Orders Management Project

Post-CareLink Analysis of Clerical Workload

Final Report

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Executive Summary

CareLink, the new electronic order-entry system, has changed the nature of clerical workload, but those changes have not been quantified and documented. This project is a study on the effect of CareLink on clerk workload in the University of Michigan Health System (UMHS). The Senior Training Specialist of the Central Staffing Resource Department asked for a comparison of the clerical workload breakdown and time spent per task for pre- and post-CareLink workloads in units 4A, 4B, 4BC, 5C, 5D, 8A, 8B, 8C and CVC5.

Background
The unit clerks perform tasks such as processing patient care orders and handling daily admissions, transfers, and discharges. Before the implementation of CareLink, unit clerks had to process orders by completing multiple copies of paper forms before sending them to multiple destinations. This process was time-consuming as processing paper orders took 53 seconds on average to be processed and occupied about 51% of clerical workload (Edwards, Kakarala, Raschke, & Sehgal, 2004). Furthermore, losses from transit and clerical errors resulted in delays and safety concerns. CareLink has made inputting and processing orders electronic, available to all clinicians, more automated, and faster.

Methodology
The project team did the following throughout the project:

- *Performed literature search and extract historical data.* The team conducted a literature search of pre-CareLink studies on UH clerical workload. The data extracted from the pre-CareLink studies include the fraction of time clerks spent on each task before CareLink and time study data of common clerical tasks.

- *Observed clerical tasks.* Members of the project team watched clerks perform their duties at their workstations for an hour per unit (10 hours total) and asked questions regarding their tasks and processes to gain a better understanding of their daily activities. These observations allowed the team familiarize themselves with the common clerical tasks so that the team could create the task log sheet.

- *Performed workload sampling study.* The study required a pre-programmed beeper, set to beep randomly on average of 4 times an hour, and a task log sheet for one clerk in each of the units in the study. The workload sampling study took place on each unit, on every shift, and every day for a 1-week time period.

- *Obtained and extracted CareLink data.* Application Systems Analysts provided the team with CareLink’s database records of all orders entered through CareLink in all of the units from February 17, 2008 to March 25, 2008. To supplement the workload sampling study data, the team extracted data corresponding to the study’s time frame, after merging order categories in each data field to match the categories used in the task log sheet.
• **Performed time studies.** The team observed the clerks on morning and afternoon shifts in each unit for one hour per shift to find the average times that were spent for each of the tasks on the task log sheet. The time studies observations lasted 2 hours per unit (20 hours total).

• **Validated and evaluated data.** The team validated the time study data with historical time study data and validated the workload beeper sampling data with time study data from this project. The team examined each unit’s CareLink orders data and workload sampling data and then compared the total data with corresponding pre-CareLink studies’ data.

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**Findings and Conclusions**

The team arrived at the following findings and conclusions by comparing pre- and post-CareLink data and by comparing data of each unit to other units in the study.

• **Workload Distribution:** CareLink has reduced the proportion of time that clerks spend working on orders from 51% to 29%, resulting in a more even distribution of the clerk’s time. Also, the proportion of time spent on each task varies slightly from unit to unit but the variation is not statistically significant.

• **CareLink Orders Data:** The number of orders placed by each unit though CareLink varies greatly across the units, with 4BC, 5D and 8B placing the highest number of orders each week. The proportions of orders received by each unit are very similar. Laboratory Orders, Medication Orders and Physician Orders make up almost 90% of total orders. The proportion of each type of unit falls within the 95% confidence interval for all order types, meaning the proportions of orders are about the same for each unit.

• **Orders Initiation:** The clerks do not start all of the orders anymore from the CareLink orders data; therefore, the team created a breakdown by the initiator of each order (see Table 1).

• **Order Process Time:** The average time spent on orders has reduced from 53 seconds to 35 seconds. The reduction in time spent processing each order is seen in all orders types except diet orders, whose process was not greatly altered by the implementation of CareLink.

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**Recommendations**

Based on the conclusions of the study, the team has made the following recommendations:

• **Resource Sharing Between Units:** CareLink has significantly reduced order workload, and it might be possible that clerical resources can be shared between units that are geographically close to each other. The team recommends that a trial study of combining 4A and 4B units or other similar units. 4A and 4B is a good candidate pair for a trial study because the combined order frequencies are still lower than some individual units. The results of the studies should then be compared to current workload data in order to examine any improvement in resource utilization.

• **Recommended Future Studies:** Due to changes in the handling and processing of patient-care orders, there is a need to understand the types of orders that require the most attention.
CareLink has reduced much of the non-value added order processing times. Therefore, the team recommends an extensive study of the types of orders that clerks follow up on and the time spent doing so. A lean based project, including detailed flow-charts and value-stream mapping, would be ideal.

Table 1: Proportion of order initiation source

<table>
<thead>
<tr>
<th>Source</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician</td>
<td>56.983%</td>
</tr>
<tr>
<td>Nurse</td>
<td>16.581%</td>
</tr>
<tr>
<td>Physician Assistant</td>
<td>15.246%</td>
</tr>
<tr>
<td>Advanced Practice Nurse</td>
<td>7.308%</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>1.243%</td>
</tr>
<tr>
<td>Dietitian</td>
<td>1.222%</td>
</tr>
<tr>
<td>Allied Health Tech</td>
<td>0.488%</td>
</tr>
<tr>
<td>Med Student</td>
<td>0.384%</td>
</tr>
<tr>
<td>Therapist</td>
<td>0.261%</td>
</tr>
<tr>
<td>Clerk</td>
<td>0.202%</td>
</tr>
<tr>
<td>Research Staff</td>
<td>0.040%</td>
</tr>
<tr>
<td>Scheduling Clerk</td>
<td>0.019%</td>
</tr>
<tr>
<td>Nurse Student</td>
<td>0.015%</td>
</tr>
<tr>
<td>Analyst</td>
<td>0.006%</td>
</tr>
<tr>
<td>Social Work</td>
<td>0.002%</td>
</tr>
</tbody>
</table>
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1. Introduction

CareLink is the new physician order-entry system at the University of Michigan Health System (UMHS) that was implemented from 2007 to 2008. CareLink allows clinicians to place and process patient care orders, such as medication, dietary orders, and lab tests, electronically. Electronic processing of medication orders enables UMHS to improve patient safety by reducing medication errors and risk associated with handling of paper orders. Electronic ordering over CareLink also reduces the process times for placing orders. In addition, the nature of the clerical workload has changed significantly since the implementation of CareLink, and the Central Staffing Resource Department believes that the current scheduling of clerks should be re-optimized to minimize redundancy and allow the sharing of clerical resources in adjacent units. Therefore, the Central Staffing Resource Department would like to quantify the proportion of time that clerks spend on each task to better schedule and allocate clerical resources.

The Central Staffing Resource Department from the UMHS has asked the team to quantify and determine the impact of the implementation of CareLink on clerical workload in the inpatient units. The purpose of this project is to quantify the unit clerks’ daily workload and analyze the impact of CareLink by comparing the team’s findings with previous studies on clerical workload before the implementation of CareLink. The team has completed data collection of the clerks’ workload, compared the findings to previously completed studies on the clerks’ workload before the implementation of CareLink, and used the result of the analyses to develop conclusions and make recommendations on scheduling of clerks. This report includes the team’s findings, conclusions, and recommendations for this project, as well as the supporting documents.

2.0 Background

Currently all of the inpatient units at the University Hospital (UH) have at least one clerk on duty at all times. The unit clerks perform tasks that include processing patient care orders, now handled by CareLink, and handling daily transfers, discharges and admissions. In June 2007, an electronic order entry system named CareLink was implemented in inpatient units within Obstetrics, Neonatal Intensive Care Unit, and C.S. Mott Children’s Hospital. CareLink was expanded to include the University Hospital and the Cardiovascular Center (CVC) in April of 2008.

Before the implementation of CareLink, unit clerks had to complete multiple copies of paper forms before sending them to multiple destinations. This process was time consuming and unreliable as paper orders took a long time to be sent to another department. Furthermore, losses in transit and clerical errors resulted in delays and safety concerns. Electronic ordering via CareLink allows the clerks to quickly complete multiple forms and eliminates the risk of misplaced orders associated with the paper forms due to the multiple “hand offs” of information
between departments. Physicians and nurses can enter medical orders directly into CareLink, bypassing the clerks all together. In this case, CareLink automates the order process and ensures that orders are sent to the correct department. Additionally, the implementation of electronic ordering through CareLink has significantly reduced the amount of time that a clerk had previously spent to complete numerous copies of hardcopy forms (see Appendix D).

Currently, the workload for unit clerks after the implementation of CareLink at UH has not been quantified. As such, there is concern that the current scheduling of the unit clerks does not reflect a unit’s true demand for clerical staff. Quantifying the clerks’ workload will allow Central Staffing Resources Department to better allocate clerks to units according to the units’ workload volume.

The main purpose of this project is to quantify the daily workload of the unit clerks after the implementation of CareLink. Also, as part of this project, the results of the post-CareLink analysis will be compared to previous studies on clerical workload that were done on similar units before the implementation of CareLink. The direct comparison of clerical workload post-CareLink against their workload pre-CareLink will allow University Hospital (UH) to better understand the changes in order processing times after the implementation of CareLink. In addition, the analysis of the current unit clerks’ daily workload will assist UH in assigning clerical staff to the various units more efficiently.

The units included in the ongoing study are 4A, 4B, 4B/C, 5C, 5D, 8A, 8B, 8C and CVC5. All of the units in the study, with exception of CVC5, were part of a pre-CareLink clerical workload study completed in 2004. Therefore, studying these units again will make this analysis of changes in clerical workload before and after the implementation of CareLink appropriate. Cardiovascular Center (CVC) is a recent addition to the University of Michigan Health System, and its clerical workload has not been studied previously. Therefore, CVC5 was requested to be included in this study to quantify the clerical workload at CVC.

2.1 Key Issues

The following key issues are driving the need for the project:

- Nature of the clerical workload has changed since the implementation of CareLink and current clerks’ workloads have not been quantified
- A better understanding of the unit clerks’ daily workload is needed to better schedule clerical staff in the future

2.2 Goals and Objectives

The primary goals of the project are to:

- Quantify the fraction of time unit clerks spend on each task during the day
- Determine the time required to complete common clerical tasks
- Determine the impact of CareLink on order processing time by comparing the current time required to complete ordering tasks against pre-CareLink ordering times.
The objectives of the project are to:
- Observe and document daily tasks of unit clerks
- Interview unit clerks regarding their daily work
- Set up and conduct random beeper sampling to determine the time commitment required for daily tasks in the selected units
- Analyze and compare collected data to pre-CareLink studies to determine the impact of CareLink on clerical workload

2.3 Project Scope
The scope of this project includes:
- Collection of data on clerical workload from units 4A, 4B, 4B/C, 5C, 5D, 8A, 8B, 8C and CVC5
- Analysis on clerical workload studies done prior to the implementation of CareLink
- Comparison of pre-CareLink and post-CareLink workload studies (see Work Cited page at the end of this report)

The scope of this project excludes:
- A workload analysis of any hospital staff other than clerks from the list of units above
- Analysis of roles and duties of clerks in emergency situations, such as patient death

3.0 Project Methodology
This section details the methodology used by the team throughout the course of this project. The methodology used is divided into the following main sections:
- Data collection
- Data Validation
- Data Analysis

3.1 Data Collection
The team spent a total of 6 weeks, from Feb 9th 2009 to Mar 23rd 2009 collecting data on for the project. The collection of data can be divided into the following sections:
- Perform literature search and extract historical data
- Observe clerical tasks
- Perform workload sampling study
- Obtain and extract CareLink order data
- Perform time study
3.1.1 Perform literature search and extract historical data
The team conducted a literature search and extracted relevant data from the written reports of previous studies done on clerical workload before and after the implementation of CareLink. These studies and the data contained within them will enable the team to validate data collected in workload sampling study and compare pre-CareLink and post-CareLink workload time metrics. The studies cited are listed in the “Work Cited” section at the end of this report.

The data extracted from the pre-CareLink studies include the fraction of time clerks spent on each task before the implementation of CareLink and time study data of common clerical tasks. This information will be essential in the comparison of the pre-CareLink and post-CareLink workload time metrics. The post-CareLink study of Mott’s Children Hospital (Jensen & Brubaker, 2008) provides a sample of the post-CareLink clerical workload proportions. The workload proportions provided in these reports enabled the team to develop the task log sheet used by the clerks to record their daily tasks in the workload sampling study.

3.1.2 Observe clerical tasks
During the first week of data collection, the team shadowed the unit clerks and observed them in their daily routine. Members of the project team sat at the clerical work stations to watch clerks perform their duties and asked questions regarding their tasks and processes to gain a better understanding of their daily activities. These observations allowed the team familiarize themselves with the common clerical tasks so that the team could create the task log sheet as mentioned in the previous section.

3.1.3 Perform workload sampling study
The team carried out a workload sampling study on the unit clerks. This self-sampling study consisted of assigning each unit clerk with a specially programmed beeper which would go off at random times. When the beeper goes off, the clerk would then note down on a specially designed workload task log sheet their current primary activity. This particular method of study was chosen as the large number of units that was included in the study, and the relatively short timeline, meant that direct observation of the all the units was not possible. This study would allow us to better understand the proportion of time that the clerks spent on each task during a regular working shift. During discussions with our project coordinator, Robert Beasley, the team decided to only collect primary activities to obtain a representative data sample.

In preparation for the workload sampling study, the team designed the task log sheet for the clerks to record the type of task they are performing. The task log sheet contains main clerical tasks noted in the team’s observation of clerk’s daily tasks and those given in the previous studies. The task log sheet also allows for clerks to write in miscellaneous tasks not specified in the sheet. The task log sheet separates the task data records by hours so that the team can stratify
the data in the analysis phase. Along with the task log sheet, the team provided an instruction sheet to help the clerks understand how the beeper functions and how to properly record data. A sample of the task log sheet can be found in Appendix A.

After discussions with the client and our coordinator, the team decided to conduct the workload sampling for each unit for one week. This was decided on after taking into consideration time restrictions and possibility for problems to occur during data collection. To efficiently use the limited beepers that were available, the team also designed a staggered schedule to carry out the workload sampling study at the various units.

The workload sampling study took place on each unit, on every shift, and every day for 1-week time period. A pre-programmed beeper, set to activate randomly on average 4 times an hour, along with a task log sheet was given to the one clerk in each of the units being studied. The clerk must carry the beeper at all times while on shift. The team instructed the clerk to pass the beeper and the task log sheet to next shift’s clerk at end of each shift. Each time the beeper went off, the clerk would then mark down the specific task that he was performing at that time on the provided task log sheet.

3.1.4 Obtain and extract CareLink data

While the workload sampling study was taking place, the team reached out to Tommy Fung, Application Systems Analyst of UMHS Medical Center Information Technology Department, to obtain order entry data from CareLink database. Application Systems Analysts provided the team with CareLink database’s records of all orders entered through CareLink in all of the units within the scope of this project during the last week of February and the entire month of March. From the unprocessed data, the team extracted data records of each unit during the time frame when the workload sampling study took place in that unit. The team also merged order category labels in each data field so that they match the categories used in the task log sheet in the workload sampling study. For example, the team combined seven different medication and pharmacy categories (general medication, anti-infective medication, pain management medication, etc) into one category, “medication/pharmacy orders”. The extracted data was then used in the data analysis phase of the project to supplement the workload sampling study data.

3.1.5 Perform time study

Following the completion of the workload sampling study, the team observed the clerks on morning and afternoon shifts in each unit for one hour each. Overall, the team performed a total of 20 hours of direct observations on the clerks after the completion of workload sampling study. During these observations, the team members noted each task performed by the clerks and recorded the time taken to perform these tasks. At the completion of the time study, the tasks were categorized and the times are compiled to find the average time required to complete common clerical tasks.
3.2 Data Validation

The team must validate the workload sampling data and the time study data before analyzing the collected data. The collected data have to be representative of the underlying real-world system and processes to be valid. First the team validated the collected time study data against the post-CareLink time study data collected in August, 2008 in C.S. Mott Children’s and Women’s Hospital (Jensen & Brubaker, 2008). Then the team compared the workload sampling proportions data to the work proportions calculated using the collected time study data.

3.2.1 Validate time study data

The mean, standard deviation, and the confidence interval were calculated from the collected time study data and compared them to historical data (Jensen & Brubaker, 2008) where applicable. Most of the historical average mean times fall within the range of the 95% confidence interval of the time study data that the team collected, and the only exception is time for paging task. This difference could be a result of different methodology between the collection of historical data and current time study data. Because most of the data are very similar to historical post-CareLink data, the team can conclude that the time study data are validated. A summary of the comparison done can be found in table 1 below.

Table 1: Comparison of collected time study data against historical pre-CareLink time study data

<table>
<thead>
<tr>
<th></th>
<th>No. of observations</th>
<th>Collected time study data</th>
<th>Historical data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean time (s) Stdev</td>
<td>95%CI LCL</td>
</tr>
<tr>
<td>Phone</td>
<td>90</td>
<td>36.9 34.3 29.9 44.0</td>
<td>175 32</td>
</tr>
<tr>
<td>Paging</td>
<td>43</td>
<td>20.1 10.2 17.1 23.2</td>
<td>64 30</td>
</tr>
<tr>
<td>Reception</td>
<td>11</td>
<td>39.3 34.2 19.0 59.5</td>
<td>39 40</td>
</tr>
<tr>
<td>Staff assistance</td>
<td>28</td>
<td>79.2 78.7 50.0 108.4</td>
<td>44 67</td>
</tr>
<tr>
<td>Admission</td>
<td>6</td>
<td>95.8 42.0 62.2 129.4</td>
<td>7 80</td>
</tr>
<tr>
<td>Discharge</td>
<td>9</td>
<td>154.0 67.4 110.0 198.0</td>
<td>2 170</td>
</tr>
<tr>
<td>Transfer</td>
<td>2</td>
<td>140.0 77.8 32.2 247.8</td>
<td>-- --</td>
</tr>
<tr>
<td>Open charts/label</td>
<td>5</td>
<td>185.0 67.8 125.6 244.4</td>
<td>6 211</td>
</tr>
<tr>
<td>Close charts</td>
<td>8</td>
<td>225.6 80.1 170.1 281.1</td>
<td>4 216</td>
</tr>
<tr>
<td>Chart maint</td>
<td>9</td>
<td>169.6 179.3 52.4 286.7</td>
<td>15 147</td>
</tr>
<tr>
<td>Diet order</td>
<td>33</td>
<td>59.6 44.3 44.5 74.7</td>
<td>15 52</td>
</tr>
<tr>
<td>Mats services</td>
<td>16</td>
<td>98.7 126.3 36.8 160.6</td>
<td>31 75</td>
</tr>
<tr>
<td>Patient transport</td>
<td>7</td>
<td>61.4 24.1 43.6 79.3</td>
<td>-- --</td>
</tr>
<tr>
<td>Med order</td>
<td>2</td>
<td>95.5 36.1 45.5 145.5</td>
<td>-- --</td>
</tr>
<tr>
<td>Ilb order</td>
<td>2</td>
<td>47.5 10.6 32.8 62.2</td>
<td>-- --</td>
</tr>
<tr>
<td>OR form</td>
<td>2</td>
<td>105.5 62.9 18.3 192.7</td>
<td>-- --</td>
</tr>
<tr>
<td>Blood-work</td>
<td>4</td>
<td>86.3 40.9 46.2 126.3</td>
<td>-- --</td>
</tr>
<tr>
<td>Check CareLink</td>
<td>69</td>
<td>14.9 11.2 12.3 17.6</td>
<td>50 15</td>
</tr>
<tr>
<td>Search for personnel</td>
<td>4</td>
<td>107.8 58.1 50.8 164.7</td>
<td>-- --</td>
</tr>
<tr>
<td>Edit nurse paging list</td>
<td>2</td>
<td>222.0 26.9 184.8 259.2</td>
<td>6 285</td>
</tr>
<tr>
<td>Call light</td>
<td>8</td>
<td>13.1 7.1 8.2 18.0</td>
<td>65 14</td>
</tr>
<tr>
<td>Census</td>
<td>1</td>
<td>75.0 -- -- --</td>
<td>8 78</td>
</tr>
</tbody>
</table>

*Data source: Time study (Mar, 09) and Mott time study (Jul, 2008) (Jensen & Brubaker, 2008)
3.2.2 Validate workload sampling study
To ensure quality of the self-collected data for workload sampling study, team members went to the units at regular intervals to check that the clerks were correctly collecting data for the workload sampling study. After the completion of workload sampling study, the team conducted direct observations and a time study of the clerks to validate the data collected from the workload sampling study. For this validation, the clerks’ duties into the following task groups:

- Administrative duties (phone, paging, receptionist duties)
- Patient movement (admission, discharge, transfer)
- Charts (open chart, close chart, chart maintenance)
- Orders

The team then did a direct comparison of the workload sampling study data against the observed data from the time study. The results of the data validation can be seen in table 2.

<table>
<thead>
<tr>
<th></th>
<th>Workload Sampling Data</th>
<th>Observational Data</th>
<th>95% CI LCL</th>
<th>95% CI UCL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>Proportion</td>
<td>Observations</td>
<td>Proportion</td>
<td>Std. Dev.</td>
</tr>
<tr>
<td>Administrative</td>
<td>1403</td>
<td>170</td>
<td>33.02%</td>
<td>29.41%</td>
</tr>
<tr>
<td>Patient movement</td>
<td>638</td>
<td>17</td>
<td>10.87%</td>
<td>8.53%</td>
</tr>
<tr>
<td>Charts</td>
<td>609</td>
<td>20</td>
<td>19.47%</td>
<td>14.84%</td>
</tr>
<tr>
<td>Orders</td>
<td>1422</td>
<td>117</td>
<td>19.32%</td>
<td>16.84%</td>
</tr>
</tbody>
</table>

*Data source: Workload sampling study (Feb-Mar, 09) and time study (Mar, 09)

Table 2 above shows that the workload sampling proportions are within or close to the 95% confidence interval of the observational proportions, with the exception of orders. The difference in proportion of times spent on orders may have been caused by some self-collection bias. The team cannot calculate the confidence interval of the workload sampling proportions because the workload sampling study does not provide the team with variance of the data collected. The mean of the workload sampling proportions are close enough to the 95% confidence interval of the observational data that the team can conclude that the 95% confidence interval of the two data sets would overlap, and thus the team can conclude that the workload sampling data is valid for our analysis.

3.3 Data Analysis
The primary goal of the team’s data analysis was to quantify and present the effect of CareLink on the workload of clerks. The team’s approach was to break the data analysis into three sections as follows:

- Analysis of task proportions and workload distribution
- Analysis of CareLink orders
- Analysis of order processing times
The results and findings of the data analysis section will be detailed in the Findings section of this report.

3.3.1 Analysis of task proportions and workload distribution

The team first converted the booklets of task log sheets compiled during the workload sampling study into data sheets in Microsoft Excel. Then the team summarized and stratified the data by task to find proportions of clerks’ time spent on each task. The data is then further stratified by unit to compare the differences among the units in this project. To compare the data with pre-CareLink workload distribution metrics, the team combined tasks into the following groups:

- Administrative duties (phone, paging, receptionist)
- Patient movement (admission, discharge, transfer)
- Orders (processing various orders)
- Charts (new charts, close charts, chart maintenance)
- Miscellaneous

3.3.2 Analysis of CareLink orders

The team compiled the unprocessed CareLink orders data (from 17th Feb 2009 to 18th Mar 2009) into a Microsoft Access database to analyze the orders data by various stratifications, such as units, order type, and origin of order (physician, nurses, etc). The data in this analysis were again stratified into similar task groups that were used in the workload distribution analysis. The task groups are as follows: Post-op Orders, Resuscitation Orders, Movement, Diet, Diagnostics, Physician Orders, Medication Orders, Medication and Laboratory.

The team used the CareLink orders data for two separate analyses. The first analysis of the CareLink orders data was to pull out orders data from the time periods where the respective units were undergoing the Workload Sampling Study. This data was then broken down into the various task groups as per the Workload Sampling Study. This analysis would serve to understand the proportions of each type of orders that are placed by the units via CareLink.

For the second analysis, the team decided to study the entire CareLink order data to find trends from whom the bulk of the orders were being initiated from. Typically, orders placed via CareLink are not initiated from the clerks as the clerks do not have the necessary clearance to do so. However, each order sent out by the unit is sent to the clerk for follow up purposes. This analysis will then allow us to find out which group of personnel is placing the most orders via CareLink.
3.3.3 Analysis of order processing times
The team used the workload sampling study data and the CareLink order data to find the time taken by the clerks to perform each order type. To achieve this, the team re-evaluated the workload distribution analysis and calculated the amount of time that clerks spent on each task in a period of 7 days by multiplying the proportion of time spent on each task and the total time clerks were on staff in one workweek. This was compared to the frequency of each order type in CareLink orders data, which were also scaled down to represent the number of orders processed by the clerks during one workweek. Using these two data sets, the team was able to calculate the average time it takes to process each type of order.

4.0 Findings and Conclusions
The following section provides a detailed breakdown of the findings obtained during the team’s analysis, which were divided into four main sections; the workload distribution study, Carelink orders data analysis, Carelink orders initiation source analysis and order process time calculations.

4.1 Workload Distribution Results
The team performed a workload distribution study to analyze the impact of CareLink on the amount of time that clerks were dedicating to each task that they were required to perform. Previous studies were also obtained, and a comparison was made between the team’s post-Carelink study and the existent pre-Carelink study results. As seen in Figure 1 below, CareLink has reduced the proportion of time that clerks spend working on orders from 51% to 29%. This has resulted in a more even distribution of the clerk’s time, which is now spread more evenly across the remaining fields. The tasks which now occupy more of the clerks’ time are phone calls and other administrative duties, movement (consists of admission, transfer and discharge processes) and miscellaneous tasks. Additionally, a reduction of time spent on charts from 13% to 12% was observed. Based on interviews and observation, some clerks considered preparing new patient charts and close charts as part of admission and discharge processes, resulting in a lower reported value.
The team also stratified the data by unit in order to observe inter-unit variation. Figure 2 below is a percentage based graph that shows the distribution of workload in similar format to the previous pie charts of Figure 1.

*Data source: Workload sampling study (Feb-Mar, 09) and workload distribution (Edwards, Kakarala, Raschke, & Sehgal, 2004)
By observation, there appears not to be any large difference in workload between each of the units. To further verify this, the individual unit data was tested at 95% confidence. As shown in Table 3 below, proportions for phone and administrative duties, orders, and meals fall within the confidence limits for most units, with the exception of a few outliers. For charts and miscellaneous duties, it was observed that proportions for many units fell outside the confidence interval. This can be attributed to the discrepancy in data collection that was mentioned earlier, as some clerks record some chart-related tasks as miscellaneous duties.

Table 3: Workload distribution by unit for workload sampling study period

<table>
<thead>
<tr>
<th>Unit</th>
<th>Phone/Admin</th>
<th>Movement</th>
<th>Orders</th>
<th>Charts</th>
<th>Meals</th>
<th>Misc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4A</td>
<td>31.8%</td>
<td>20.9%</td>
<td>21.1%</td>
<td>14.3%</td>
<td>0.4%</td>
<td>11.4%</td>
</tr>
<tr>
<td>4B</td>
<td>33.3%</td>
<td>18.0%</td>
<td>19.8%</td>
<td>11.7%</td>
<td>2.9%</td>
<td>14.3%</td>
</tr>
<tr>
<td>4BC</td>
<td>31.6%</td>
<td>18.6%</td>
<td>27.4%</td>
<td>12.2%</td>
<td>1.9%</td>
<td>8.2%</td>
</tr>
<tr>
<td>4C</td>
<td>31.1%</td>
<td>17.0%</td>
<td>29.6%</td>
<td>14.3%</td>
<td>1.0%</td>
<td>7.0%</td>
</tr>
<tr>
<td>5C</td>
<td>27.5%</td>
<td>14.0%</td>
<td>24.2%</td>
<td>15.5%</td>
<td>2.3%</td>
<td>16.4%</td>
</tr>
<tr>
<td>5D</td>
<td>27.2%</td>
<td>8.2%</td>
<td>37.7%</td>
<td>6.5%</td>
<td>3.8%</td>
<td>16.5%</td>
</tr>
<tr>
<td>8A</td>
<td>26.1%</td>
<td>13.5%</td>
<td>18.0%</td>
<td>16.2%</td>
<td>2.7%</td>
<td>23.4%</td>
</tr>
<tr>
<td>8B</td>
<td>30.9%</td>
<td>8.9%</td>
<td>22.7%</td>
<td>13.7%</td>
<td>2.5%</td>
<td>21.3%</td>
</tr>
<tr>
<td>8C</td>
<td>27.3%</td>
<td>11.7%</td>
<td>32.0%</td>
<td>20.3%</td>
<td>3.1%</td>
<td>5.5%</td>
</tr>
<tr>
<td>CVC5</td>
<td>24.2%</td>
<td>7.1%</td>
<td>34.8%</td>
<td>14.3%</td>
<td>3.1%</td>
<td>16.5%</td>
</tr>
<tr>
<td>Cumulative</td>
<td>28.8%</td>
<td>12.5%</td>
<td>28.9%</td>
<td>12.4%</td>
<td>2.6%</td>
<td>14.9%</td>
</tr>
<tr>
<td>95% LCL</td>
<td>25.6%</td>
<td>9.1%</td>
<td>24.1%</td>
<td>9.9%</td>
<td>1.8%</td>
<td>10.6%</td>
</tr>
<tr>
<td>95% UCL</td>
<td>31.9%</td>
<td>15.9%</td>
<td>33.6%</td>
<td>15.0%</td>
<td>3.3%</td>
<td>19.1%</td>
</tr>
</tbody>
</table>

*Data source: Workload sampling study (Feb-Mar, 09)*

In addition to the previous analysis, the team also stratified order data by order type. As seen in Figure 3 below, most the time spent by clerks on orders is focused on physician, movement and diet orders, which account for 44%, 34% and 16% of total order processing time respectively. A much smaller proportion of time is spent on the remaining diagnostic, medication, laboratory and post-op orders.
4.2 CareLink Orders Data Analysis Results

To ensure that the collected data is relevant for comparison to the other studies in this project, the time period from which the data was extracted from corresponds to the same time period for which the unit was being studied. As these time periods which the units were being studied varied in length, the data was corrected to represent the frequency of orders placed in one week. Table 4 below shows a summary of the results and figure 4 below shows a graphical representation of the analysis. A more detailed breakdown of order frequency by unit can be found in Appendix E.
Table 4: Frequency of Orders in one week, by unit

<table>
<thead>
<tr>
<th></th>
<th>Laboratory</th>
<th>Medication</th>
<th>Physician Orders</th>
<th>Diagnostics</th>
<th>Diet</th>
<th>Movement</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>4A</td>
<td>845</td>
<td>750</td>
<td>571</td>
<td>203</td>
<td>127</td>
<td>82</td>
<td>2578</td>
</tr>
<tr>
<td>4B</td>
<td>496</td>
<td>429</td>
<td>353</td>
<td>103</td>
<td>81</td>
<td>48</td>
<td>1510</td>
</tr>
<tr>
<td>4BC</td>
<td>1609</td>
<td>1444</td>
<td>1063</td>
<td>336</td>
<td>275</td>
<td>135</td>
<td>4862</td>
</tr>
<tr>
<td>5C</td>
<td>1297</td>
<td>1129</td>
<td>737</td>
<td>206</td>
<td>205</td>
<td>82</td>
<td>3655</td>
</tr>
<tr>
<td>5D</td>
<td>2928</td>
<td>1120</td>
<td>1318</td>
<td>217</td>
<td>144</td>
<td>86</td>
<td>5814</td>
</tr>
<tr>
<td>8A</td>
<td>1710</td>
<td>885</td>
<td>613</td>
<td>142</td>
<td>87</td>
<td>35</td>
<td>3472</td>
</tr>
<tr>
<td>8B</td>
<td>2610</td>
<td>964</td>
<td>858</td>
<td>204</td>
<td>133</td>
<td>76</td>
<td>4844</td>
</tr>
<tr>
<td>8C</td>
<td>1171</td>
<td>901</td>
<td>654</td>
<td>205</td>
<td>211</td>
<td>107</td>
<td>3249</td>
</tr>
<tr>
<td>CVC5</td>
<td>1338</td>
<td>926</td>
<td>482</td>
<td>177</td>
<td>135</td>
<td>110</td>
<td>3167</td>
</tr>
<tr>
<td>Total</td>
<td>14003</td>
<td>8549</td>
<td>6649</td>
<td>1793</td>
<td>1397</td>
<td>760</td>
<td></td>
</tr>
</tbody>
</table>

min 496 429 353 103 81 35 1510
max 2928 1444 1318 336 275 135 5814
average 1556 950 739 199 155 84 3683
stdev 784 279 300 63 63 31 1310
95 lcl 20 403 151 75 31 24 1117
95 ucl 3092 1497 1327 324 279 144 6250

*Data source: CareLink database records (Feb-Mar, 09)

From the table 4 above and figure 3 above, the number of orders placed by each unit through CareLink varies greatly across the units, with 4BC, 5D and 8B placing the highest number of orders each week. The team next used the proportion of orders to observe trends in the type of orders placed by each unit. Figure 5 below shows the proportion of total orders placed each week by all the units.
From the figure 5 above, Laboratory Orders, Medication Orders and Physician Orders make up the bulk of orders placed each week, with these three types of orders making up almost 90% of total orders. To get a better understanding of order distribution by unit, the team stratified the data by unit. Table 5 and figure 6 below shows the results.

Table 5: Proportion of orders type each week, by unit

<table>
<thead>
<tr>
<th></th>
<th>Movement</th>
<th>Physician Orders</th>
<th>Laboratory</th>
<th>Medication</th>
<th>Diagnostics</th>
<th>Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>4A</td>
<td>3%</td>
<td>22%</td>
<td>33%</td>
<td>29%</td>
<td>8%</td>
<td>5%</td>
</tr>
<tr>
<td>4B</td>
<td>3%</td>
<td>23%</td>
<td>33%</td>
<td>28%</td>
<td>7%</td>
<td>5%</td>
</tr>
<tr>
<td>4BC</td>
<td>3%</td>
<td>22%</td>
<td>33%</td>
<td>30%</td>
<td>7%</td>
<td>6%</td>
</tr>
<tr>
<td>5C</td>
<td>2%</td>
<td>20%</td>
<td>35%</td>
<td>31%</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>5D</td>
<td>1%</td>
<td>23%</td>
<td>50%</td>
<td>19%</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>8A</td>
<td>1%</td>
<td>18%</td>
<td>49%</td>
<td>25%</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>8B</td>
<td>2%</td>
<td>18%</td>
<td>54%</td>
<td>20%</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>8C</td>
<td>3%</td>
<td>20%</td>
<td>36%</td>
<td>28%</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>CVC5</td>
<td>3%</td>
<td>15%</td>
<td>42%</td>
<td>29%</td>
<td>6%</td>
<td>4%</td>
</tr>
</tbody>
</table>

*Data source: CareLink database records (Feb-Mar, 09)

Sample size = 33151
Table 5 above shows that the average proportion of the various orders for each unit falls within a 95% confidence interval. It is thus safe to conclude, to 95% accuracy, that the proportion of orders placed is similar across all units. This can also be seen graphically in figure 6 above, which breaks down the order proportion by unit and order type. A more detailed description of the frequency and proportion of orders per week, stratified by unit, can be found in Appendix E and Appendix F respectively.

4.3 CareLink Orders Initiation Source Analysis Results
In the second analysis done on the CareLink data, the team extracted CareLink data from the time period 17th Feb to 18th Mar 2009. An analysis was then conducted to gain a better understanding on from whom the orders placed via CareLink was being initiated. Figure 7 below shows the distribution of from whom the CareLink orders is being initiated from.
From figure 7 above, Physicians, Physician Assistants, Nurses and Advance Practice Nurses place the bulk of orders via CareLink. These four groups of people initiate up to 95% of the orders placed via CareLink. Table 6 below shows a more detailed breakdown of who initiates the orders placed via CareLink.

**Table 6: Proportion of order initiation source**

<table>
<thead>
<tr>
<th>Source</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician</td>
<td>56.983%</td>
</tr>
<tr>
<td>Nurse</td>
<td>16.581%</td>
</tr>
<tr>
<td>Physician Assistant</td>
<td>15.246%</td>
</tr>
<tr>
<td>Advanced Practice Nurse</td>
<td>7.308%</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>1.243%</td>
</tr>
<tr>
<td>Dietitian</td>
<td>1.222%</td>
</tr>
<tr>
<td>Allied Health Tech</td>
<td>0.488%</td>
</tr>
<tr>
<td>Med Student</td>
<td>0.384%</td>
</tr>
<tr>
<td>Therapist</td>
<td>0.261%</td>
</tr>
<tr>
<td>Clerk</td>
<td>0.202%</td>
</tr>
<tr>
<td>Research Staff</td>
<td>0.040%</td>
</tr>
<tr>
<td>Scheduling Clerk</td>
<td>0.019%</td>
</tr>
<tr>
<td>Nurse Student</td>
<td>0.015%</td>
</tr>
<tr>
<td>Analyst</td>
<td>0.006%</td>
</tr>
<tr>
<td>Social Work</td>
<td>0.002%</td>
</tr>
</tbody>
</table>

*Data source: CareLink database records (Feb-Mar, 09)*
From table 5 above, the proportion of orders that are initiated via clerks in the period 17th Feb 2009 to 18th Mar 2009 is only 0.2% of the total orders. This seems to be in direct contrast to the findings from the workload sampling study findings which indicated that the clerks spent roughly 40% of their workday on orders and patient movement. This trend is also seen when the data is stratified by unit. (A more detailed breakdown of the orders initiation source by unit can be found in Appendix G). However, through our time studies and interviews with clerks, the team found that although clerks do not initiate the bulk of the orders, all orders still pass though the clerks’ desk and the clerks still have to follow up on certain orders. The team thus reconciles that the clerks now spend about 30% of their workday following up on orders.

In summary, clerks now spend more time following up on orders instead of filling up paper orders, which indicates greater time spend on the ‘value added’ portion of orders. As the type of orders requiring follow up action is not currently known, the team recommends that a further study be done on which type of orders require follow up action by the clerks and the times required to act on them. This study will serve to better identify areas for improvement.

4.4 Order Process Time Results

Table 7 below shows the comparison of average order processing time from a Pre-CareLink time study, result calculated from the workload sampling and CareLink data, and the team’s team study.

Table 7: Comparison of Average Time Spent Processing Each Order

<table>
<thead>
<tr>
<th>Orders Data (All Orders)</th>
<th>Sample Size</th>
<th>Average Time Per Order (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Study</td>
<td>662</td>
<td>53.10</td>
</tr>
<tr>
<td>Calculated Data</td>
<td>31,073</td>
<td>34.69</td>
</tr>
<tr>
<td>Time Study Data</td>
<td>117</td>
<td>34.05</td>
</tr>
</tbody>
</table>

*Data sources: pre-study data (Beauchamp, Frank, Miller, & Palsson, 2004), calculated data from Workload sampling study (Feb-Mar, 09) and CareLink database records (Feb-Mar, 09), and time study (Mar, 09)

Table 7 above shows that the current-state data matches the data from the time study. In addition, the current-state shows an improvement over the Pre-CareLink data.

Next, the team stratified the orders by order type and also included patient movement data (admission, discharge, and transfer). Figure 8 below shows results of this analysis for the current-state while Figure 8 below shows the times taken to perform the tasks listed pre-CareLink. The data from Figure 9 is taken from the pre-CareLink clerical order processing study (Beauchamp, Frank, Miller, & Palsson, 2004).
Comparing figure 8 and 9 above, the process time of patient movement orders appears to take longer in the current-state than the pre-study time. This was expected since the methodology in the pre-study only take account the time taken to process the paper admission, discharge and transfer forms. The current-state data accounts for also the time takes to open and close charts,
preparing discharge envelop, and create labels in the admission, discharge, and transfer processes. For the rest of order types, only diet orders (the team cannot prove they are statistically significantly different) take longer in the current-state than the time in the pre-study. From the above findings, the team can conclude that the order processing time has decreased since the implementation of CareLink and with the move from paper-based forms to electronic order processing. A more detailed breakdown of the findings from the time study can be found in Appendix H

4.5 Summary of Conclusions
The implementation of CareLink had a significant impact on the composition of the clerks’ workload. The percentage of time spent on processing patient care orders has reduced from 51% to 29% (figure 1). This reduction is larger according to the team’s time study findings (table 1), to 19% (sample size = 117), and the difference in result can be caused by small time study sample size, instances of bias or ambiguity (an uncommon task that can be categorized in multiple ways) in self-collection, or both. The change in workload distribution was similar in all units studied (figure 2).

Proportions of each order type processed in all of the units that are part of this project are not statistically different, as shown in table 4 and figure 5. This is especially true on the units in floor 4. According to table 4, the proportions of each order type processed by 4A, 4B, 4BC, and 4C are almost identical.

The team also noted that although the clerks process (which requires at least reading the order on CareLink) every order sent to or from their unit, they only initiate 0.2% of all orders. Most orders are initiated by physicians and nurses.

The amount of time clerks spend on each order has drastically reduced from an average of 53 seconds per order before the implementation of CareLink to 35 seconds per order. The reduction in order processing time is seen in almost every order type. The one exception is diet orders, which are still sent by clerks over WebDoes.

5.0 Recommendations
Based on the conclusions of the study, the team has made the following recommendations.

5.1 Resource Sharing Between Units
The results of the CareLink order proportions study shows that all units handle similar compositions and proportions of order types. Since CareLink has significantly reduced order workload, it might be possible that clerical resources can be shared between units that are geographically close to each other. For example, 4A and 4B have similar order compositions
and lower order frequencies than other units, and they could be a test case for possible resource sharing.

The team recommends that a trial study of combining 4A and 4B units or other similar units. 4A and 4B should be the first units to undergo the trial study run because the combined order frequency of the two units is still lower than some individual units. The results of the studies should then be compared to current workload data in order to examine any improvement in resource utilization.

5.2 Recommended Future Studies
In light of the changes in the handling and processing of patient-care orders, there is a need to understand the types of orders that require the most attention. CareLink has reduced much of the non-value added order processing times, such as manually completing and routing multiple copies of the same order forms. Therefore, the team recommends an extensive study of the types of orders that clerks follow up on and the time spent doing so. As a suggestion the team believes that a lean based project, including detailed flow-charts and value-stream mapping would be ideal for a future study.
Works Cited


## Appendix A: Workload Task Sheet “cut-out”

<table>
<thead>
<tr>
<th>Time</th>
<th>0700h</th>
<th>0800h</th>
<th>0900h</th>
<th>1000h</th>
<th>1100h</th>
<th>1200h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receptionist</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paging / Telephone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Admit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharges</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physician Orders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Referral/Diagnostic Orders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmacy Orders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet Orders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Send out Lab Orders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post Op Orders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O.R. Charts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prep. New Patient Charts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closing Charts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chart Maintenance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meal Break</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix B: Current Common Task Descriptions

Admission:
- Input patient admit order information into CareLink
- Update flowboard for future and current admissions
- Compile chart for the anticipated admission
- Obtain CPI cards from admission
- Make labels for charts, patient door, and locator board
- Notify nurses of admission

Discharge:
- Notify nurses of discharge order unless clerks are told by nurse about the discharge
- Compile a discharge envelope with prescription, survey cards, and discharge navigator
- Schedule outpatient discharge appointments
- Remove patient from Mainframe system
- Close patient charts after discharge

CareLink Orders:
- Routine checking of order list page in CareLink system to spot flagged orders that require clerk’s attention.
  - Over 95% of the orders do not require further attention, clear flag in the order list
  - Other orders may require paging nurses, calling corresponding departments, printing slips, and preparing paper forms when signature is required.

Census:
- Record admissions, transfers, and discharges on paper unit census forms

Chart Maintenance:
- File patient paperwork in blue chart binder
- Organize paperwork in chart
- Remove old, unnecessary paperwork from chart
- Stamp patient paperwork with CPI identification cards

Diet Orders:
- Receive diet order instructions verbally from nurses or through CareLink
- Enter diet, tube feeding, or supplement orders into WebDOEs
- Make diet changes and additional food when necessary

Diagnostic Test Schedule:
• Schedule diagnostic test with appropriate department
• Follow up on scheduled time with department
• Arrange transportation for patient

Nurse Assignment List:
• Update physicians on call information and pager numbers on locator board
• Near the end of a shift, write a copy of nurse assignment list and pager numbers for the next clerk on duty
Appendix C: Pre-CareLink Process FlowCharts of Inpatient Clerical Tasks

Source: (Beauchamp, Frank, Miller, & Palsson, 2004)
Figure 3: Lab Orders

Pull Chart

- Note (date/time/initials)
- Pull lab requisitions
- Stamp requisition with CPI Card
- Fill out lab requisition

**STAT?**

- Page venipuncture/nurse (if STAT)
  - Put STAT sticker on form (if STAT)
- Place requisition in box for venipuncture/nurse

- Pink Copy → Pharmacy
- Hard Copy → Nurse

Replace Chart
Figure 4: D&T Orders
Figure 5: Admission Orders
Appendix E: Frequency of Orders per Week, by Unit

Figure 1: 4A - Frequency of Orders per week

Figure 2: 4B - Frequency of Orders per week
Figure 3: 4BC - Frequency of Orders per week

Figure 4: 5C - Frequency of Orders per week
Figure 5: 5D - Frequency of Orders per week

Figure 6: 8A - Frequency of Orders per week
Figure 7: 8B - Frequency of Orders per week

Figure 8: 8C - Frequency of Orders per week
Figure 9: CVC5 - Frequency of Orders per week
Appendix F: Proportion of Orders per Week, by Unit

Figure 1: 4A - Proportion of Orders per week

- Laboratory: 31%
- Medication: 27%
- Physician Orders: 23%
- Diagnostics: 9%
- Diet: 6%
- Movement: 4%

Figure 2: 4B - Proportion of Orders per week

- Laboratory: 34%
- Medication: 26%
- Physician Orders: 23%
- Diagnostics: 7%
- Diet: 6%
- Movement: 4%
Figure 3: 4BC - Proportion of Orders per week

- Laboratory: 32%
- Medication: 30%
- Movement: 5%
- Diet: 5%
- Diagnostics: 7%
- Physician Orders: 21%

Figure 4: 5C - Proportion of Orders per week

- Laboratory: 34%
- Medication: 30%
- Movement: 5%
- Diet: 6%
- Diagnostics: 6%
- Physician Orders: 19%
Figure 5: 5D - Proportion of Orders per week

- Laboratory: 50%
- Physician Orders: 21%
- Medication: 20%
- Movement: 2%
- Diet: 3%
- Diagnostics: 4%

Figure 6: 8A - Proportion of Orders per week

- Laboratory: 49%
- Physician Orders: 20%
- Medication: 23%
- Movement: 1%
- Diet: 3%
- Diagnostics: 4%
Figure 7: 8B - Proportion of Orders per week

- Laboratory: 47%
- Medication: 23%
- Physician Orders: 19%
- Diagnostics: 5%
- Movement: 2%
- Diet: 4%

Figure 8: 8C - Proportion of Orders per week

- Laboratory: 35%
- Medication: 29%
- Physician Orders: 20%
- Diagnostics: 7%
- Movement: 3%
- Diet: 6%
Figure 9: CVC5 - Proportion of Orders per week

Laboratory 42%

Medication 29%

Physician Orders 16%

Diagnostics 5%

Diet 4%

Movement 4%
Appendix G: Order Initiation Source by Unit

Figure 1: 4A – Order Initiation Source

Physician 71%

Advanced Practice Nurse 9%

Nurse 14%

Pharmacist 1%

Dietitian 2%

Physician Assistant 2%

Others 1%

Figure 2: 4B - Order Initiation Source

Physician 68%

Advanced Practice Nurse 7%

Nurse 14%

Med Student 2%

Dietitian 2%

Physician Assistant 6%

Others 1%
Figure 3: 4BC - Order Initiation Source

- Physician: 39%
- Nurse: 17%
- Physician Assistant: 39%
- Advanced Practice Nurse: 2%
- Dietitian: 1%
- Others: 2%

Figure 4: 5C - Order Initiation Source

- Physician: 68%
- Nurse: 10%
- Physician Assistant: 15%
- Advanced Practice Nurse: 3%
- Pharmacist: 2%
- Others: 2%
Figure 5: 5D - Order Initiation Source

Physician 60%

Nurse 33%

Physician Assistant 1%

Dietitian 1%

Others 3%

Figure 6: 8A - Order Initiation Source

Physician 40%

Advanced Practice Nurse 24%

Nurse 17%

Physician Assistant 15%

Dietitian 2%

Others 2%
Figure 7: 8B - Order Initiation Source

- Physician: 66%
- Nurse: 13%
- Physician Assistant: 17%
- Dietitian: 1%
- Pharmacist: 1%
- Others: 2%

Figure 8: 8C - Order Initiation Source

- Physician: 74%
- Nurse: 12%
- Physician Assistant: 9%
- Pharmacist: 2%
- Dietitian: 1%
- Others: 2%
Figure 9: CVC5 - Order Initiation Source

- Physician: 36%
- Advanced Practice Nurse: 30%
- Physician Assistant: 22%
- Nurse: 10%
- Dietitian: 1%
- Others: 1%
## Appendix H: Detailed Time Study Results

<table>
<thead>
<tr>
<th>Activity</th>
<th>count</th>
<th>min</th>
<th>max</th>
<th>avg</th>
<th>stdev</th>
<th>sum</th>
<th>percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone</td>
<td>89</td>
<td>3</td>
<td>205</td>
<td>37.19</td>
<td>10.11</td>
<td>3310</td>
<td>16.05%</td>
</tr>
<tr>
<td>Paging</td>
<td>42</td>
<td>8</td>
<td>48</td>
<td>20.23</td>
<td>10.09</td>
<td>850</td>
<td>4.12%</td>
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<tr>
<td>Reception</td>
<td>11</td>
<td>7</td>
<td>125</td>
<td>39.27</td>
<td>34.24</td>
<td>432</td>
<td>2.09%</td>
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<tr>
<td>Staff assistance</td>
<td>28</td>
<td>15</td>
<td>290</td>
<td>79.21</td>
<td>78.75</td>
<td>2218</td>
<td>10.76%</td>
</tr>
<tr>
<td>Admission (patient info only)</td>
<td>6</td>
<td>45</td>
<td>155</td>
<td>95.83</td>
<td>42.02</td>
<td>575</td>
<td>2.79%</td>
</tr>
<tr>
<td>Discharge (patient info &amp; discharge envelop)</td>
<td>9</td>
<td>45</td>
<td>225</td>
<td>154</td>
<td>67.40</td>
<td>1386</td>
<td>6.72%</td>
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<tr>
<td>Transfer</td>
<td>2</td>
<td>85</td>
<td>195</td>
<td>140</td>
<td>77.78</td>
<td>280</td>
<td>1.36%</td>
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<tr>
<td>Open charts/make label</td>
<td>4</td>
<td>175</td>
<td>245</td>
<td>212.5</td>
<td>33.04</td>
<td>850</td>
<td>4.12%</td>
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<tr>
<td>Close charts</td>
<td>7</td>
<td>150</td>
<td>320</td>
<td>234.29</td>
<td>62.28</td>
<td>1640</td>
<td>7.95%</td>
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<td>Chart maintenance</td>
<td>9</td>
<td>10</td>
<td>530</td>
<td>169.55</td>
<td>179.26</td>
<td>1526</td>
<td>7.40%</td>
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<tr>
<td>Diet order</td>
<td>34</td>
<td>15</td>
<td>173</td>
<td>59</td>
<td>45.91</td>
<td>2006</td>
<td>9.73%</td>
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<tr>
<td>Mats services</td>
<td>16</td>
<td>15</td>
<td>505</td>
<td>98.69</td>
<td>126.26</td>
<td>1579</td>
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<td>Patient transport</td>
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<td>95</td>
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<td>24.10</td>
<td>430</td>
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<tr>
<td>Med order</td>
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<td>60</td>
<td>121</td>
<td>90.5</td>
<td>43.13</td>
<td>181</td>
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<tr>
<td>Lab order</td>
<td>3</td>
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<td>43.33</td>
<td>28.43</td>
<td>130</td>
<td>0.63%</td>
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<tr>
<td>OR form</td>
<td>2</td>
<td>51</td>
<td>150</td>
<td>100.5</td>
<td>70.00</td>
<td>201</td>
<td>0.97%</td>
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<tr>
<td>Blood</td>
<td>4</td>
<td>30</td>
<td>125</td>
<td>86.25</td>
<td>40.90</td>
<td>345</td>
<td>1.67%</td>
</tr>
<tr>
<td>Check/process CareLink orders</td>
<td>72</td>
<td>4</td>
<td>65</td>
<td>15.57</td>
<td>10.93</td>
<td>1121</td>
<td>5.44%</td>
</tr>
<tr>
<td>Search for personnel</td>
<td>5</td>
<td>36</td>
<td>225</td>
<td>131.2</td>
<td>72.68</td>
<td>656</td>
<td>3.18%</td>
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<tr>
<td>Edit nurse paging list</td>
<td>3</td>
<td>200</td>
<td>285</td>
<td>242</td>
<td>42.51</td>
<td>726</td>
<td>3.52%</td>
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<tr>
<td>Call light</td>
<td>8</td>
<td>4</td>
<td>24</td>
<td>13.12</td>
<td>7.06</td>
<td>105</td>
<td>0.51%</td>
</tr>
<tr>
<td>Census</td>
<td>1</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>--</td>
<td>75</td>
<td>0.36%</td>
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<td>Total:</td>
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<td></td>
<td>2062</td>
<td>100.00%</td>
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</table>

*All data in seconds (s) other than count and percentage fields.*
Appendix I: Results of T-Tests on Workload Distribution Data

One-Sample T: Phone/Admin

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone/Admin</td>
<td>10</td>
<td>0.28767</td>
<td>0.02994</td>
<td>0.00947</td>
<td>(0.25627, 0.3191)</td>
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</table>

One-Sample T: Movement

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<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Movement</td>
<td>10</td>
<td>0.1249</td>
<td>0.0478</td>
<td>0.0151</td>
<td>(0.09067, 0.15907)</td>
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</tbody>
</table>

One-Sample T: Orders

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orders</td>
<td>10</td>
<td>0.2889</td>
<td>0.0668</td>
<td>0.0211</td>
<td>(0.2411, 0.3366)</td>
</tr>
</tbody>
</table>

One-Sample T: Charts

<table>
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<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charts</td>
<td>10</td>
<td>0.1243</td>
<td>0.0353</td>
<td>0.0112</td>
<td>(0.0991, 0.1496)</td>
</tr>
</tbody>
</table>

One-Sample T: Meals

<table>
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<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meals</td>
<td>10</td>
<td>0.02563</td>
<td>0.01021</td>
<td>0.00323</td>
<td>(0.01833, 0.03294)</td>
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</tbody>
</table>

One-Sample T: Misc.

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<th>Variable</th>
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<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Misc.</td>
<td>10</td>
<td>0.1486</td>
<td>0.0598</td>
<td>0.0189</td>
<td>(0.1058, 0.1914)</td>
</tr>
</tbody>
</table>
Appendix J: Workload Distribution by Unit

Figure 1: 4A – Workload Distribution

![Workload Distribution Chart](chart1)

Figure 2: 4B – Workload Distribution

![Workload Distribution Chart](chart2)
Figure 3: 4C – Workload Distribution

![Pie chart showing work sampling results with categories: Phone/Admin 32%, Movement 19%, Orders 27%, Charts 12%, Meals 2%, Misc. 8%]

Figure 4: 4BC – Workload Distribution

![Pie chart showing work sampling results with categories: Phone/Admin 31%, Movement 17%, Orders 30%, Charts 14%, Meals 1%, Misc. 7%]
Figure 5: 5C – Workload Distribution

![Work Sampling Results](image)

Figure 6: 5D – Workload Distribution

![Work Sampling Results](image)
Figure 7: 8A – Workload Distribution

Figure 8: 8B – Workload Distribution
Figure 9: 8C – Workload Distribution

Figure 10: CVC5 – Workload Distribution