a standardized approach to correcting discrepant hours is not feasible and therefore records with excessive or negative hours will be dropped from all subsequent analyses. The project analytic team plans to determine a threshold for each pay period interval (e.g., seven day pay period, fourteen day pay period) and exclude all records that exceed the threshold. Removing records determined to have an invalid number of hours will directly impact the precision of the staffing measures computed from these data.

It is noteworthy to mention that although records with excessive hours for a given pay period will be removed, a comprehensive solution to addressing the problem of incorporating employee payouts into total productive hours cannot be implemented and therefore a bias toward over-reporting staffing hours likely will exist in the staffing measures developed.

Records missing facility identifiers - Some records are missing all facility identifiers. Initial attempts to associate these records with specific facilities will include cross-referencing other data files by employee ID and requesting additional information from the nursing home corporations. In the event that a record cannot be associated with a specific facility that record will be dropped from all subsequent analyses. Removing these records will result in a decrease in the number of staffing hours reported and will impact the precision of the turnover and retention measures. As the number of records with missing facility identifiers is relatively small, the magnitude of the problem likely will be inconsequential. Furthermore there is no indication that identifiers are systematically missing for an entire facility, for specific groups of employees (e.g., RNs), or for a specific pay period.

Records with inconsistent or illogical dates - Several records in the payroll and employee status files have been identified as containing inconsistent or illogical dates. A moderate number of records have dates out of the expected range (e.g., pay period end dates in CY2002, termination dates in CY2005) while several other records have dates that do not relate in a logical manner (e.g., termination dates that occur before the original start date, pay period start dates that occur more than 30 days before the pay period end date). When inconsistent or illogical dates cannot be reconciled based on other data (e.g., a record with an invalid pay period start date could be associated with a specific pay period based on the end date), the records will be dropped from subsequent analyses. As with the records missing facility identifiers, removing records with inconsistent or illogical dates will result in a decrease in the number of staffing hours reported and will impact the precision of the turnover and retention measures; however, the overall magnitude of the problem is anticipated to be trivial.

Facilities with missing pay period data - One of the next steps to be undertaken in the process of developing a staffing quality measure involves linking pay periods to create staffing levels for the time periods of interest (e.g., monthly, quarterly, annually). It is possible that during this process facilities with missing data for an entire pay period will be identified. If this situation occurs, the team proposes calculating the average number of hours by job category across all pay periods with valid data and substituting this average for the missing pay period. Mean substitution does restrict measure variability; however, since the scenario is likely to be a fairly rare event it is not anticipated that this process will significantly impact the statistical properties of the staffing measures.

As mentioned previously, in addition to identifying resolvable data problems, the team has also begun to identify problems that exist in the data, but are considered irresolvable. Issues surrounding these data problems tend to be more systematic, far reaching, and likely will impact the integrity of the staffing measures that will be developed during the course of this project. Table 4.4 lists irresolvable data problems and associated implications.

Over-reporting productive hours - There is an apparent bias in the payroll data toward over-reporting of productive hours either due to productive and non-productive hours being reported together, or due to issues related to employee payouts, or reporting errors. (Productive hours are hours actually worked at the facility and do not include non-work time such as vacation or sick leave. Non-productive hours are hours paid for absences from the work place such as vacation, sick leave, or administrative leave.) While procedures will be implemented (as described above) to correct records with unusually high or negative hours, the underlying issue (an over-reporting of productive hours) cannot be addressed based on the data and information provided from the corporations. For example, an employee may have "worked" eight hours during a seven-day pay period but the payroll record reflects 40 hours worked as a result of paid vacation time awarded.

Employees with multiple jobs or responsibilities not identified consistently - The ability to report payroll hours by job code when an employee's job responsibilities change during a pay period varied by corporation. Some corporations provided multiple records per pay period when an employee functioned in various job codes, whereas other corporations provided a single record with one job code identified. For example, if an employee worked eight hours as a receptionist and 24 hours as a CNA during a seven-day pay period, Corporation A would provide two records, one representing the receptionist hours and one representing the CNA hours. However, for this same employee Corporation B would submit one record for the pay period with one job code listed (either the receptionist or the CNA). The data for Corporation B would result in either an over-reporting or an under-reporting of CNA hours depending on the job code provided in the payroll file.

Submission of census data by the month or year - Census data provided by month or by year constrain the ability to capture subtle, but important, variations and associations in daily census and staffing rates. This scenario will likely affect the precision of the staffing measures.

Table 4.4: Irresolvable data issues and implications

Issues Description	Implications
Payroll data	
Shift level data not provided	Limited work can be done on measures that are computed at the shift level
Missing corrections to discrepant payroll hours	Errors in some payroll records were adjusted at a later time outside of the payroll database (e.g., number of hours, job codes, dates), but these corrections are not reflected consistently in the submitted files
Productive and nonproductive hours reported together	An over-reporting of staffing hours
Hours for employee payouts are combined with productive hours	An over-reporting of staffing hours
Employees with multiple jobs or responsibilities during a single pay period are not identified consistently. Some corporations provided multiple records for employees whose job responsibilities varied during a pay period; other corporations did not make this distinction.	Less precision in measures that examine staffing hours by job category
Most of the submitted data did not designate direct (patient care) versus indirect (hours spent in training, in staff meetings, etc.) hours	Staffing measures reflect total hours worked not total hours of direct patient care
Census data	
Daily census data not provided	Less precision in the staffing measures
Because payroll data was most commonly provided for 7- and 14-day pay periods and census data was provided either daily, monthly, or annually, the unit of measurement between payroll data and census data differs. This issue is complicated by the fact that pay periods do not typically begin on the first day of the month or end on the last day of the month.	A method of prorating the pay period data will be applied to create partial pay periods that correspond to census data for the time period of interest (e.g., monthly staffing, quarterly staffing, annual staffing)

Table 4.4: Irresolvable data problems and implications (continued)

Problem Description	Implications
Census data	
Census data could not be provided by payer source (e.g., Medicare, Medicaid, or private pay)	Measures by payer source will only be computed for facilities with payer source data
Employee status data	
Employee status data could not always be provided	Tenure measures will only be computed for those facilities with employee status data; tenure measures will not be available for 352 facilities. Retention and turnover measures will be computed based on payroll data and validated against employee status data when available. Creating records from the payroll data will impact the accuracy of the measures (e.g., terminations will be identified by an employee's absence from the payroll data versus an actual record of termination).
Records for some employees who were terminated in 2003 and later rehired in 2003 do not contain the employee's original start date; the number of days worked in 2003 prior to the termination date is therefore not available	The payroll data will be examined to determine the time period worked in 2003 prior to first termination date. Tenure for the original employment episode will not be available.
Missing termination dates resulting from transfers to other facilities or data errors	Establish a threshold to designate employees as inactive based on payroll data (e.g., if the employee does not appear in the payroll record for three months, consider the employee inactive/terminated). Less precision in retention and turnover measures.
Data on the reason for termination (voluntary or involuntary) not provided	Only the 333 facilities that provided information on voluntary versus involuntary terminations will be included in measures related to termination reason

Mismatch in the unit of measurement between census data, payroll data, and staffing measures - The ability to link census and payroll data for specific time intervals is compromised by the fact that census data and payroll data were provided for different units of time. For most corporations, pay periods are defined in one or two week increments that rarely begin on the first day of the month or end on the last day of the month. For example, a seven-day pay period might begin on April 27, 2003 and end on May 3, 2003. In order to determine staffing hours per resident day for the month of April, a method of prorating the pay period data will have to be applied to create partial pay periods that correspond to census data for the time period of interest (e.g., monthly staffing, quarterly staffing, annual staffing). This process of prorating pay periods introduces a degree of error for every prorated period.

Missing employee status data files - Retention and turnover measures will be computed based on two different data sets and the results compared. One set of measures will be developed based on the employee status data and include only those corporations for whom these data were provided. The second set of measures will be developed using payroll data. The payroll data will be used to determine each employee's first day of employment, last day of employment, and job code history for 2003. Additionally, employment status (active versus inactive/terminated) will be determined based on the number of days the employee does not appear in the payroll record (for example, if an employee has not worked for three months, they are considered inactive).

There are several advantages and disadvantages to using payroll records (as opposed to employee status records) for retention and turnover measures. One advantage is the ability to track job code history. For most corporations, employee status data included information on the current job title/position for an employee (no information on job history was provided). Using the payroll records, the SQM data team will be able to determine when an employee changed positions and therefore more accurately classify employees into specific job categories for measures that examine staffing by job category. A second advantage of using payroll data is that preliminary analyses indicate that employees exist in the payroll records but do not exist in the employee status record. Measures derived from payroll records will represent all employees who worked at least one day in CY2003. A disadvantage of using payroll data to determine employment information is the potential misclassification of employees (for example, considering an employee as inactive/terminated when they are on leave). An additional disadvantage is that employee start dates cannot be extracted from the payroll records, and therefore, measures related to tenure cannot be calculated based on payroll records.

Missing termination dates due to transfers or data quality problems - One of the most significant issues related to measures of retention and turnover is the ability to accurately determine when an employee has left a facility, including transfers within a corporation from one facility to another. Most corporations do not consider an employee terminated when they leave one facility and move to another facility within the corporation. Given that staffing measures will be computed at the facility level, these transferred employees are analogous to terminated employees. This issue highlights an additional advantage of using payroll data to determine employment status. As described above, payroll data can be used to determine if an employee has left a facility, regardless of whether or not they have been terminated from the corporation.

The issues identified in Tables 4.3 and 4.4 should be considered an initial set of concerns, resolutions, and implications. It is to be expected that as data management and measure development activities continue, additional problems will be identified, alternate resolutions to existing problems will be proposed and implemented, and a deeper understanding of how variability in the data will impact our ability to reliably and consistently measure staffing levels and staff retention and turnover will be gained.

The most significant implication of both the resolvable and irresolvable data issues is that the staffing measures developed for this project are derived from data that are subject to a certain degree of imprecision. However, it is important to note that the vast majority of data provided by the collaborators for this project conformed to the data specifications and are free of data anomalies.

5. NEXT STEPS

Data files from six corporations have been received representing 829 individual facilities. These data have been described in this report. The SQM data team is awaiting resolution of data issues with one of these corporations, consisting of 279 facilities. In addition, data from three corporations corresponding to 556 facilities arrived too late to be included in this report. Our immediate next task is to convert these latter data files to SAS analytic files, thoroughly review them for data inconsistencies and other quality problems, and consult with the corporations as needed to resolve any problems identified. At the end of this project, a modified version of this report will be produced that includes the additional data received from these corporations.

After consideration of the various obstacles identified in the data files and their potential solutions and/or implications as discussed above, we determined which staffing measures can be calculated from the submitted data. We believe we can compute the staffing level measures listed in Table 5.1 and the turnover and retention measures provided in Table 5.2. Although a number of additional measures could be constructed with the submitted data files, the tables do not list measures rated by the TEP as poor measures of staffing quality (though such measures may be constructed and assessed to verify the TEP's opinions). Furthermore, the measures shown in both tables should be considered primary constructs; each construct will be assessed using a number of different morphologies. For example, nursing hours per resident day may be evaluated as a raw continuous number, as a dichotomy indicating whether the ratio is above some threshold, as a relativistic measure indicating whether a facility's value is in the lowest or highest category compared to other facilities, etc. These various forms remain to be determined for each measure, and therefore they are not listed individually in either table. At the end of this project, a formal data dictionary of all measures ultimately used in the analyses will be provided as an appendix to the project's final report.

Table 5.1 shows staffing level measures that can be calculated from the data provided by the nursing home corporations. Due to the differences in data provided by the different corporations, different measures are available for different sets of facilities. Staffing levels, staff mix, and proportion of hours provided by full time staff can be calculated for all corporations.

Table 5.1:   Staffing level measures calculable from data files provided by nursing home corporations

Measures by pay period (829 facilities from six corporations)

RN hours per resident day
LPN hours per resident day
RN+LPN hours per resident day
CNA hours per resident day
All licensed nursing hours per resident day
All nursing hours per resident day
All staff hours per resident day

Ratio of RN to LPN hours per resident day
Ratio of RN+LPN to CNA hours per resident day
Ratio of RN to all nursing hours per resident day
Ratio of RN+LPN to all nursing hours per resident day
Ratio of CNA to all nursing hours per resident day
Ratio of licensed to all nursing hours per resident day

Percent of all licensed nursing hours per resident day provided by full time employees
Percent of all nursing hours per resident day provided by full time employees
Percent of all staff hours per resident day provided by full time employees

Measures by shift (maximum of 195 facilities from one corporation)

Percent of all shifts with at least 1 RN present
Percent of day shifts with at least 1 RN present
Percent of evening shifts with at least 1 RN present
Percent of night shifts with at least 1 RN present
Percent of weekday shifts with at least 1 RN present
Percent of weekend shifts with at least 1 RN present
Percent of non-holiday shifts with at least 1 RN present
Percent of holiday shifts with at least 1 RN present

Measures by month for contract labor (53 facilities from one corporation)

Contract RN hours per resident day
Contract LPN hours per resident day
Contract RN+LPN hours per resident day
Contract CNA hours per resident day
Contract RN+LPN+CNA nursing hours per resident day

Ratio of contract RN to staff RN hours per resident day
Ratio of contract LPN to staff LPN hours per resident day
Ratio of contract RN+LPN to staff RN+LPN hours per resident day
Ratio of contract CNA to staff CNA hours per resident day
Ratio of contract RN+LPN+CNA nursing to staff all nursing hours per resident day

Only one corporation was able to provide payroll data by shift. Unfortunately, this corporation could only report census as an average for the year, so shift-level hours per resident day measures cannot be calculated. We will be able to calculate items measuring the percentage of different shifts where at least one RN was present. Although the pilot data collection had strongly suggested otherwise, one corporation was nonetheless able to provide information on contract labor. The contract information is available as total contract hours for a facility for each month for RNs, LPNs, and CNAs. This will allow the SQM data team to at least experiment with comparisons of contract versus staff labor though such data is typically not available from facilities.

Measures of staff stability calculable from the provided data are shown in Table 5.2. Again, differences in the type of data provided by different corporations allow different measures to be available for different facilities. Two corporations were not able to provide employee status data for any of their facilities; a third corporation provided these data for a subset of their facilities. Information regarding dates of hire and termination is therefore available for only 477 of the 829 facilities. Without a hire date, tenure measures cannot be calculated. Turnover and retention measures for these facilities, however, could be estimated from the payroll records. In this scenario, a termination date could be approximated by searching each employee's work history and identifying the date when no more records occur for that employee. If an entire year of payroll history is present, then the employee was not terminated during the year. To attempt to distinguish employees who are terminated and later rehired from employees not terminated but possibly on a leave of absence, certain assumptions would have to be made regarding the length of allowable breaks in the payroll history. The technical details and accuracy of this approach will be evaluated in the coming months.

Table 5.2: Staff stability measures calculable from data files provided by nursing home corporations*

Turnover

Number of RNs employed at year end minus beginning
Number of CNAs employed at year end minus beginning
Number of total nursing staff employed at year end minus beginning
Number of total nursing staff voluntary terminations (data available from 333 facilities)

Percent of RNs leaving in CY2003
Percent of licensed (RN+LPN) staff leaving in CY2003
Percent of CNAs leaving in CY2003
Percent of total nursing staff leaving in CY2003
Percent of full-time total nursing staff leaving in CY2003
Percent of part-time total nursing staff leaving in CY2003

Number of DONs leaving during CY2003
Number of administrators leaving during CY2003

Table 5.2: Staff stability measures calculable from data files provided by nursing home corporations* (continued)

Retention

    Percent of RNs remaining for entire CY2003
    Percent of licensed (RN+LPN) staff remaining for entire CY2003
    Percent of CNAs remaining for entire CY2003
    Percent of total nursing staff remaining for entire CY2003

Tenure

    Percent of staff tenure to date > 1 year
    Percent of staff tenure to date > 5 years

Other

    Total nursing home staff

---

* If based on employee status file, these measures are available for 477 facilities from four corporations. If based on payroll records, turnover, retention, and total staff measures are available for 829 facilities from six corporations.

Before any of the position-specific measures of staffing levels or turnover-retention can be calculated, the various job titles at each facility must be classified into common categories. For example, a category of "nursing assistant" might be created that includes the titles CNAs, restorative aides, nursing assistants, nursing technicians, certified medication aides, etc. The corporations provided 1248 individual job titles used by their facilities.

The major tasks remaining to be completed are the writing of program code to create the measures and the evaluation of their statistical properties. Given the fundamental differences in each corporation's data and the compromises that had to be made, the code will likely need to be customized to fit each individual corporation's data. The final measures used will be consistent across all facilities, but the code required to create them may well be different for each organization. These measures will be reviewed by the project team and refined as additional insights are gained. Different forms of the constructs will be tested. Descriptive, distributional, and correlational analyses will be conducted to assess central tendency and variation, extreme values, and relationships between measures. A final report will be prepared for CMS at the conclusion of the project.

6. APPENDIX

Date

Name
Address
Address

Dear ,

The Colorado Foundation for Medical Care has been awarded a contract from the Centers for Medicare & Medicaid Services to develop a nursing home staffing measure(s) that can be appropriately used as a quality measure for public reporting. Note that it is not the intent of the project to address the issue of minimum staffing levels. The University of Colorado Health Sciences Center, Abt Associates, and the University of Missouri join CFMC in this effort.

Specifically the project is addressing:
- Review of relevant studies to gain an understanding of the "state of the art" in measurement of staffing.
- Consultation of experts through the use of a panel of recognized leaders in this field.
- Determination of the aspects of staffing that matter most to our stakeholders.
- Investigation of options for collection of the relevant staffing data.
- Construction of a draft measure or measures.
- Analysis of the relationship of draft measures with quality outcomes using existing data.

Toward this goal, CFMC has been working with several nursing home corporations on obtaining pilot payroll, census, and employment status data for a one-month period of time for a single nursing home. Five nursing home corporations provided data during this initial phase of the project. We anticipate approximately ten

nursing home organizations will contribute data for our second data request. Based on a review of the initial data we have gained a better understanding of what is feasible to request from nursing homes with regard to payroll, census, and employment data and are now ready to proceed with a larger data request to support the project goals specified above.

By providing data for the project your organization is contributing to:
- Development of what is feasible for facilities to submit
- Development of a large data set so that variation and consistencies can be tested as well as a viable data set to develop the best QM for public reporting in the industry
- Testing of an accurate staffing quality measure
- Testing of a variety of staffing quality measures that will best meet stakeholder and industry needs

We are requesting payroll, census, and employment status data for calendar year (CY) 2003 for all facilities within your organization. Following is a summary of the data being requested.

Payroll Data
- *Shift Data* **(Preferred)** - In order to compute several of the staffing measures of interest, we are requesting payroll data in its most unaggregated form -- raw time-clock data recording clock-in and clock-out times.

- *Pay Period Data* - If a facility is **unable** to report employee hours by shift, we are requesting the number of hours worked by each employee for each pay period in CY 2003. For example, if employees are paid every two weeks and an employee worked the entire year, 26 payroll records would be provided for that employee.

Census Data
- We are requesting daily census data by payer source for CY 2003.

Employment Status Data
- In order to test turnover and retention measures, we are requesting dates of hire and termination for all staff that worked at least one day at a facility during CY 2003.

Although we are requesting data from all facilities within your organization, we recognize that some facilities may not be able to submit some or all of the requested

data. The project team is sensitive to your concerns. To aide in future requests and recommendations, we would like to obtain information on the number of facilities within your organization that will be able to submit data and the number that will not be able to submit data. Additionally, information on barriers encountered for those facilities that will not be able to provide data is requested.

We are asking that all data files be submitted to CFMC no later than July 19, 2004. Files may be sent to CFMC via UPS and paid for through third party billing to CMFC. Additional enclosures with this letter describe the formats for data submission and packaging.

We would like to contact you the week of June 28, 2004 to discuss the progression of this data request and review any questions or concerns you have regarding the requested data, timeline, and/or data submission format. If you have questions prior to that call, please do not hesitate to contact either of the data team members indicated below. We are available to help you in any way possible.

We appreciate your interest and involvement in this project and look forward to working with you on this data request.

Sincerely,

Kris Mattivi   Terry Eilertsen
Colorado Foundation for Medical Care   University of Colorado Health
                                              Sciences Center
Phone: (303) 306-4510   Phone: (303) 724-2436
Email: kmattivi@coqio.sdps.org   Email: terry.eilertsen@uchsc.edu

Enclosures

Data Specifications

Data specifications are provided below for each file, including variable name (data item), variable description, format (size), and comments. The four file types are:

1. Payroll data by shift (Preferred)
2. Payroll data by pay period (alternate format when shift level data cannot be obtained)
3. Census data
4. Employment status data

Data can be submitted in comma delimited ASCII format or in Microsoft Excel spreadsheet format (please note that MS Excel has a limit of 65,532 rows per workbook). Data submitted in Microsoft Excel spreadsheet format should use the variable names provided in the specifications for the corresponding column labels.

ASCII Comma Delimited File Conventions

1. Data items should appear in the order presented in the data specification tables below.
2. All data items should be delimited by a comma
3. When an item is missing, leave it blank. No other fill characters should be used (e.g., -_).

      Incorrect: 3,-, 4
      Correct: 3,,4

4. When submitting Text (strings) fields do not include text qualifiers (e.g., " ")

      Incorrect: "text","text1","text2"
      Correct: text,text1,text2

Time Frame for Data Request

We are requesting data for calendar year 2003 -- chains and/or facilities can determine how to parse out the data for submission. For example, a file could contain shift data for a single pay period, a month, a quarter, or for the full year.

Submission Information

Data can be submitted on CD or DVD. Files may be sent to CFMC via UPS as described previously. The CFMC billing number is X99280. We recommend that you use "three day select" for the UPS mailing. Please place the CD/DVD in a double envelope marked confidential in order to comply with HIPAA requirements.

Payroll Data by Shift File Specifications (Preferred Payroll Data Submission)
A file contains one or more employee records for one or more facilities. An employee record contains information for a single employee for a single shift at a specific facility.

Variable	Description	Format (Size)	Comments
Medicare Provider Number	The Medicare Provider Number is a six-digit number where the first two digits identify the state (e.g., Colorado is 06) and the 3rd-6th digits uniquely identify the facility and range from 5000 to 6399 (the 3rd digit can be a U, Y, or Z, if the facility is a swing-bed unit in a hospital).	Text (6)	
State Assigned Unique Facility ID Code (FAC_ID)	This facility ID code is assigned by the state to each facility for submission of MDS data to the state system	Text (16)	
Facility State Code	Valid 2 character state code (e.g., AL - Alabama, AK - Alaska)	Text (2)	
Employee ID	The unique identifier for an employee	Text	
Actual Date In	Start date for a specific shift	Date (MM/DD/YYYY)	
Actual Time In	Start time for a specific shift	Date (HH:MM:DD)	
Actual Date Out	End date for a specific shift	Date (MM/DD/YYYY)	
Actual Time Out	End time for a specific shift	Date (HH:MM:DD)	

Variable	Description	Format (Size)	Comments
Job Code		Text	If job codes are not retained with the historical shift or payroll record, please provide documentation on how this information was obtained to create this file (e.g., job code was obtained from current employee file and reflects current job code).
Job Category (Description)		Text	Descriptions can be provided in this file or a list of all job codes and corresponding job categories can be provided separately.

Payroll Data Reported by Pay Period File Specifications

If a facility cannot generate payroll data by shift, employee data by pay period can be submitted. A file contains one or more employee records for one or more facilities. An employee record contains information for a single employee for a single pay period for a specific facility.

Variable	Description	Format	Comments
Medicare Provider Number	The Medicare Provider Number is a six-digit number where the first two digits identify the state (e.g., Colorado is 06) and the 3rd-6th digits uniquely identify the facility and range from 5000 to 6399 (the 3rd digit can be a U, Y, or Z, if the facility is a swing-bed unit in a hospital).	Text (6)	
State Assigned Unique Facility ID Code (FAC_ID)	This facility ID code is assigned by the state to each facility for submission of MDS data to the state system	Text (16)	
Facility State Code	Valid 2 character state code (e.g., AL - Alabama, AK - Alaska)	Text (2)	
Employee ID	The unique identifier for an employee.	Text	

Variable	Description	Format	Comments
Total productive hours	Total number of hours worked at the facility during the pay period. This number should not include hours for vacation leave, sick leave, etc.	Number (Single)	
Total nonproductive hours	Total number of leave (sick, vacation, administrative) hours paid during the pay period	Number (Single)	
Pay Period Start Date	First day for the pay period	Date (MM/DD/YYYY)	
Pay Period End Date	Last day for the pay period	Date (MM/DD/YYYY)	
Job Code		Text	If job codes are not retained with the historical shift or payroll record, please provide documentation on how this information was obtained to create this file (e.g., job code was obtained from current employee file and reflects current job code).
Job Category (Description)		Text	Descriptions can be provided in this file or a list of all job codes and corresponding job categories can be provided separately.

Variable	Description	Format	Comments
Special Shift Designation	Number of hours paid at a premium if the employee worked an evening, weekend, or holiday shift	Number (single)	If shift premiums can not be reported separately from other premiums (e.g., premium for excessive work hours) do not include

Census Data File Specifications

A file contains one or more census records for one or more facilities. A census record contains census information for a single day by payer source for a specific facility.

Variable	Description	Format	Comments
Medicare Provider Number	The Medicare Provider Number is a six-digit number where the first two digits identify the state (e.g., Colorado is 06) and the 3rd-6th digits uniquely identify the facility and range from 5000 to 6399 (the 3rd digit can be a U, Y, or Z, if the facility is a swing-bed unit in a hospital).	Text (6)	
State Assigned Unique Facility ID Code (FAC_ID)	This facility ID code is assigned by the state to each facility for submission of MDS data to the state system	Text (16)	
Facility State Code	Valid 2 character state code (e.g., AL - Alabama, AK - Alaska)	Text (2)	
Day		Date (MM/DD/YYYY)	
Payer Source: Private Pay	Number of residents paid by private pay	Number (Integer)	

Variable	Description	Format	Comments
Payer Source: Medicare	Number of residents paid by Medicare	Number (Integer)	
Payer Source: Medicaid	Number of residents paid by Medicaid	Number (Integer)	
Payer Source: Other	Number of residents paid by other payer sources	Number (Integer)	All residents must be classified into one of the payer source categories

Employment Status Data File Specifications

We are requesting employment status information for all staff that worked at least one day at a facility during CY 2003. A file contains one or more employee records for one or more facilities. An employee record contains employee information for a single employee for a specific facility.

Variable	Description	Format	Comments
Medicare Provider Number	The Medicare Provider Number is a six-digit number where the first two digits identify the state (e.g., Colorado is 06) and the 3rd-6th digits uniquely identify the facility and range from 5000 to 6399 (the 3rd digit can be a U, Y, or Z, if the facility is a swing-bed unit in a hospital).	Text (6)	
State Assigned Unique Facility ID Code (FAC_ID)	This facility ID code is assigned by the state to each facility for submission of MDS data to the state system	Text (16)	
Facility State Code	Valid 2 character state code (e.g., AL - Alabama, AK - Alaska)	Text (2)	
Employee ID	The unique identifier for an employee	Text (50)	
Employment Start Date		Date (MM/DD/YYYY)	

Variable	Description	Format	Comments
Employment Termination Date		Date (MM/DD/YYYY)	
Employment Rehire Date		Date (MM/DD/YYYY)	How are employee records managed for rehired personnel (e.g., a person who is rehired is considered a new employee and a new employee ID is assigned; a rehired employee retains his/her old employee ID but receives a rehire date)
Job Code		Number (Integer)	
Job Category/Description		Text (100)	
Reason for Termination (Optional)		Text (100)	A few staffing measures examine voluntary versus involuntary terminations.

Development of Staffing Quality Measures Phase I

Documentation of Nursing Home Staffing Database
Final Report: November 30, 2004

Addendum: July 25, 2005

Submitted on July 25, 2005 to:
Dr. Jean Scott, CMS, Government Task Leader
Ms. Kathy Riley, CMS, Project Officer

Prepared by:
University of Colorado Health Sciences Center
Colorado Foundation for Medical Care

CMS Contract 500-02-CO01; Modification No. CO0013

DOCUMENTATION OF NURSING HOME STAFFING DATABASE
- ADDENDUM -

The Development of Staffing Quality Measures – Phase I project was designed to investigate a range of nursing home staffing quality measures for use in a public reporting system and to assess options for collection of the necessary data. As part of this effort, a number of national nursing home corporations were invited to provide staffing information for their constituent nursing facilities. The data acquisition process and data received were described the report "Development of Staffing Quality Measures Phase I: Documentation of Nursing Home Staffing Database" dated November 30, 2004. That report was written before data acquisition was complete, and therefore described the data that had been received at that time. Additional data have since been received, and this addendum provides a very brief description of the updated and complete data files. It should be noted that although some of the data editing decisions discussed in the November 30 report were changed, they are not described in this addendum. A more complete, detailed, and updated description of the data acquisition activities and the methods ultimately used to create the final analysis files can be found in the data dictionary and file description "Creation of the Nursing Home Staffing Database Files & Data Dictionary" and in the project's final report "Final Report", both dated July 25, 2005.

Eleven nursing home corporations were contacted and formally requested to provide payroll, census, and employee status (personnel) data for calendar year 2003; eight were able to provide this information. The eight nursing home corporations represent 1453 individual nursing homes, ranging from 31 to 360 facilities per corporation.

Table 1 provides the number of facilities and records for each type of data file received from the eight corporations. All eight corporations (1453 facilities) provided payroll data. Five corporations (759 facilities) provided daily census data, and three corporations (617 facilities) provided monthly or annual average census data. Five corporations (675 facilities) provided personnel data.

Table 1: Summary of staffing data received from eight corporations

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Data file type	Number of facilities	Number of records
Payroll	1453	11,643,575
Census - Daily	759	277,035
- Monthly	279	3348
- Annual	338	338
Personnel	675	172,563

The distribution of facilities by state is presented in Table 2. Nursing homes were located in 48 states and the District of Columbia; no facilities were located in Alaska, New York, or U.S. territories.

Table 2: Distribution of nursing homes by state (total=1453)

State	Nursing homes	State	Nursing homes
Alabama	32	Montana	4
Alaska	0	Nebraska	55
Arizona	15	Nevada	2
Arkansas	32	New Hampshire	26
California	85	New Jersey	30
Colorado	43	New Mexico	9
Connecticut	23	New York	0
Delaware	4	North Carolina	73
Florida	44	North Dakota	13
Georgia	41	Ohio	55
Hawaii	1	Oklahoma	1
Idaho	19	Oregon	6
Illinois	15	Pennsylvania	76
Indiana	60	Rhode Island	7
Iowa	21	South Carolina	12
Kansas	38	South Dakota	35
Kentucky	23	Tennessee	33
Louisiana	7	Texas	119
Maine	10	Utah	5
Maryland	39	Vermont	4
Massachusetts	83	Virginia	23
Michigan	11	Washington	19
Minnesota	66	West Virginia	32
Mississippi	22	Wisconsin	48
Missouri	22	Wyoming	9

For additional detail regarding the data acquisition process, the data received, the final data editing decisions, or the measures created, please see "Creation of the Nursing Home Staffing Database Files & Data Dictionary", and "Final Report", both dated July 25, 2005. Formal measure definitions also can be found in the data dictionary section of the former report.

Appendix C: Staffing ratios, staff mix, and shift coverage measures by time interval, separately for productive hours and total hours

```
CNA Staffing ratio using productive hours

     Variable      N         Mean       Std Dev       Minimum        Maximum
     -------------------------------------------------------------------------
     Jan          747       1.9554       0.4071        0.3191         4.6785
     Feb          747       1.9353       0.3979        0.3461         4.3496
     Mar          748       1.9540       0.4190        0.0229         4.5842
     Apr          748       1.9626       0.4256        0.0042         4.5186
     May          748       1.9676       0.4172        0.0121         4.5815
     Jun          748       1.9785       0.4239        0.0000         4.4040
     Jul          748       1.9709       0.4296        0.0000         4.6996
     Aug          748       1.9747       0.4266        0.0000         4.5821
     Sep          748       1.9744       0.4223        0.0000         4.6566
     Oct          748       1.9836       0.4280        0.0000         4.8558
     Nov          747       1.9856       0.4212        0.0000         4.7065
     Dec          747       1.9770       0.4202        0.0000         4.6844

     Qtr1         748       1.9459       0.4029        0.0247         4.5313
     Qtr2         748       1.9692       0.4169        0.0055         4.5024
     Qtr3         748       1.9731       0.4217        0.0000         4.5604
     Qtr4         748       1.9822       0.4188        0.0000         4.7594

     Jan-Jun      748       1.9577       0.4055        0.0105         4.3687
     Jul-Dec      748       1.9772       0.4168        0.0000         4.6532

     Year 2003    748       1.9671       0.4071        0.0044         4.5070
     -------------------------------------------------------------------------


LPN Staffing ratio using productive hours

     Variable      N         Mean       Std Dev       Minimum        Maximum
     -------------------------------------------------------------------------
     Jan          747       0.6415       0.2226        0.0236         1.9200
     Feb          747       0.6417       0.2287        0.0013         1.7800
     Mar          748       0.6458       0.2271        0.0189         1.6646
     Apr          748       0.6438       0.2259        0.0205         1.6114
     May          748       0.6462       0.2278        0.0000         1.7288
     Jun          748       0.6440       0.2265        0.0000         1.6597
     Jul          748       0.6394       0.2276        0.0000         1.7912
     Aug          748       0.6455       0.2344        0.0164         1.8270
     Sep          748       0.6530       0.2348        0.0086         1.8259
     Oct          748       0.6590       0.2313        0.0193         1.7547
     Nov          747       0.6642       0.2385        0.0199         2.0424
     Dec          747       0.6587       0.2350        0.0025         1.8088

     Qtr1         748       0.6429       0.2233        0.0140         1.7871
     Qtr2         748       0.6445       0.2236        0.0264         1.6675
     Qtr3         748       0.6458       0.2287        0.0107         1.8150
     Qtr4         748       0.6605       0.2321        0.0169         1.8467

     Jan-Jun      748       0.6437       0.2208        0.0370         1.7275
     Jul-Dec      748       0.6527       0.2278        0.0137         1.8295

     Year 2003    748       0.6480       0.2207        0.0381         1.7258
     -------------------------------------------------------------------------
```

RN Staffing ratio using productive hours

```
      Variable      N         Mean       Std Dev       Minimum       Maximum
      -------------------------------------------------------------------------
      Jan          747       0.2961      0.1709        0.0000        1.1537
      Feb          747       0.2968      0.1698        0.0000        1.1142
      Mar          748       0.2977      0.1697        0.0000        1.2285
      Apr          748       0.2979      0.1668        0.0000        1.1846
      May          748       0.2936      0.1679        0.0000        1.1407
      Jun          748       0.2937      0.1679        0.0000        1.1256
      Jul          748       0.2919      0.1677        0.0000        1.1867
      Aug          748       0.2885      0.1643        0.0000        1.0438
      Sep          748       0.2926      0.1675        0.0000        1.0179
      Oct          748       0.2927      0.1689        0.0000        0.9922
      Nov          747       0.2912      0.1688        0.0000        0.9725
      Dec          747       0.2872      0.1702        0.0000        1.0276

      Qtr1         748       0.2968      0.1679        0.0000        1.1673
      Qtr2         748       0.2950      0.1651        0.0024        1.1346
      Qtr3         748       0.2908      0.1639        0.0000        1.0764
      Qtr4         748       0.2904      0.1671        0.0000        0.9974

      Jan-Jun      748       0.2958      0.1645        0.0019        1.1504
      Jul-Dec      748       0.2906      0.1632        0.0000        0.9841

      Year 2003    748       0.2930      0.1610        0.0013        1.0589
      -------------------------------------------------------------------------
```

RN+LPN Staffing ratio using productive hours

```
      Variable      N         Mean       Std Dev       Minimum       Maximum
      -------------------------------------------------------------------------
      Jan          747       0.9376      0.2145        0.1259        2.2848
      Feb          747       0.9385      0.2202        0.0988        2.1269
      Mar          748       0.9435      0.2203        0.0742        2.0310
      Apr          748       0.9417      0.2211        0.0612        1.9742
      May          748       0.9398      0.2211        0.0664        2.0595
      Jun          748       0.9376      0.2151        0.0815        2.0084
      Jul          748       0.9313      0.2145        0.0629        2.0767
      Aug          748       0.9340      0.2186        0.0803        2.0948
      Sep          748       0.9456      0.2174        0.0976        2.0942
      Oct          748       0.9517      0.2184        0.1017        2.1631
      Nov          747       0.9554      0.2261        0.1042        2.2763
      Dec          747       0.9458      0.2200        0.1047        2.0768

      Qtr1         748       0.9397      0.2140        0.1163        2.1315
      Qtr2         748       0.9395      0.2149        0.0699        2.0142
      Qtr3         748       0.9367      0.2120        0.0771        2.0632
      Qtr4         748       0.9509      0.2178        0.1034        2.1345

      Jan-Jun      748       0.9395      0.2114        0.0911        2.0730
      Jul-Dec      748       0.9433      0.2112        0.0939        2.0857

      Year 2003    748       0.9410      0.2074        0.0924        2.0793
      -------------------------------------------------------------------------
```

Licensed nursing staffing ratio using productive hours

Variable	N	Mean	Std Dev	Minimum	Maximum
Jan	747	1.1038	0.2364	0.1721	2.4042
Feb	747	1.1037	0.2434	0.1786	2.2933
Mar	748	1.1094	0.2392	0.1730	2.1486
Apr	748	1.1071	0.2436	0.1652	2.2286
May	748	1.1030	0.2420	0.1647	2.2192
Jun	748	1.1002	0.2391	0.1614	2.1868
Jul	748	1.0898	0.2385	0.1559	2.2142
Aug	748	1.0939	0.2413	0.1688	2.2678
Sep	748	1.1066	0.2381	0.1436	2.2817
Oct	748	1.1156	0.2366	0.1306	2.3077
Nov	747	1.1181	0.2447	0.1272	2.3411
Dec	747	1.1078	0.2386	0.1235	2.1886
Qtr1	748	1.1053	0.2348	0.1745	2.2805
Qtr2	748	1.1032	0.2367	0.1638	2.1635
Qtr3	748	1.0965	0.2344	0.1647	2.2506
Qtr4	748	1.1137	0.2358	0.1278	2.2812
Jan-Jun	748	1.1042	0.2328	0.1691	2.2222
Jul-Dec	748	1.1045	0.2312	0.1481	2.2355
Year 2003	748	1.1039	0.2280	0.1656	2.2288

All nursing staffing ratio using productive hours

Variable	N	Mean	Std Dev	Minimum	Maximum
Jan	747	3.0844	0.4936	0.5295	5.6413
Feb	747	3.0661	0.4921	0.5643	5.9355
Mar	748	3.0945	0.4985	0.5668	5.9411
Apr	748	3.1038	0.5122	0.5707	6.0432
May	748	3.1067	0.5070	0.5766	5.9252
Jun	748	3.1156	0.5104	0.5390	6.4937
Jul	748	3.0992	0.5173	0.4980	6.6401
Aug	748	3.1085	0.5139	0.4449	5.8367
Sep	748	3.1223	0.5097	0.3811	5.9468
Oct	748	3.1391	0.5065	0.3463	6.1637
Nov	747	3.1428	0.5073	0.3330	6.1565
Dec	747	3.1246	0.5012	0.3303	5.9071
Qtr1	748	3.0808	0.4838	0.5531	5.4975
Qtr2	748	3.1080	0.5020	0.5730	6.1510
Qtr3	748	3.1094	0.5063	0.4360	6.0836
Qtr4	748	3.1355	0.4995	0.3377	6.0460
Jan-Jun	748	3.0945	0.4877	0.5631	5.7611
Jul-Dec	748	3.1214	0.4979	0.3850	6.0656
Year 2003	748	3.1071	0.4872	0.4911	5.9054

All staff staffing ratio using productive hours

```
Variable     N         Mean      Std Dev      Minimum      Maximum
-------------------------------------------------------------------------
Jan         747        4.6953     0.8783       1.1419        9.9623
Feb         747        4.6630     0.8837       1.1140       10.0652
Mar         748        4.6925     0.8925       1.1006        9.5912
Apr         748        4.6942     0.9022       1.0466        9.5449
May         748        4.6822     0.9029       0.9122        9.9333
Jun         748        4.6888     0.9147       0.8462        9.9966
Jul         748        4.6594     0.9098       0.7734        9.8606
Aug         748        4.6698     0.9141       0.6956       10.2384
Sep         748        4.6923     0.9178       0.5939        9.6343
Oct         748        4.7147     0.9177       0.5505       10.0185
Nov         747        4.7110     0.9151       0.5248        9.6021
Dec         747        4.6855     0.9293       0.5221       10.3717

Qtr1        748        4.6828     0.8734       1.1240        9.9142
Qtr2        748        4.6872     0.8984       0.9287        9.8249
Qtr3        748        4.6728     0.9069       0.6795        9.9317
Qtr4        748        4.7025     0.9117       0.5344        9.9221

Jan-Jun     748        4.6847     0.8810       1.0177        9.8657
Jul-Dec     748        4.6862     0.9044       0.6041        9.9275

Year 2003   748        4.6841     0.8861       0.7628        9.8956
-------------------------------------------------------------------------
```

```
RN to LPN ratio using productive hours

     Variable       N         Mean       Std Dev      Minimum      Maximum
     -----------------------------------------------------------------------
     Jan          1077        0.7732       2.5582       0.0000      79.0823
     Feb          1077        0.8930       6.2645       0.0000     204.3072
     Mar          1078        0.7360       1.3199       0.0000      26.9645
     Apr          1079        0.7048       0.8984       0.0000      11.6876
     May          1078        0.6879       0.8664       0.0000      10.3565
     Jun          1078        0.6869       0.8258       0.0000       8.6486
     Jul          1078        0.7045       0.9698       0.0000      14.6799
     Aug          1078        0.7251       1.6958       0.0000      47.1905
     Sep          1078        0.7929       3.6753       0.0000     117.8594
     Oct          1079        0.6985       1.4690       0.0000      41.5954
     Nov          1078        0.6833       1.4742       0.0000      43.3458
     Dec          1078        0.9668      10.7341       0.0000     352.3438

     Qtr1         1078        0.7131       1.0518       0.0000      19.3437
     Qtr2         1079        0.7011       1.0016       0.0000      20.1599
     Qtr3         1079        0.7807       3.1787       0.0000     100.5566
     Qtr4         1079        0.6898       1.7185       0.0000      52.4624

     Jan-Jun      1079        0.7016       0.9606       0.0000      15.5945
     Jul-Dec      1079        0.7181       2.2717       0.0000      71.6648

     Year 2003    1079        0.6764       0.8799       0.0000      16.0960
     -----------------------------------------------------------------------


RN+LPN to CNA ratio using productive hours

     Variable       N         Mean       Std Dev      Minimum      Maximum
     -----------------------------------------------------------------------
     Jan          1078        0.4814       0.1478       0.0475       1.5714
     Feb          1078        0.4869       0.1474       0.0294       1.4422
     Mar          1079        0.5362       1.6465       0.0183      54.3485
     Apr          1079        0.7770       9.6363       0.0156     316.9802
     May          1079        0.5762       3.1222       0.0166     102.9269
     Jun          1078        0.4780       0.1447       0.0200       1.2058
     Jul          1078        0.4762       0.1419       0.0143       1.4008
     Aug          1078        0.4771       0.1423       0.0190       1.3282
     Sep          1078        0.4854       0.1462       0.0238       1.5639
     Oct          1078        0.4859       0.1455       0.0232       1.5220
     Nov          1077        0.4871       0.1476       0.0288       1.5907
     Dec          1077        0.4841       0.1464       0.0365       1.6275

     Qtr1         1079        0.5319       1.5763       0.0334      52.0413
     Qtr2         1079        0.7022       7.2894       0.0175     239.8757
     Qtr3         1078        0.4788       0.1395       0.0181       1.3736
     Qtr4         1078        0.4850       0.1435       0.0273       1.5773

     Jan-Jun      1079        0.5964       3.7709       0.0242     124.2604
     Jul-Dec      1078        0.4813       0.1386       0.0225       1.3584

     Year 2003    1079        0.7442       8.6478       0.0233     284.5104
     -----------------------------------------------------------------------
```

RN to all nursing ratio using productive hours

```
      Variable      N        Mean      Std Dev     Minimum     Maximum
      --------------------------------------------------------------------
      Jan         1078      0.0982     0.0522      0.0000      0.3331
      Feb         1078      0.0989     0.0521      0.0000      0.3198
      Mar         1079      0.0984     0.0519      0.0000      0.3381
      Apr         1079      0.0980     0.0510      0.0000      0.3355
      May         1079      0.0969     0.0509      0.0000      0.3246
      Jun         1079      0.0964     0.0508      0.0000      0.3139
      Jul         1079      0.0963     0.0511      0.0000      0.2725
      Aug         1079      0.0950     0.0504      0.0000      0.2706
      Sep         1079      0.0965     0.0513      0.0000      0.2887
      Oct         1079      0.0957     0.0506      0.0000      0.2744
      Nov         1078      0.0954     0.0504      0.0000      0.2765
      Dec         1078      0.0944     0.0507      0.0000      0.2878

      Qtr1        1079      0.0985     0.0514      0.0000      0.3294
      Qtr2        1079      0.0971     0.0502      0.0000      0.3246
      Qtr3        1079      0.0959     0.0501      0.0000      0.2732
      Qtr4        1079      0.0952     0.0499      0.0000      0.2795

      Jan-Jun     1079      0.0978     0.0502      0.0000      0.3269
      Jul-Dec     1079      0.0955     0.0493      0.0000      0.2763

      Year 2003   1079      0.0966     0.0489      0.0000      0.3011
      --------------------------------------------------------------------
```

RN+LPN to all nursing ratio using productive hours

```
      Variable      N        Mean      Std Dev     Minimum     Maximum
      --------------------------------------------------------------------
      Jan         1078      0.2937     0.0588      0.0440      0.5922
      Feb         1078      0.2956     0.0596      0.0277      0.5645
      Mar         1079      0.2951     0.0590      0.0175      0.5407
      Apr         1079      0.2935     0.0591      0.0149      0.5226
      May         1079      0.2926     0.0590      0.0159      0.5160
      Jun         1079      0.2913     0.0580      0.0191      0.5129
      Jul         1079      0.2910     0.0571      0.0138      0.5107
      Aug         1079      0.2911     0.0570      0.0182      0.5235
      Sep         1079      0.2943     0.0568      0.0227      0.5318
      Oct         1079      0.2943     0.0570      0.0222      0.5305
      Nov         1078      0.2952     0.0577      0.0276      0.5320
      Dec         1078      0.2943     0.0576      0.0346      0.5173

      Qtr1        1079      0.2948     0.0580      0.0314      0.5660
      Qtr2        1079      0.2925     0.0577      0.0167      0.5170
      Qtr3        1079      0.2921     0.0557      0.0173      0.5181
      Qtr4        1079      0.2945     0.0564      0.0261      0.5244

      Jan-Jun     1079      0.2936     0.0570      0.0230      0.5412
      Jul-Dec     1079      0.2933     0.0551      0.0215      0.5212

      Year 2003   1079      0.2934     0.0551      0.0223      0.5311
      --------------------------------------------------------------------
```

CNA to all nursing ratio using productive hours

Variable	N	Mean	Std Dev	Minimum	Maximum
Jan	1078	0.6292	0.0723	0.2849	0.9396
Feb	1078	0.6261	0.0741	0.2814	0.9446
Mar	1079	0.6257	0.0774	0.0069	0.9574
Apr	1079	0.6259	0.0781	0.0012	0.9589
May	1079	0.6272	0.0792	0.0033	0.9583
Jun	1079	0.6283	0.0796	0.0000	0.9566
Jul	1079	0.6294	0.0787	0.0000	0.9636
Aug	1079	0.6289	0.0797	0.0000	0.9575
Sep	1079	0.6252	0.0792	0.0000	0.9531
Oct	1079	0.6242	0.0787	0.0000	0.9560
Nov	1078	0.6252	0.0794	0.0000	0.9569
Dec	1078	0.6268	0.0792	0.0000	0.9493
Qtr1	1079	0.6266	0.0749	0.0072	0.9408
Qtr2	1079	0.6271	0.0777	0.0015	0.9579
Qtr3	1079	0.6279	0.0780	0.0000	0.9591
Qtr4	1079	0.6254	0.0779	0.0000	0.9555
Jan-Jun	1079	0.6269	0.0753	0.0029	0.9505
Jul-Dec	1079	0.6267	0.0770	0.0000	0.9574
Year 2003	1079	0.6268	0.0749	0.0012	0.9540

Licensed nursing to all nursing ratio using productive hours

Variable	N	Mean	Std Dev	Minimum	Maximum
Jan	1078	0.3492	0.0600	0.0604	0.6231
Feb	1078	0.3510	0.0608	0.0554	0.6086
Mar	1079	0.3500	0.0606	0.0426	0.5848
Apr	1079	0.3487	0.0604	0.0411	0.5645
May	1079	0.3465	0.0600	0.0417	0.5631
Jun	1079	0.3447	0.0597	0.0434	0.5530
Jul	1079	0.3436	0.0588	0.0364	0.5992
Aug	1079	0.3438	0.0587	0.0425	0.5638
Sep	1079	0.3478	0.0582	0.0469	0.5690
Oct	1079	0.3484	0.0575	0.0440	0.5682
Nov	1078	0.3477	0.0592	0.0431	0.5675
Dec	1078	0.3468	0.0588	0.0507	0.5560
Qtr1	1079	0.3500	0.0593	0.0592	0.6056
Qtr2	1079	0.3466	0.0589	0.0421	0.5554
Qtr3	1079	0.3450	0.0572	0.0409	0.5569
Qtr4	1079	0.3476	0.0573	0.0445	0.5605
Jan-Jun	1079	0.3482	0.0582	0.0495	0.5801
Jul-Dec	1079	0.3462	0.0563	0.0426	0.5587
Year 2003	1079	0.3472	0.0563	0.0460	0.5693

Licensed nursing, percent of hours provided by full-time employees using productive hours

Variable	N	Mean	Std Dev	Minimum	Maximum
Jan	733	0.6951	0.1879	0.0000	1.0000
Feb	734	0.6975	0.1881	0.0000	1.0000
Mar	734	0.7007	0.1875	0.0000	1.0000
Apr	734	0.7051	0.1887	0.0000	0.9998
May	734	0.7011	0.1898	0.0000	0.9986
Jun	734	0.7004	0.1908	0.0000	1.0000
Jul	734	0.6986	0.1883	0.0000	1.0000
Aug	734	0.6996	0.1867	0.0000	0.9985
Sep	734	0.7013	0.1854	0.0000	0.9925
Oct	734	0.7045	0.1845	0.0000	0.9838
Nov	733	0.6997	0.1845	0.0000	1.0000
Dec	733	0.6976	0.1861	0.0000	1.0000
Qtr1	734	0.6977	0.1862	0.0000	1.0000
Qtr2	734	0.7021	0.1881	0.0000	0.9984
Qtr3	734	0.6999	0.1851	0.0000	0.9877
Qtr4	734	0.7010	0.1834	0.0000	0.9843
Jan-Jun	734	0.7000	0.1859	0.0000	0.9948
Jul-Dec	734	0.7005	0.1829	0.0000	0.9822
Year 2003	734	0.7002	0.1825	0.0000	0.9838

All nursing, percent of hours provided by full-time employees using productive hours

Variable	N	Mean	Std Dev	Minimum	Maximum
Jan	733	0.6456	0.1638	0.0000	0.9882
Feb	734	0.6497	0.1642	0.0000	0.9906
Mar	734	0.6508	0.1655	0.0000	0.9760
Apr	734	0.6557	0.1649	0.0000	0.9794
May	734	0.6542	0.1684	0.0000	0.9827
Jun	734	0.6501	0.1705	0.0000	0.9753
Jul	734	0.6488	0.1696	0.0000	0.9767
Aug	734	0.6508	0.1692	0.0000	0.9947
Sep	734	0.6591	0.1651	0.0000	0.9761
Oct	734	0.6616	0.1637	0.0000	0.9702
Nov	733	0.6578	0.1648	0.0000	0.9690
Dec	733	0.6570	0.1641	0.0000	0.9679
Qtr1	734	0.6487	0.1636	0.0000	0.9862
Qtr2	734	0.6533	0.1672	0.0000	0.9792
Qtr3	734	0.6528	0.1672	0.0000	0.9741
Qtr4	734	0.6590	0.1636	0.0000	0.9662
Jan-Jun	734	0.6511	0.1648	0.0000	0.9829
Jul-Dec	734	0.6558	0.1648	0.0000	0.9692
Year 2003	734	0.6534	0.1637	0.0000	0.9764

All staff, percent of hours provided by full-time employees using productive hours

Variable	N	Mean	Std Dev	Minimum	Maximum
Jan	733	0.6630	0.1559	0.0712	0.9474
Feb	734	0.6676	0.1567	0.0715	0.9441
Mar	734	0.6681	0.1589	0.0751	0.9513
Apr	734	0.6721	0.1575	0.0688	0.9491
May	734	0.6694	0.1605	0.0650	0.9522
Jun	734	0.6650	0.1621	0.0693	0.9673
Jul	734	0.6621	0.1609	0.0718	0.9633
Aug	734	0.6635	0.1611	0.0651	0.9543
Sep	734	0.6722	0.1569	0.0773	0.9532
Oct	734	0.6742	0.1559	0.0741	0.9489
Nov	733	0.6696	0.1581	0.0768	0.9563
Dec	733	0.6685	0.1560	0.0666	0.9544
Qtr1	734	0.6662	0.1567	0.0726	0.9452
Qtr2	734	0.6688	0.1596	0.0677	0.9560
Qtr3	734	0.6659	0.1593	0.0713	0.9514
Qtr4	734	0.6711	0.1564	0.0744	0.9529
Jan-Jun	734	0.6675	0.1578	0.0701	0.9512
Jul-Dec	734	0.6684	0.1575	0.0729	0.9521
Year 2003	734	0.6680	0.1571	0.0715	0.9516

```
Day shift % RN coverage using productive hours

    Variable     N        Mean       Std Dev     Minimum       Maximum
    ------------------------------------------------------------------------
    Jan         194       0.7329      0.2647      0.0220        1.0000
    Feb         194       0.7421      0.2495      0.0239        1.0000
    Mar         194       0.7343      0.2522      0.0205        1.0000
    Apr         194       0.7387      0.2501      0.0148        1.0000
    May         194       0.7379      0.2409      0.0210        1.0000
    Jun         194       0.7311      0.2477      0.0019        1.0000
    Jul         194       0.7257      0.2519      0.0193        1.0000
    Aug         194       0.7308      0.2460      0.0021        1.0000
    Sep         194       0.7339      0.2601      0.0000        1.0000
    Oct         194       0.7325      0.2523      0.0000        1.0000
    Nov         194       0.7367      0.2456      0.0062        1.0000
    Dec         194       0.7186      0.2561      0.0063        1.0000

    Qtr1        194       0.7363      0.2501      0.0221        1.0000
    Qtr2        194       0.7359      0.2400      0.0178        1.0000
    Qtr3        194       0.7301      0.2445      0.0198        1.0000
    Qtr4        194       0.7292      0.2453      0.0163        1.0000

    Jan-Jun     194       0.7361      0.2407      0.0199        0.9998
    Jul-Dec     194       0.7296      0.2405      0.0201        1.0000

    Year 2003   194       0.7328      0.2338      0.0200        0.9999
    ------------------------------------------------------------------------


Evening shift % RN coverage using productive hours

    Variable     N        Mean       Std Dev     Minimum       Maximum
    ------------------------------------------------------------------------
    Jan         194       0.6228      0.2932      0.0022        1.0000
    Feb         194       0.6284      0.2874      0.0039        1.0000
    Mar         194       0.6240      0.2882      0.0283        1.0000
    Apr         194       0.6221      0.2866      0.0221        1.0000
    May         194       0.6205      0.2915      0.0255        1.0000
    Jun         194       0.6124      0.2895      0.0059        1.0000
    Jul         194       0.6114      0.2921      0.0181        1.0000
    Aug         194       0.5981      0.2974      0.0071        1.0000
    Sep         194       0.6033      0.2979      0.0000        1.0000
    Oct         194       0.6128      0.2892      0.0000        1.0000
    Nov         194       0.5998      0.2864      0.0000        1.0000
    Dec         194       0.5905      0.2937      0.0166        1.0000

    Qtr1        194       0.6250      0.2838      0.0323        1.0000
    Qtr2        194       0.6184      0.2842      0.0313        0.9997
    Qtr3        194       0.6043      0.2880      0.0085        1.0000
    Qtr4        194       0.6010      0.2827      0.0102        1.0000

    Jan-Jun     194       0.6217      0.2801      0.0339        0.9998
    Jul-Dec     194       0.6026      0.2782      0.0094        0.9998

    Year 2003   194       0.6121      0.2711      0.0345        0.9998
    ------------------------------------------------------------------------
```

Night shift % RN coverage using productive hours

```
     Variable     N        Mean      Std Dev     Minimum      Maximum
     -----------------------------------------------------------------------
     Jan         194       0.4967     0.3325      0.0000       0.9960
     Feb         194       0.4956     0.3332      0.0017       1.0000
     Mar         194       0.5026     0.3311      0.0000       1.0000
     Apr         194       0.4982     0.3319      0.0001       1.0000
     May         194       0.4857     0.3200      0.0019       1.0000
     Jun         194       0.4800     0.3196      0.0015       1.0000
     Jul         194       0.4810     0.3206      0.0000       1.0000
     Aug         194       0.4705     0.3227      0.0026       1.0000
     Sep         194       0.4639     0.3221      0.0000       1.0000
     Oct         194       0.4719     0.3260      0.0000       1.0000
     Nov         194       0.4641     0.3217      0.0000       1.0000
     Dec         194       0.4724     0.3230      0.0000       1.0000

     Qtr1        194       0.4984     0.3277      0.0031       0.9986
     Qtr2        194       0.4879     0.3170      0.0023       1.0000
     Qtr3        194       0.4719     0.3148      0.0019       1.0000
     Qtr4        194       0.4695     0.3184      0.0014       1.0000

     Jan-Jun     194       0.4931     0.3185      0.0027       0.9993
     Jul-Dec     194       0.4707     0.3121      0.0025       0.9998

     Year 2003   194       0.4818     0.3088      0.0053       0.9994
     -----------------------------------------------------------------------
```

24-hour period (11pm-11pm) % RN coverage using productive hours

```
     Variable     N        Mean      Std Dev     Minimum      Maximum
     -----------------------------------------------------------------------
     Jan         194       0.6175     0.2297      0.0646       0.9982
     Feb         194       0.6220     0.2223      0.1006       1.0000
     Mar         194       0.6203     0.2236      0.1375       1.0000
     Apr         194       0.6197     0.2272      0.1013       1.0000
     May         194       0.6147     0.2205      0.0961       0.9993
     Jun         194       0.6078     0.2214      0.1050       1.0000
     Jul         194       0.6060     0.2257      0.1386       0.9987
     Aug         194       0.5998     0.2261      0.1069       0.9963
     Sep         194       0.6004     0.2322      0.0000       0.9971
     Oct         194       0.6057     0.2279      0.0000       0.9981
     Nov         194       0.6002     0.2247      0.0734       0.9984
     Dec         194       0.5938     0.2290      0.0519       0.9967

     Qtr1        194       0.6199     0.2227      0.1131       0.9994
     Qtr2        194       0.6141     0.2199      0.1039       0.9982
     Qtr3        194       0.6021     0.2241      0.1083       0.9966
     Qtr4        194       0.5999     0.2237      0.0414       0.9975

     Jan-Jun     194       0.6170     0.2192      0.1085       0.9983
     Jul-Dec     194       0.6010     0.2207      0.0749       0.9949

     Year 2003   194       0.6089     0.2159      0.1636       0.9959
     -----------------------------------------------------------------------
```

Weekdays % RN coverage using productive hours

Variable	N	Mean	Std Dev	Minimum	Maximum
Jan	194	0.6146	0.2390	0.0000	0.9975
Feb	194	0.6208	0.2312	0.0196	1.0000
Mar	194	0.6198	0.2362	0.0709	1.0000
Apr	194	0.6167	0.2389	0.0069	0.9998
May	194	0.6146	0.2307	0.0049	1.0000
Jun	194	0.6077	0.2294	0.0254	1.0000
Jul	194	0.6034	0.2352	0.0832	0.9986
Aug	194	0.6009	0.2382	0.0893	1.0000
Sep	194	0.5989	0.2470	0.0000	0.9963
Oct	194	0.6057	0.2398	0.0000	0.9992
Nov	194	0.6018	0.2378	0.0130	0.9989
Dec	194	0.5924	0.2439	0.0232	0.9973
Qtr1	194	0.6183	0.2327	0.0352	0.9991
Qtr2	194	0.6130	0.2295	0.0123	0.9993
Qtr3	194	0.6011	0.2359	0.1021	0.9956
Qtr4	194	0.6000	0.2366	0.0337	0.9977
Jan-Jun	194	0.6157	0.2288	0.0237	0.9992
Jul-Dec	194	0.6005	0.2327	0.0720	0.9942
Year 2003	194	0.6080	0.2261	0.1065	0.9955

Weekends % RN coverage using productive hours

Variable	N	Mean	Std Dev	Minimum	Maximum
Jan	194	0.6244	0.2265	0.0355	0.9998
Feb	194	0.6248	0.2235	0.1465	1.0000
Mar	194	0.6233	0.2232	0.1013	1.0000
Apr	194	0.6240	0.2219	0.1682	1.0000
May	194	0.6157	0.2167	0.1708	1.0000
Jun	194	0.6115	0.2252	0.0918	1.0000
Jul	194	0.6087	0.2229	0.0541	1.0000
Aug	194	0.5965	0.2176	0.0422	1.0000
Sep	194	0.6065	0.2218	0.0000	0.9993
Oct	194	0.6040	0.2204	0.0000	0.9997
Nov	194	0.6006	0.2205	0.0766	0.9969
Dec	194	0.5955	0.2209	0.0419	0.9992
Qtr1	194	0.6242	0.2195	0.1483	0.9999
Qtr2	194	0.6171	0.2155	0.1788	0.9981
Qtr3	194	0.6039	0.2138	0.0456	0.9994
Qtr4	194	0.6001	0.2150	0.0533	0.9977
Jan-Jun	194	0.6206	0.2137	0.1767	0.9971
Jul-Dec	194	0.6020	0.2096	0.0494	0.9969
Year 2003	194	0.6112	0.2071	0.1913	0.9970

```
Holidays % RN coverage using productive hours

Variable               N      Mean      Std Dev      Minimum      Maximum
-------------------------------------------------------------------------------
Holiday_Year 2003      194    0.5924    0.2194       0.0922       0.9949
NonHoliday_Year 2003   194    0.6093    0.2162       0.1623       0.9960
-------------------------------------------------------------------------------
```

```
CNA Staffing ratio using total hours

    Variable     N        Mean        Std Dev      Minimum      Maximum
    -------------------------------------------------------------------------
    Jan         624       2.0954       0.3600       0.3492       4.5533
    Feb         624       2.0398       0.3493       0.3633       4.3704
    Mar         625       2.0542       0.3518       0.0229       4.2446
    Apr         625       2.0803       0.3655       0.0042       4.7047
    May         625       2.1390       0.3839       0.0121       4.9243
    Jun         625       2.1310       0.3755       0.0000       4.7294
    Jul         625       2.1845       0.3894       0.0000       4.9296
    Aug         625       2.1456       0.3811       0.0000       4.9773
    Sep         625       2.1409       0.3789       0.0000       5.0137
    Oct         625       2.1131       0.3736       0.0000       5.1663
    Nov         609       2.1455       0.3610       0.0000       5.1550
    Dec         609       2.1313       0.3866       0.0000       5.0076

    Qtr1        625       2.0612       0.3531       0.0247       4.3915
    Qtr2        625       2.1159       0.3661       0.0055       4.7877
    Qtr3        625       2.1562       0.3758       0.0000       4.9734
    Qtr4        625       2.1401       0.3625       0.0000       5.1257

    Jan-Jun     625       2.0883       0.3542       0.0105       4.5910
    Jul-Dec     625       2.1495       0.3670       0.0000       5.0445

    Year 2003   625       2.1178       0.3553       0.0044       4.8115
    -------------------------------------------------------------------------


LPN Staffing ratio using total hours

    Variable     N        Mean        Std Dev      Minimum      Maximum
    -------------------------------------------------------------------------
    Jan         624       0.7313       0.2389       0.0401       3.0186
    Feb         624       0.7186       0.2375       0.0465       2.9372
    Mar         625       0.7189       0.2372       0.0589       2.8929
    Apr         625       0.7270       0.2348       0.0550       2.5333
    May         625       0.7526       0.2435       0.0000       2.7311
    Jun         625       0.7428       0.2410       0.0000       2.5465
    Jul         625       0.7572       0.2507       0.0000       2.8527
    Aug         625       0.7514       0.2487       0.0221       2.6092
    Sep         625       0.7514       0.2463       0.0086       2.3997
    Oct         625       0.7455       0.2396       0.0176       2.2844
    Nov         609       0.7678       0.2592       0.0199       2.7639
    Dec         609       0.7606       0.2540       0.0025       2.2485

    Qtr1        625       0.7231       0.2354       0.0548       2.9541
    Qtr2        625       0.7406       0.2369       0.0498       2.6009
    Qtr3        625       0.7530       0.2454       0.0107       2.6164
    Qtr4        625       0.7589       0.2444       0.0169       2.4194

    Jan-Jun     625       0.7317       0.2335       0.0522       2.7732
    Jul-Dec     625       0.7558       0.2427       0.0137       2.5234

    Year 2003   625       0.7432       0.2344       0.0397       2.6614
    -------------------------------------------------------------------------
```

RN Staffing ratio using total hours

Variable	N	Mean	Std Dev	Minimum	Maximum
Jan	624	0.2923	0.1960	0.0000	1.9066
Feb	624	0.2865	0.1899	0.0000	1.8933
Mar	625	0.2906	0.2039	0.0000	2.7216
Apr	625	0.2914	0.1961	0.0000	2.3383
May	625	0.2965	0.2033	0.0000	2.4655
Jun	625	0.2923	0.1984	0.0000	2.2889
Jul	625	0.2978	0.2095	0.0000	2.7056
Aug	625	0.2928	0.2032	0.0000	2.6689
Sep	625	0.2927	0.2033	0.0000	2.6373
Oct	625	0.2920	0.2071	0.0000	2.8851
Nov	609	0.2990	0.2228	0.0000	3.4205
Dec	609	0.2976	0.2130	0.0000	2.8328
Qtr1	625	0.2898	0.1938	0.0000	2.1338
Qtr2	625	0.2932	0.1974	0.0000	2.3636
Qtr3	625	0.2943	0.2033	0.0000	2.6700
Qtr4	625	0.2954	0.2114	0.0000	3.0324
Jan-Jun	625	0.2915	0.1939	0.0000	2.2515
Jul-Dec	625	0.2946	0.2054	0.0000	2.8410
Year 2003	625	0.2929	0.1963	0.0000	2.5154

RN+LPN Staffing ratio using total hours

Variable	N	Mean	Std Dev	Minimum	Maximum
Jan	624	1.0236	0.2674	0.0582	4.9252
Feb	624	1.0051	0.2625	0.0465	4.8305
Mar	625	1.0095	0.2848	0.0589	5.6145
Apr	625	1.0184	0.2699	0.0550	4.8716
May	625	1.0490	0.2801	0.0442	5.1966
Jun	625	1.0350	0.2681	0.0501	4.8355
Jul	625	1.0550	0.2910	0.0379	5.5583
Aug	625	1.0441	0.2807	0.0344	5.2781
Sep	625	1.0441	0.2754	0.0231	5.0370
Oct	625	1.0376	0.2758	0.0176	5.1695
Nov	609	1.0669	0.3130	0.0218	6.1844
Dec	609	1.0583	0.2921	0.0208	5.0813
Qtr1	625	1.0129	0.2677	0.0548	5.0880
Qtr2	625	1.0338	0.2691	0.0498	4.9645
Qtr3	625	1.0472	0.2784	0.0318	5.2863
Qtr4	625	1.0543	0.2838	0.0199	5.4519
Jan-Jun	625	1.0232	0.2661	0.0522	5.0248
Jul-Dec	625	1.0504	0.2785	0.0265	5.3644
Year 2003	625	1.0361	0.2685	0.0397	5.1768

```
Licensed nursing staffing ratio using total hours
                                Level

    Variable      N          Mean       Std Dev      Minimum       Maximum
    ----------------------------------------------------------------------------
    Jan          624        1.1991       0.3072       0.1790        6.1032
    Feb          624        1.1803       0.3019       0.1882        5.9284
    Mar          625        1.1837       0.3364       0.1854        7.1512
    Apr          625        1.1931       0.3058       0.1734        5.9074
    May          625        1.2252       0.3233       0.1786        6.4673
    Jun          625        1.2094       0.3098       0.1822        6.0654
    Jul          625        1.2297       0.3430       0.1832        7.1197
    Aug          625        1.2179       0.3284       0.1809        6.7407
    Sep          625        1.2182       0.3173       0.1521        6.3168
    Oct          625        1.2098       0.3101       0.1349        6.2505
    Nov          609        1.2362       0.3557       0.1396        7.4796
    Dec          609        1.2239       0.3299       0.1299        6.1794

    Qtr1         625        1.1876       0.3103       0.1840        6.3398
    Qtr2         625        1.2087       0.3089       0.1780        6.1366
    Qtr3         625        1.2213       0.3253       0.1790        6.7188
    Qtr4         625        1.2261       0.3211       0.1358        6.6026

    Jan-Jun      625        1.1980       0.3072       0.1810        6.2358
    Jul-Dec      625        1.2233       0.3208       0.1566        6.6640

    Year 2003    625        1.2099       0.3104       0.1805        6.4274
    ----------------------------------------------------------------------------


All nursing staffing ratio using total hours

    Variable      N          Mean       Std Dev      Minimum       Maximum
    ----------------------------------------------------------------------------
    Jan          624        3.3502       0.4885       0.5678        7.1586
    Feb          624        3.2776       0.4764       0.5947        7.0411
    Mar          625        3.3042       0.4938       0.6031        8.3891
    Apr          625        3.3441       0.4873       0.6096        7.1956
    May          625        3.4412       0.5161       0.6141        7.7706
    Jun          625        3.4193       0.5062       0.5620        7.3098
    Jul          625        3.4945       0.5391       0.5358        8.3996
    Aug          625        3.4410       0.5145       0.4808        8.0466
    Sep          625        3.4384       0.5036       0.4104        7.6084
    Oct          625        3.4006       0.4854       0.3655        7.4455
    Nov          609        3.4610       0.4924       0.3639        8.5045
    Dec          609        3.4341       0.5178       0.3571        7.2783

    Qtr1         625        3.3108       0.4757       0.5883        7.4673
    Qtr2         625        3.4001       0.4903       0.6137        7.4159
    Qtr3         625        3.4565       0.5064       0.4700        8.0116
    Qtr4         625        3.4449       0.4743       0.3632        7.7190

    Jan-Jun      625        3.3551       0.4768       0.6010        7.4410
    Jul-Dec      625        3.4515       0.4865       0.4145        7.8735

    Year 2003    625        3.4013       0.4740       0.5282        7.6346
    ----------------------------------------------------------------------------
```

All staff staffing ratio using total hours

Variable	N	Mean	Std Dev	Minimum	Maximum
Jan	624	5.3607	0.8588	1.2383	15.2551
Feb	624	5.2557	0.8407	1.1726	15.4620
Mar	625	5.2832	0.9312	1.1574	19.7192
Apr	625	5.3314	0.8615	1.1196	15.3797
May	625	5.4599	0.9338	1.0001	17.6402
Jun	625	5.4313	0.9085	0.8847	16.7446
Jul	625	5.5387	0.9766	0.8468	19.2796
Aug	625	5.4597	0.9333	0.7486	18.0161
Sep	625	5.4469	0.9126	0.6478	17.8239
Oct	625	5.3698	0.8918	0.5791	17.7412
Nov	609	5.4422	0.9839	0.5747	21.5018
Dec	609	5.4110	0.9866	0.5682	18.4448
Qtr1	625	5.2994	0.8585	1.2013	16.5983
Qtr2	625	5.4047	0.8833	0.9943	16.5333
Qtr3	625	5.4794	0.9281	0.7387	18.3549
Qtr4	625	5.4241	0.9129	0.5751	19.0772
Jan-Jun	625	5.3512	0.8640	1.0887	16.5650
Jul-Dec	625	5.4542	0.9123	0.6537	18.6957
Year 2003	625	5.4000	0.8765	0.8206	17.5188

```
RN to LPN ratio using total hours

    Variable      N        Mean      Std Dev     Minimum      Maximum
    ----------------------------------------------------------------------
    Jan          763      0.5697      0.8147      0.0000      12.4937
    Feb          763      0.5519      0.6164      0.0000       7.3319
    Mar          764      0.5481      0.6004      0.0000       7.5539
    Apr          764      0.5439      0.6328      0.0000       8.6650
    May          763      0.5370      0.6526      0.0000      11.6152
    Jun          763      0.5231      0.5162      0.0000       6.3223
    Jul          763      0.5280      0.5628      0.0000       7.4352
    Aug          763      0.5832      1.9607      0.0000      52.9221
    Sep          763      0.6895      4.7697      0.0000     131.4974
    Oct          764      0.5741      1.6742      0.0000      44.7173
    Nov          748      0.5812      1.9624      0.0000      52.5467
    Dec          748      1.0221     13.9514      0.0000     381.8438

    Qtr1         764      0.5490      0.6135      0.0000       7.7685
    Qtr2         764      0.5527      0.8988      0.0000      20.5548
    Qtr3         764      0.6813      4.1631      0.0000     113.8631
    Qtr4         764      0.5855      2.1719      0.0000      59.0862

    Jan-Jun      764      0.5409      0.6185      0.0000       9.2585
    Jul-Dec      764      0.6163      2.9490      0.0000      80.9569

    Year 2003    764      0.5362      0.7495      0.0000      16.4275
    ----------------------------------------------------------------------


RN+LPN to CNA ratio using total hours

    Variable      N        Mean      Std Dev     Minimum      Maximum
    ----------------------------------------------------------------------
    Jan          763      0.5075      0.2095      0.0246       4.6667
    Feb          763      0.5108      0.1994      0.0205       4.3415
    Mar          764      0.5814      1.9597      0.0240      54.3761
    Apr          764      0.9284     11.5738      0.0251     320.3728
    May          764      0.6518      3.8905      0.0184     107.9131
    Jun          763      0.5077      0.1894      0.0239       3.8860
    Jul          763      0.5050      0.1988      0.0148       4.3426
    Aug          763      0.5085      0.1919      0.0152       4.0419
    Sep          763      0.5110      0.1918      0.0098       3.8999
    Oct          763      0.5144      0.2010      0.0076       4.3262
    Nov          747      0.5217      0.2499      0.0102       6.0345
    Dec          747      0.5194      0.2112      0.0105       4.6241

    Qtr1         764      0.5766      1.8763      0.0232      52.0669
    Qtr2         764      0.8348      9.0085      0.0223     249.4552
    Qtr3         763      0.5074      0.1914      0.0133       4.0891
    Qtr4         763      0.5160      0.2139      0.0091       4.8832

    Jan-Jun      764      0.6753      4.6151      0.0227     127.9593
    Jul-Dec      763      0.5108      0.1992      0.0115       4.4350

    Year 2003    764      0.9010     10.8356      0.0173     299.9620
    ----------------------------------------------------------------------
```

RN to all nursing ratio using total hours

```
Variable     N         Mean      Std Dev     Minimum     Maximum
-----------------------------------------------------------------------------
Jan         763       0.0901     0.0531      0.0000      0.3262
Feb         763       0.0901     0.0524      0.0000      0.3157
Mar         764       0.0902     0.0523      0.0000      0.3333
Apr         764       0.0895     0.0511      0.0000      0.3312
May         764       0.0890     0.0520      0.0000      0.3200
Jun         764       0.0884     0.0515      0.0000      0.3131
Jul         764       0.0880     0.0513      0.0000      0.3221
Aug         764       0.0875     0.0509      0.0000      0.3317
Sep         764       0.0880     0.0517      0.0000      0.3466
Oct         764       0.0881     0.0515      0.0000      0.3875
Nov         748       0.0883     0.0516      0.0000      0.4022
Dec         748       0.0882     0.0516      0.0000      0.3892

Qtr1        764       0.0901     0.0521      0.0000      0.3255
Qtr2        764       0.0889     0.0510      0.0000      0.3196
Qtr3        764       0.0878     0.0507      0.0000      0.3333
Qtr4        764       0.0878     0.0510      0.0000      0.3929

Jan-Jun     764       0.0895     0.0510      0.0000      0.3224
Jul-Dec     764       0.0878     0.0503      0.0000      0.3608

Year 2003   764       0.0886     0.0499      0.0000      0.3295
-----------------------------------------------------------------------------
```

RN+LPN to all nursing ratio using total hours

```
Variable     N         Mean      Std Dev     Minimum     Maximum
-----------------------------------------------------------------------------
Jan         763       0.3024     0.0556      0.0186      0.6880
Feb         763       0.3032     0.0550      0.0152      0.6861
Mar         764       0.3024     0.0547      0.0183      0.6693
Apr         764       0.3019     0.0557      0.0191      0.6770
May         764       0.3023     0.0556      0.0137      0.6688
Jun         764       0.3009     0.0543      0.0178      0.6615
Jul         764       0.3000     0.0536      0.0117      0.6617
Aug         764       0.3011     0.0535      0.0116      0.6559
Sep         764       0.3019     0.0542      0.0077      0.6620
Oct         764       0.3029     0.0540      0.0058      0.6943
Nov         748       0.3052     0.0542      0.0074      0.7272
Dec         748       0.3053     0.0544      0.0078      0.6981

Qtr1        764       0.3027     0.0540      0.0175      0.6814
Qtr2        764       0.3017     0.0542      0.0167      0.6694
Qtr3        764       0.3009     0.0526      0.0104      0.6598
Qtr4        764       0.3038     0.0531      0.0068      0.7063

Jan-Jun     764       0.3021     0.0532      0.0171      0.6753
Jul-Dec     764       0.3022     0.0520      0.0088      0.6813

Year 2003   764       0.3022     0.0516      0.0131      0.6781
-----------------------------------------------------------------------------
```

CNA to all nursing ratio using total hours

Variable	N	Mean	Std Dev	Minimum	Maximum
Jan	763	0.6179	0.0721	0.1474	0.7843
Feb	763	0.6149	0.0729	0.1580	0.7947
Mar	764	0.6133	0.0781	0.0069	0.7830
Apr	764	0.6130	0.0789	0.0011	0.8388
May	764	0.6122	0.0797	0.0032	0.8367
Jun	764	0.6131	0.0797	0.0000	0.7971
Jul	764	0.6150	0.0801	0.0000	0.7982
Aug	764	0.6132	0.0808	0.0000	0.8245
Sep	764	0.6122	0.0814	0.0000	0.8366
Oct	764	0.6102	0.0808	0.0000	0.7988
Nov	748	0.6088	0.0817	0.0000	0.7965
Dec	748	0.6104	0.0829	0.0000	0.7940
Qtr1	764	0.6149	0.0755	0.0072	0.7870
Qtr2	764	0.6128	0.0785	0.0014	0.8266
Qtr3	764	0.6136	0.0799	0.0000	0.8188
Qtr4	764	0.6103	0.0804	0.0000	0.7927
Jan-Jun	764	0.6138	0.0761	0.0028	0.8062
Jul-Dec	764	0.6121	0.0794	0.0000	0.7897
Year 2003	764	0.6130	0.0766	0.0012	0.7989

Licensed nursing to all nursing ratio using total hours

Variable	N	Mean	Std Dev	Minimum	Maximum
Jan	763	0.3564	0.0557	0.0842	0.8526
Feb	763	0.3582	0.0548	0.0811	0.8420
Mar	764	0.3566	0.0552	0.0790	0.8524
Apr	764	0.3556	0.0556	0.0821	0.8210
May	764	0.3550	0.0557	0.0721	0.8323
Jun	764	0.3534	0.0542	0.0824	0.8298
Jul	764	0.3515	0.0542	0.0711	0.8476
Aug	764	0.3533	0.0539	0.0732	0.8377
Sep	764	0.3541	0.0546	0.0692	0.8302
Oct	764	0.3553	0.0533	0.0689	0.8395
Nov	748	0.3562	0.0544	0.0732	0.8795
Dec	748	0.3548	0.0548	0.0848	0.8490
Qtr1	764	0.3570	0.0541	0.0814	0.8490
Qtr2	764	0.3546	0.0540	0.0786	0.8275
Qtr3	764	0.3529	0.0530	0.0712	0.8386
Qtr4	764	0.3551	0.0526	0.0735	0.8554
Jan-Jun	764	0.3557	0.0531	0.0800	0.8380
Jul-Dec	764	0.3538	0.0519	0.0722	0.8464
Year 2003	764	0.3547	0.0516	0.0762	0.8419

Licensed nursing percent of hours provided by full-time employees using total hours

Variable	N	Mean	Std Dev	Minimum	Maximum
Jan	763	0.7617	0.1131	0.3473	1.0000
Feb	764	0.7655	0.1124	0.2837	1.0000
Mar	764	0.7685	0.1090	0.3004	1.0000
Apr	764	0.7725	0.1110	0.3816	1.0000
May	764	0.7730	0.1116	0.3512	0.9995
Jun	764	0.7739	0.1112	0.3642	1.0000
Jul	764	0.7738	0.1096	0.3758	1.0000
Aug	764	0.7752	0.1106	0.3516	0.9988
Sep	764	0.7753	0.1104	0.3521	1.0000
Oct	764	0.7748	0.1091	0.3709	1.0000
Nov	748	0.7713	0.1094	0.3601	1.0000
Dec	748	0.7685	0.1097	0.3085	1.0000
Qtr1	764	0.7652	0.1093	0.3290	1.0000
Qtr2	764	0.7731	0.1091	0.3684	0.9987
Qtr3	764	0.7747	0.1080	0.3835	0.9988
Qtr4	764	0.7725	0.1073	0.3471	1.0000
Jan-Jun	764	0.7692	0.1073	0.3611	0.9994
Jul-Dec	764	0.7736	0.1060	0.3686	0.9988
Year 2003	764	0.7713	0.1038	0.3757	0.9992

All nursing percent of hours provided by full-time employees using total hours

Variable	N	Mean	Std Dev	Minimum	Maximum
Jan	763	0.6860	0.1059	0.3223	0.9271
Feb	764	0.6918	0.1056	0.2827	0.9209
Mar	764	0.6935	0.1056	0.2862	0.9378
Apr	764	0.6977	0.1051	0.2864	0.9394
May	764	0.6996	0.1049	0.3111	0.9391
Jun	764	0.6986	0.1052	0.3293	0.9467
Jul	764	0.6987	0.1049	0.3540	0.9475
Aug	764	0.7022	0.1040	0.3439	0.9407
Sep	764	0.7063	0.1036	0.3589	0.9359
Oct	764	0.7072	0.1019	0.3557	0.9382
Nov	748	0.7036	0.1010	0.3609	0.9536
Dec	748	0.7019	0.1017	0.3286	0.9547
Qtr1	764	0.6903	0.1044	0.2977	0.9212
Qtr2	764	0.6985	0.1040	0.3092	0.9417
Qtr3	764	0.7023	0.1031	0.3522	0.9400
Qtr4	764	0.7059	0.1009	0.3580	0.9460
Jan-Jun	764	0.6945	0.1030	0.3034	0.9281
Jul-Dec	764	0.7040	0.1011	0.3554	0.9429
Year 2003	764	0.6992	0.1005	0.3541	0.9353

```
All staff percent of hours provided by full-time employees using total hours

     Variable      N         Mean        Std Dev      Minimum       Maximum
     ------------------------------------------------------------------------
     Jan          763        0.7124       0.0858       0.4390        0.9224
     Feb          764        0.7181       0.0852       0.4261        0.9163
     Mar          764        0.7194       0.0857       0.4257        0.9229
     Apr          764        0.7223       0.0856       0.4146        0.9352
     May          764        0.7228       0.0849       0.4230        0.9369
     Jun          764        0.7206       0.0852       0.4406        0.9375
     Jul          764        0.7188       0.0858       0.4202        0.9323
     Aug          764        0.7217       0.0850       0.4584        0.9316
     Sep          764        0.7257       0.0850       0.4574        0.9258
     Oct          764        0.7261       0.0832       0.4653        0.9276
     Nov          748        0.7225       0.0830       0.4707        0.9319
     Dec          748        0.7200       0.0839       0.4409        0.9310

     Qtr1         764        0.7166       0.0848       0.4319        0.9157
     Qtr2         764        0.7219       0.0845       0.4297        0.9314
     Qtr3         764        0.7220       0.0845       0.4568        0.9299
     Qtr4         764        0.7244       0.0830       0.4668        0.9301

     Jan-Jun      764        0.7192       0.0839       0.4342        0.9235
     Jul-Dec      764        0.7231       0.0832       0.4670        0.9300

     Year 2003    764        0.7212       0.0825       0.4572        0.9267
     ------------------------------------------------------------------------
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Appendix D: Retention, turnover, short-term, and tenure measures, separately for full-time and part-time staff

Table D1: Distributional statistics of retention, turnover, and short-term measures for full-time staff

Measure	n	Mean	Standard deviation	Minimum	10th Percentile	Median	90th Percentile	99th Percentile	Maximum
Cohort turnover									
CNA	1037	24.7%	13.4%	0.0%	8.8%	23.5%	42.9%	59.1%	85.7%
LPN	1026	23.5%	19.3%	0.0%	0.0%	22.2%	50.0%	75.0%	100.0%
RN	930	31.9%	31.1%	0.0%	0.0%	25.0%	76.4%	100.0%	100.0%
RN+LPN	1036	26.4%	17.7%	0.0%	0.0%	25.0%	50.0%	75.0%	100.0%
DON+ADON	858	32.5%	40.3%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
Licensed nursing	1038	23.2%	15.9%	0.0%	0.0%	22.2%	44.4%	66.7%	100.0%
All nursing	1038	23.9%	11.5%	0.0%	10.0%	22.9%	39.2%	54.3%	80.0%
All staff	1038	20.5%	9.4%	0.0%	8.9%	20.0%	32.7%	44.1%	63.8%
Cohort retention									
CNA	1037	75.3%	13.4%	14.3%	57.1%	76.5%	91.2%	100.0%	100.0%
LPN	1026	76.5%	19.3%	0.0%	50.0%	77.8%	100.0%	100.0%	100.0%
RN	930	68.1%	31.1%	0.0%	23.6%	75.0%	100.0%	100.0%	100.0%
RN+LPN	1036	73.6%	17.7%	0.0%	50.0%	75.0%	100.0%	100.0%	100.0%
DON+ADON	858	67.5%	40.3%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
Licensed nursing	1038	76.8%	15.9%	0.0%	55.6%	77.8%	100.0%	100.0%	100.0%
All nursing	1038	76.1%	11.5%	20.0%	60.8%	77.1%	90.0%	100.0%	100.0%
All staff	1038	79.5%	9.4%	36.2%	67.3%	80.0%	91.1%	100.0%	100.0%
Position turnover									
CNA	1038	37.4%	26.7%	0.0%	12.4%	32.9%	67.4%	116.1%	488.1%
LPN	1029	26.4%	24.8%	0.0%	0.0%	22.3%	54.7%	105.9%	225.0%
RN	942	57.8%	63.2%	0.0%	0.0%	40.9%	136.4%	281.3%	437.5%
RN+LPN	1037	32.7%	25.7%	0.0%	4.0%	28.1%	63.2%	118.9%	232.9%
DON+ADON	881	46.3%	61.0%	0.0%	0.0%	0.0%	125.0%	225.0%	400.0%
Licensed nursing	1039	32.0%	24.1%	0.0%	0.0%	27.5%	62.7%	113.2%	156.2%
All nursing	1039	33.5%	18.3%	0.0%	13.2%	30.5%	57.2%	85.2%	139.1%
All staff	1039	27.4%	14.3%	0.0%	11.4%	25.4%	46.4%	68.7%	103.7%

Table D1: Distributional statistics of retention, turnover, and short-term measures for full-time staff (continued)

Measure	n	Mean	Standard deviation	Minimum	10th Percentile	Median	90th Percentile	99th Percentile	Maximum
Short-term									
CNA	1038	9.5%	7.8%	0.0%	0.0%	8.3%	19.0%	31.5%	92.7%
LPN	1031	7.6%	9.8%	0.0%	0.0%	4.8%	20.0%	40.0%	66.7%
RN	994	14.2%	20.0%	0.0%	0.0%	0.0%	41.7%	100.0%	100.0%
RN+LPN	1038	9.9%	10.2%	0.0%	0.0%	8.0%	22.2%	40.0%	100.0%
DON	863	6.0%	16.8%	0.0%	0.0%	0.0%	33.3%	50.0%	100.0%
DON+ADON	895	7.2%	16.2%	0.0%	0.0%	0.0%	33.3%	66.7%	100.0%
Licensed nursing	1039	6.9%	7.1%	0.0%	0.0%	5.6%	16.7%	30.0%	44.1%
All nursing	1039	8.0%	5.5%	0.0%	1.4%	7.1%	15.3%	22.7%	41.7%
Administrator	822	5.4%	15.9%	0.0%	0.0%	0.0%	33.3%	66.7%	100.0%
All staff	1039	6.3%	4.3%	0.0%	1.4%	5.7%	12.0%	18.6%	30.8%

Table D2: Distributional statistics of retention, turnover, and short-term measures for part-time staff

Measure	n	Mean	Standard deviation	Minimum	10th Percentile	Median	90th Percentile	99th Percentile	Maximum
Cohort turnover									
CNA	1042	55.2%	18.5%	0.0%	31.3%	55.0%	80.0%	100.0%	100.0%
LPN	1001	47.4%	28.4%	0.0%	0.0%	50.0%	85.7%	100.0%	100.0%
RN	933	48.2%	32.0%	0.0%	0.0%	50.0%	100.0%	100.0%	100.0%
RN+LPN	1039	48.5%	23.9%	0.0%	16.7%	50.0%	80.0%	100.0%	100.0%
DON+ADON	83	23.9%	41.5%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
Licensed nursing	1040	47.1%	23.9%	0.0%	16.7%	46.2%	80.0%	100.0%	100.0%
All nursing	1043	52.6%	16.5%	5.9%	31.6%	52.4%	75.0%	90.0%	100.0%
All staff	1043	49.2%	14.6%	10.7%	29.8%	50.0%	69.0%	80.0%	90.0%
Cohort retention									
CNA	1042	44.8%	18.5%	0.0%	20.0%	45.0%	68.8%	84.2%	100.0%
LPN	1001	52.6%	28.4%	0.0%	14.3%	50.0%	100.0%	100.0%	100.0%
RN	933	51.8%	32.0%	0.0%	0.0%	50.0%	100.0%	100.0%	100.0%
RN+LPN	1039	51.5%	23.9%	0.0%	20.0%	50.0%	83.3%	100.0%	100.0%
DON+ADON	83	76.1%	41.5%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
Licensed nursing	1040	52.9%	23.9%	0.0%	20.0%	53.8%	83.3%	100.0%	100.0%
All nursing	1043	47.4%	16.5%	0.0%	25.0%	47.6%	68.4%	83.3%	94.1%
All staff	1043	50.8%	14.6%	10.0%	31.0%	50.0%	70.2%	81.8%	89.3%
Position turnover									
CNA	1045	139.8%	81.6%	15.7%	55.6%	120.0%	240.5%	420.3%	528.0%
LPN	1015	89.0%	70.8%	0.0%	18.4%	70.3%	180.0%	334.9%	466.7%
RN	968	112.5%	89.3%	0.0%	20.9%	94.7%	225.0%	420.0%	600.0%
RN+LPN	1043	92.3%	61.2%	0.0%	29.8%	78.3%	173.2%	304.2%	500.8%
DON+ADON	93	35.0%	68.7%	0.0%	0.0%	0.0%	100.0%	300.0%	300.0%
Licensed nursing	1044	112.5%	80.7%	0.0%	31.4%	92.5%	218.9%	368.2%	646.2%
All nursing	1045	126.4%	65.6%	13.4%	57.1%	111.9%	214.7%	346.2%	442.5%
All staff	1045	112.0%	52.6%	15.5%	51.6%	102.2%	187.2%	260.0%	302.8%

Table D2: Distributional statistics of retention, turnover, and short-term measures for part-time staff (continued)

Measure	n	Mean	Standard deviation	Minimum	10th Percentile	Median	90th Percentile	99th Percentile	Maximum
Short-term									
CNA	1045	31.6%	14.2%	0.0%	14.3%	30.4%	51.4%	68.0%	90.9%
LPN	1035	27.6%	19.6%	0.0%	0.0%	25.0%	52.0%	75.0%	100.0%
RN	1023	27.1%	23.0%	0.0%	0.0%	25.0%	55.6%	100.0%	100.0%
RN+LPN	1045	27.5%	15.9%	0.0%	7.7%	26.1%	50.0%	66.7%	100.0%
DON	168	39.5%	46.9%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
DON+ADON	242	44.7%	47.0%	0.0%	0.0%	16.7%	100.0%	100.0%	100.0%
Licensed nursing	1045	26.9%	16.2%	0.0%	6.7%	25.0%	50.0%	66.7%	100.0%
All nursing	1045	30.2%	12.5%	0.0%	15.2%	29.1%	47.3%	60.0%	71.4%
Administrator	242	16.0%	36.2%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
All staff	1045	28.0%	11.4%	2.6%	13.6%	27.3%	44.1%	55.6%	59.2%

Table D3: Distributional statistics of tenure measures for full-time staff

Measure	n	Mean	Standard deviation	Minimum	10th Percentile	Median	90th Percentile	99th Percentile	Maximum
Length of employment, years (tenure)									
CNA	659	4.6	2.4	0.2	2.0	4.0	8.0	12.2	14.2
LPN	653	5.3	3.8	0.3	1.8	4.5	10.0	18.0	33.1
RN	636	4.1	3.3	0.0	0.9	3.3	8.5	16.0	22.0
RN+LPN	659	4.8	3.1	0.6	1.8	4.1	8.6	16.5	23.7
DON	488	6.0	6.4	0.1	0.9	3.6	15.0	29.0	38.5
DON+ADON	518	5.8	5.7	0.0	0.9	3.8	14.2	26.7	38.5
Licensed nursing	659	5.0	3.0	0.6	2.0	4.5	8.8	14.8	26.0
All nursing	659	4.6	2.2	0.6	2.2	4.1	7.7	11.2	14.7
Administrator	452	5.3	5.6	0.0	0.9	3.6	11.7	29.3	34.5
All staff	659	5.2	2.3	0.7	2.6	4.8	8.1	12.0	17.1
Tenure > 1 year (departed)									
CNA	644	52.7%	27.6%	0.0%	16.7%	50.0%	100.0%	100.0%	100.0%
LPN	486	58.4%	35.3%	0.0%	0.0%	60.0%	100.0%	100.0%	100.0%
RN	444	55.4%	40.4%	0.0%	0.0%	50.0%	100.0%	100.0%	100.0%
RN+LPN	572	58.4%	32.2%	0.0%	9.1%	60.0%	100.0%	100.0%	100.0%
DON	160	69.9%	43.5%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
DON+ADON	215	69.1%	42.2%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
Licensed nursing	566	57.2%	31.9%	0.0%	0.0%	57.1%	100.0%	100.0%	100.0%
All nursing	646	52.0%	23.5%	0.0%	25.0%	50.0%	83.3%	100.0%	100.0%
Administrator	132	74.4%	40.6%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
All staff	645	53.0%	21.5%	0.0%	26.3%	51.1%	80.0%	100.0%	100.0%
TTD > 1 year (employed)									
CNA	659	72.9%	15.8%	0.0%	52.6%	74.2%	92.9%	100.0%	100.0%
LPN	653	74.1%	21.8%	0.0%	50.0%	75.0%	100.0%	100.0%	100.0%
RN	610	72.5%	29.1%	0.0%	33.3%	75.0%	100.0%	100.0%	100.0%
RN+LPN	658	74.0%	18.7%	0.0%	50.0%	75.4%	100.0%	100.0%	100.0%
DON	468	81.2%	37.9%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
DON+ADON	503	79.9%	36.0%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
Licensed nursing	659	75.3%	17.2%	0.0%	53.3%	76.9%	100.0%	100.0%	100.0%
All nursing	659	72.8%	13.6%	1.8%	55.0%	74.1%	88.9%	100.0%	100.0%
Administrator	440	79.6%	39.3%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
All staff	659	76.3%	11.2%	1.1%	62.8%	77.3%	89.9%	100.0%	100.0%

Table D3: Distributional statistics of tenure measures for full-time staff (continued)

Measure	n	Mean	Standard deviation	Minimum	10th Percentile	Median	90th Percentile	99th Percentile	Maximum
Tenure > 5 years (departed)									
CNA	644	15.3%	21.4%	0.0%	0.0%	7.1%	42.9%	100.0%	100.0%
LPN	486	18.5%	30.5%	0.0%	0.0%	0.0%	66.7%	100.0%	100.0%
RN	444	17.3%	30.5%	0.0%	0.0%	0.0%	66.7%	100.0%	100.0%
RN+LPN	572	18.8%	27.5%	0.0%	0.0%	0.0%	50.0%	100.0%	100.0%
DON	160	23.3%	41.4%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
DON+ADON	215	24.9%	40.6%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
Licensed nursing	566	17.6%	27.1%	0.0%	0.0%	0.0%	50.0%	100.0%	100.0%
All nursing	646	14.3%	17.6%	0.0%	0.0%	10.0%	35.7%	75.0%	100.0%
Administrator	132	27.7%	42.3%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
All staff	645	13.5%	14.7%	0.0%	0.0%	11.1%	33.3%	66.7%	100.0%
TTD > 5 years (employed)									
CNA	659	28.8%	18.3%	0.0%	0.0%	27.3%	53.8%	74.1%	100.0%
LPN	653	33.6%	27.0%	0.0%	0.0%	33.3%	69.2%	100.0%	100.0%
RN	610	28.0%	30.3%	0.0%	0.0%	20.0%	67.9%	100.0%	100.0%
RN+LPN	658	32.1%	23.6%	0.0%	0.0%	30.8%	61.9%	100.0%	100.0%
DON	468	36.7%	47.9%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
DON+ADON	503	36.6%	44.7%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
Licensed nursing	659	33.3%	22.7%	0.0%	0.0%	31.3%	63.6%	100.0%	100.0%
All nursing	659	30.0%	17.1%	0.0%	4.0%	30.2%	50.8%	77.8%	100.0%
Administrator	440	33.8%	46.4%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
All staff	659	33.8%	17.0%	0.0%	4.6%	34.7%	53.8%	76.9%	91.3%

Table D4: Distributional statistics of tenure measures for part-time staff

Measure	n	Mean	Standard deviation	Minimum	10th Percentile	Median	90th Percentile	99th Percentile	Maximum
Length of employment, years (tenure)									
CNA	663	2.3	1.6	0.2	0.8	1.9	4.4	8.1	10.9
LPN	657	3.2	3.0	0.1	0.6	2.3	6.9	16.8	23.8
RN	657	3.0	2.7	0.0	0.5	2.2	6.7	12.5	14.7
RN+LPN	663	3.1	2.4	0.2	0.7	2.4	6.5	10.9	14.1
DON	91	6.9	7.1	0.0	0.4	3.7	18.2	31.5	31.5
DON+ADON	133	6.3	6.7	0.0	0.2	3.5	17.2	26.8	27.3
Licensed nursing	663	3.2	2.4	0.2	0.8	2.5	6.8	10.4	12.4
All nursing	663	2.4	1.6	0.3	0.9	2.1	4.7	7.5	9.3
Administrator	196	6.3	6.3	0.0	0.9	4.1	14.9	28.2	29.6
All staff	663	2.6	1.5	0.4	1.1	2.2	4.9	7.4	9.0
Tenure > 1 year (departed)									
CNA	663	33.1%	21.6%	0.0%	6.7%	31.6%	63.3%	95.2%	100.0%
LPN	602	38.6%	34.4%	0.0%	0.0%	33.3%	100.0%	100.0%	100.0%
RN	572	43.5%	37.6%	0.0%	0.0%	40.0%	100.0%	100.0%	100.0%
RN+LPN	648	41.9%	30.5%	0.0%	0.0%	39.4%	100.0%	100.0%	100.0%
DON	25	76.0%	43.6%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
DON+ADON	49	61.2%	49.2%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
Licensed nursing	649	41.4%	30.2%	0.0%	0.0%	38.5%	100.0%	100.0%	100.0%
All nursing	663	32.5%	19.0%	0.0%	9.5%	31.3%	57.1%	81.0%	100.0%
Administrator	17	70.6%	47.0%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
All staff	663	33.5%	16.8%	0.0%	13.2%	31.3%	55.6%	76.5%	88.9%
TTD > 1 year (employed)									
CNA	663	47.8%	20.1%	0.0%	21.6%	47.6%	75.0%	91.2%	100.0%
LPN	656	54.4%	28.3%	0.0%	16.7%	50.0%	100.0%	100.0%	100.0%
RN	633	57.7%	31.6%	0.0%	0.0%	60.0%	100.0%	100.0%	100.0%
RN+LPN	663	55.8%	23.4%	0.0%	23.1%	57.1%	85.7%	100.0%	100.0%
DON	72	81.9%	37.8%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
DON+ADON	95	77.4%	41.1%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
Licensed nursing	663	56.3%	23.4%	0.0%	25.0%	57.7%	86.7%	100.0%	100.0%
All nursing	663	49.3%	18.3%	0.0%	23.8%	49.2%	73.7%	85.7%	93.7%
Administrator	183	89.3%	30.9%	0.0%	0.0%	100.0%	100.0%	100.0%	100.0%
All staff	663	51.9%	16.3%	7.3%	30.3%	52.7%	73.5%	86.3%	93.3%

Table D4: Distributional statistics of tenure measures for part-time staff (continued)

Measure	n	Mean	Standard deviation	Minimum	10th Percentile	Median	90th Percentile	99th Percentile	Maximum
Tenure > 5 years (departed)									
CNA	663	6.2%	9.3%	0.0%	0.0%	2.0%	18.2%	42.9%	50.0%
LPN	602	10.4%	22.7%	0.0%	0.0%	0.0%	40.0%	100.0%	100.0%
RN	572	14.3%	26.9%	0.0%	0.0%	0.0%	50.0%	100.0%	100.0%
RN+LPN	648	12.8%	21.1%	0.0%	0.0%	0.0%	42.9%	100.0%	100.0%
DON	25	44.0%	46.4%	0.0%	0.0%	50.0%	100.0%	100.0%	100.0%
DON+ADON	49	34.7%	44.7%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
Licensed nursing	649	12.3%	20.7%	0.0%	0.0%	0.0%	40.0%	100.0%	100.0%
All nursing	663	6.6%	7.7%	0.0%	0.0%	4.3%	16.7%	33.3%	45.0%
Administrator	17	5.9%	24.3%	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%
All staff	663	6.4%	6.6%	0.0%	0.0%	4.5%	16.0%	28.6%	41.7%
TTD > 5 years (employed)									
CNA	663	14.8%	13.6%	0.0%	0.0%	11.8%	33.3%	55.9%	84.6%
LPN	656	21.1%	24.6%	0.0%	0.0%	14.3%	55.6%	100.0%	100.0%
RN	633	20.5%	25.6%	0.0%	0.0%	11.1%	50.0%	100.0%	100.0%
RN+LPN	663	20.5%	20.2%	0.0%	0.0%	16.7%	50.0%	76.5%	100.0%
DON	72	43.1%	49.2%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
DON+ADON	95	45.8%	48.7%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
Licensed nursing	663	21.1%	20.4%	0.0%	0.0%	16.7%	50.0%	78.9%	88.9%
All nursing	663	16.3%	13.3%	0.0%	0.0%	14.0%	35.7%	54.3%	68.4%
Administrator	183	45.1%	48.9%	0.0%	0.0%	0.0%	100.0%	100.0%	100.0%
All staff	663	17.5%	12.6%	0.0%	1.8%	16.0%	35.0%	51.0%	69.7%