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Executive Summary

The Respiratory Care Department in the Mott Children’s Hospital at the University of Michigan-Ann Arbor is a critical part to the entire health care team. The department worked with a previous Industrial and Operations Engineering project team to examine the time standards of therapists’ care procedures. To validate the previous team’s findings and get an accurate evaluation of the impact of winter months on therapists’ workload (the winter months bring more acute patients to the department, therapists’ workload might be increased), the IOE 481 project team was asked to conduct time studies to assess the therapists’ current workload. The collected times would be used to better calculate staff scheduling and determine the current level of care time on a per-patient basis.

The project team conducted time studies in three Intensive Care Units (ICU) - NICU or Holden (Neonatal ICU), PICU (Pediatric ICU), and PCTU (Pediatric Cardiothoracic Unit), as well as the General Care Area. We categorized our time study data into direct patient activities, indirect patient activities, and incidental time (break/lunch/non-activity time). Based on these three categories, we compared the data collected during different shifts (morning hours and afternoon hours), and the care time allocation on per-patient basis. Additionally, we developed time standards of individual tasks among direct patient activities and indirect patient activities according to our observations.

ICU Findings and Conclusions

The project team observed 80 hours of therapists’ activities in ICU. The average percentage of time allocation of each category is listed in Table 1. Except for the time allocation of each category in different units, we also found that therapists spent more time doing direct and indirect patient activities in the morning (87.7% of the total observation time) than in the afternoon (70% of the total observation time). Also during a 12-hour period, therapists allocated 2.75 hours of care time to each ventilator patient in the units, of which 2.25 hours were dedicated to direct and indirect patient activities. Furthermore, the top three time consuming direct patient activities are: Vent check with documentation, Patient assessment, and Suctioning; the top three (three most frequent ones) indirect patient activities are: Communication, Documentation, and Patient rounds/report.

Table 1. Time allocation in ICU (sample size: 80 hours)

<table>
<thead>
<tr>
<th>Activities</th>
<th>PICU</th>
<th>Holden</th>
<th>PCTU</th>
<th>All Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct patient activities</td>
<td>53%</td>
<td>56%</td>
<td>57%</td>
<td>55%</td>
</tr>
<tr>
<td>Indirect patient activities</td>
<td>32%</td>
<td>24%</td>
<td>26%</td>
<td>28%</td>
</tr>
<tr>
<td>Incidental time</td>
<td>15%</td>
<td>20%</td>
<td>17%</td>
<td>17%</td>
</tr>
</tbody>
</table>
General Care Area Findings and Conclusions

The project team observed 24 hours of therapists’ activities in General Care Area. The average percentage of time allocation of each category is listed in Table 2. As shown in Table 2, therapists spent equal time doing direct and indirect patient activities. Also during a 12-hour period, therapists allocated 0.71 hour of care time to each patient in General Care Area, of which 0.64 hours were dedicated to direct and indirect patient activities. Furthermore, the top three (three most frequent ones) direct patient activities in General Care Area are: Medication administration, Patient assessment, and Suctioning; the top three time consuming indirect patient activities are: Documentation, Communication, and Stocking/re-stocking of supplies and equipment.

Table 2. Time allocation in General Care Area (sample size: 24 hours)

<table>
<thead>
<tr>
<th>Activities</th>
<th>General Care Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct patient activities</td>
<td>45%</td>
</tr>
<tr>
<td>Indirect patient activities</td>
<td>45%</td>
</tr>
<tr>
<td>Incidental time</td>
<td>10%</td>
</tr>
</tbody>
</table>

Recommendations for Future Study

During the 5-week time studies in ICU and 2-week time studies in the General Care Area, we observed the variability of therapists’ time standards in different time of day (day shift and night shift), in different units (due to different patient acuities in different units), and in different day of week (weekdays and weekends). Therefore, we recommend the future project team to control above variables in their time study to gain more insights regarding time standards of therapists’ care tasks. Additionally, since we allocated time evenly to simultaneous tasks in any 5-minute interval in our time study, our results are only approximations if durations of simultaneous tasks differ significantly. Hence, we recommend the future project team allocate therapists’ care time within a less than 5 minutes interval to get a more robust assessment. Finally, we recommend the future project team collect a larger sample to validate our findings.

Implications of Current Study

Based on our findings and conclusions from the time study, we recommend the Respiratory Care Department to recalibrate its productivity model to adopt the results of this project in its staff assignment.
Introduction

At the Respiratory Care Department of the Mott Children’s Hospital, a previous study examined the time standards of the Respiratory Therapists’ care tasks within the hospital. The time standards developed by the previous team were not on a per-patient basis. To get a better understanding of care time requirements of an individual patient, the department would like our team to develop time standards of the Respiratory Therapists’ activities on a per-patient basis, instead of a general workload. Also, the winter months brought more acute cases of respiratory conditions, which meant the time standards for the winter months might differ from previous studies which examined time standards in non-winter months. Therefore, the primary focus of this project was to determine time standards for the Intensive Care Unit (ICU) since most of the acute cases are treated in ICU, and determine time standards for the General Care area. These time standards were separate entities because of the difference in levels of care. The project team calculated the breakdown of indirect, direct, and incidental times in both the ICU and the General Care Area. The project team also calculated breakdown percentages of tasks among both direct patient activities and indirect patient activities. All of our data was collected during a seven-week period starting February 1st. Eighty hours of data collection was conducted in the ICU area and 24 hours in the general care area. The purpose of this project was to determine time standards on a per-patient basis for Respiratory Therapists in the ICU and General Care Area of the Mott Children’s Hospital, and to determine the expected therapists’ workload. Detailed analysis is performed in the latter sections of the report.

Background

Respiratory Therapists at the Mott Children’s Hospital are vital members of the health care team. They provide patient assessments and education, deliver inhaled medications, and manage mechanical ventilation for infants and children with complex cardiopulmonary illnesses. Respiratory Care Department worked with a previous Industrial and Operations Engineering project team to assess the time standards for ventilator care and medication administration. The project focused on non-ICU and ICU areas. Some of the results of the previous study showed that the total ventilator care time needed to increase by 284%. However, based on the daily experience of the Respiratory Therapy medical staff, there was no significant shortage of the total ventilator care time in terms of staff assignments. Furthermore, with the recent Respiratory Season, the department expected to have more acute patients in their units. More acute patients contributed to an increased workload on the therapy staff. Therefore, the department had us examine the procedural time standards in the ICU areas. Our team utilized modified data collection tools to determine whether the department has allocated sufficient time to each patient in the ICU area. The project team determined respiratory care time standards for winter months and the appropriate level of care time on a per-patient basis based on our data analysis and conclusions.
Before the project team started the time study, the Respiratory Care Department gave us their current productivity model: therapists are scheduled to work at 80% productivity, which provides 9.6 hours per therapist per 12-hour shift. The current average time allocation for an individual ventilator patient is budgeted at 1.9 hours per shift (12 hours). Therefore, the current allocation is based on 5 ventilator patients assigned to each therapist per 12-hour shift. To update these time standards and get a more detailed and accurate assessment of the Respiratory Therapist workload, the project team collected data in on-site time studies, categorized the therapists’ activity time, and calculated the time allocation to each patient.

Key Issues

The following key issues provided the need for this project:

- A better understanding of the care time requirements placed on respiratory therapists in the ICU on a per-patient basis.
- More data analysis surrounding the effect of the respiratory season on the time allocation of Respiratory Therapists.

Goals and Objectives

The primary goals of this project were to develop time standards on a per-patient basis for Respiratory Therapists in the ICU and general care areas of the Mott Children’s Hospital, and determine the expected therapist workload. The time standards we developed apply to the winter months when respiratory cases are more acute. In developing these time standards, the project team also:
  - Classified all direct and indirect tasks.
  - Calculated percentage breakdowns of direct, indirect, and incidental time.
  - Created percentage breakdowns of all tasks within direct and indirect tasks.
  - Compared care time allocation between morning hours (8am-12pm) and afternoon hours(1pm-9pm).

Project Scope

This project focused on two patient treatment areas of the Mott Children’s Hospital - the ICU (PICU, PCTU, and NICU) and the General Care Area. The daily activities of the Respiratory Therapy staff, comprised of direct and indirect patient activities, and incidental time, were closely monitored and recorded. The activities of the nursing staff and doctors were not included, as our focus was solely on the respiratory therapy staff.
Project Approach and Methodology

Shadow Therapists for Time Studies in ICU and General Care Area

Within the aggregated ICU areas (PICU, PCTU and Holden NICU), each member of the project team shadowed a therapist for four hours every week for five weeks to collect time study data (20 therapists were shadowed, 80 hours in total).

Within the General Care Area, two members of the team shadowed a therapist for four hours every week for two weeks, and the other two members shadowed a therapist for four hours in one week to collect time study data (6 therapists were shadowed, 24 hours in total).

Data Categorization

We categorized the time study data into direct patient activities, indirect patient activities, and incidental time. Based on the standard data collection sheet provided by the Respiratory Care Department, we deemed any time spent face-to-face with any particular patient as direct patient activities, any time spent regarding general patients as indirect patient activities, and any time spent in break, lunch, or non-activity as incidental time. Below is a division of the detailed categories:

**Direct patient activities:**
- Taping/repositioning
- Suctioning
- Bagging
- Intubation/Extubation
- CPR
- Equipment initiation/discontinuation
- Vent check with documentation
- Tubing/equipment change
- Blood sampling/analysis
- Medication Administration
- Patient assessment
- Transport
- Hand-washing and isolation

**Indirect patient activities:**
- Order verification/chart review
- Patient rounds/report
- Documentation
- Billing
- Communication (Staff, family, others)
- Stocking/re-stocking of supplies and equipment
- Discontinuation of equipment
- Equipment rounds
Emergency/unscheduled activity

**Incidental time:**
Breaks/lunch/non-activity

**Record Time Study Data**

The project team broke up each four-hour observation block into five minute intervals. During these five-minute intervals, each team member placed a mark in the standard data collection sheet (provided by the department) for each task completed. For example, if during a five minute interval both suctioning and bagging were observed, a mark was made in the “Suctioning” row as well as the “Bagging” row. As indicated by the Respiratory Care Department, we allocated time evenly to each task - 2.5 minutes to “Suctioning” and 2.5 minutes to “Bagging”. Exceptionally, according to the department’s standard, we allocated 30 seconds (0.5 min) for each hand-washing and isolation in the category of direct patient activities. Each team member recorded each observed activity as the specific activity taking place and the duration of the activity.

**Analyze Time Study Data**

We focused on 4 aspects in analyzing the time study data using Microsoft Excel and Minitab statistical software:

- Time Allocation to three categories of activities based on units
- Time Allocation to three categories of activities based on time of day
- Time allocation per-vent patient in ICU and per-patient in General Care Area
- Distribution of individual tasks among direct/indirect patient activities in ICU and General Care Area

**Intensive Care Unit Time Assessment Findings**

The project team conducted the data analysis of the Intensive Care Unit (ICU) in the following steps. Firstly, we computed the time allocation of direct, indirect, and incidental time for each of the three units in ICU and the average of these three units. Secondly, we separated the time study data between the morning and afternoon shifts, and calculated the respective breakdowns of direct, indirect, and incidental time. Thirdly, we calculated the percentage occurrences of the individual tasks within the direct and indirect patient activities. Finally, we calculated the amount of care time that each ventilator patient received during a 12-hour shift in each ICU area as well as the average of all three ICU areas.

**Breakdown of direct, indirect, and incidental activities**

A bar chart (Figure 1.) displays the time allocation of direct, indirect, and incidental activities in each ICU area as well as the average of the overall ICU area.
In Figure 1, it is important to note that most of the percentage breakdowns of the time allocation to three categories of activities in different units are very similar. This leads to the conclusion that there is no significant difference from unit to unit in terms of breakdown of indirect, direct, and incidental time. Also, notice that direct tasks take more than half of time. This means that respiratory therapists are actively engaged in one patient about 50% of the time. The above data showed that there is a high level of consistency between each ICU area, which shows that respiratory therapist’s workload doesn’t differ significantly among each ICU area.

**Breakdown of indirect, direct, and incidental time between morning and afternoon**

We performed our next investigation in time of day analysis. The goal of this analysis was to see if there were significant differences between the morning (8am-12pm) and afternoon hours (1pm-9pm). The differences between the mornings and afternoons can be seen in Figure 2 below.
Figure 2. Comparison of Morning observation and Afternoon observation

Figure 2 shows significant differences between the mornings and the afternoon shifts. Although the indirect patient activity time doesn’t change very much, the direct patient activity time and incidental time do change significantly from morning shifts to afternoon shifts. Generally, there is approximately 15% more incidental time in the afternoon shifts and 15% more direct patient activity time in the morning shifts.

Distribution of individual tasks among direct and indirect patient activities

We also investigated in the percentage distribution of individual tasks among the direct and indirect patient activities. The distribution of direct tasks can be seen in Figure 3.
*Sample size: 80 hours over a 5 week period (Jan 29-March 9, 2007)

**Figure 3. Time allocation to Individual Tasks among direct patient activities**

Figure 3 shows that vent check with documentation takes nearly 30% of the direct patient care time of the respiratory therapists. The three most time consuming activities are vent check with documentation, patient assessment, and suctioning. These three activities alone make up more than half of the direct time, at 53%. Next, indirect tasks were analyzed and shown in Figure 4 in next page.
*Sample size: 80 hours over a 5 week period (Jan 29-March 9, 2007)

**Figure 4. Time allocation to Individual Tasks among indirect patient activities**

In the indirect task allocation, communication was the most time consuming activity at 34%, or roughly one third. Documentation, at 29%, also takes close to one third of the respiratory indirect time. Since the activities of communication and documentation consume two thirds of the total indirect time, they are the activities that would offer the best opportunities for efficiency improvements.

**Breakdown of care time on a per-patient basis in a 12-hour period**

The next analysis, the primary focus of this project, is the per-patient information of care time. The breakdown of care time that each ventilator patient receives in a 12-hour period in three units in ICU area and the overall average of ICU area is shown in Figure 5.
The average time allocation of three units in ICU area shows that each ventilator patient receives approximately 2.27 hours of total care during a 12-hour period. This is calculated by adding the direct time per patient, 1.45 hours, and the indirect time per patient, .82 hours. The budgeted time that each patient receives is 1.9 hours. Therefore, each patient is receiving about .3 hours, or about 15 minutes, of additional care time than is currently allocated.

**General Care Area Time Assessment Findings**

Our analysis helped us to identify the changes in workload once respiratory season begins, as the previous project team’s study of the general care area was conducted prior to the respiratory season.

The analysis focuses on data that is stratified into three different parts: direct versus the indirect activities, allocation of time for direct activities versus the time given for indirect activities, amount of care time allocated to patients on a per patient basis.
Breakdown of indirect, direct, and incidental activities

A summary of the general floor area data indicates that direct activities and indirect patient activities each consume 45% of the time spent in the unit, whereas the incidental time makes up 10% of the time spent on the floor (shown in Figure 6). This general breakdown was expected due to the fact that general care patient’s conditions are not as severe as those patients that are treated in the ICU. This decrease in monitoring may contribute to the shift towards a more equal distribution between direct and indirect tasks necessary.

![Bar chart showing time allocation in General Care Area](image)

*Sample size: 24 hours over a 2 week period (March 12- March 22, 2007)

**Figure 6. Time allocation in General Care Area(%)**

Distribution of individual tasks among direct and indirect patient activities

For all patients, the two most time consuming activities for the respiratory therapy staff is administration of medication and patient assessment, 45% and 36% respectively of the 0.32 hours allocated to direct tasks. The rest of the breakdown of time per activity is significantly less. In Figure 7 the breakdown as a percentage of time per activity can be seen. The indirect tasks, which make up 0.32 hours of total time for patient care in a 12hr. period, have a more even distribution of time for the various tasks, as shown in Figure 8. However, documentation and communication with staff and families are the most time consuming indirect activities undertaken by the respiratory therapists, 35% and 23% respectively.
Figure 7. Time allocation for individual tasks among direct patient activities

Figure 8. Time allocation for individual tasks among indirect patient activities

*Sample size: 24 hours over a 2 week period (March 12- March 22, 2007)
Breakdown of care time on a per-patient basis in a 12-hour period

The data collected over the 4-hour period shows that the respiratory therapists spend nearly an equal amount of their time performing indirect and direct activities, 0.32 hours and 0.32 hours, respectively, for all patients. We can then use this standard to assess the time in hours spent performing tasks respectively during a regular 12hr shift. By using this standard we have converted our data to hours which can be seen in Table 2 below. This standard is also applied to the total patient care time data. The incidental time that takes place is significantly less, 0.07 hours. The total care time per patient (ventilator and non-ventilator) is 0.64 hours out of a 4 hour time period. The raw data used to compile this table can be seen in appendix B. The standard of 1.9hrs from previous studies indicates that the patients are receiving more care time than they have been allotted.

<table>
<thead>
<tr>
<th>Activities</th>
<th>General Care Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct patient activities</td>
<td>0.32</td>
</tr>
<tr>
<td>Indirect patient activities</td>
<td>0.32</td>
</tr>
<tr>
<td>Incidental time</td>
<td>0.07</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>0.64</strong></td>
</tr>
</tbody>
</table>

*Sample size: 24 hours over a 2 week period (March 12 - March 22, 2007)

In Figure 9 the breakdown between direct and indirect activities is nearly equal whereas the incidental time makes up the least amount of allotted time during the 12 hour period.

*Sample size: 24 hours over a 2 week period (March 12 - March 22, 2007)

**Figure 9. Care time per patient over 12-hour period at General Care Area**
Recommendations for Future Study

During the 5-week time studies in ICU and 2-week time studies in the General Care Area, we observed the variability of therapists’ time standards in different time of day (day shift and night shift), in different units (due to different patient acuities in different units), and in different days of week (weekdays and weekends). Therefore, we recommend the future project team to control above variables in their time study to gain more insights regarding time standards of therapists’ care tasks. Additionally, since we allocated time evenly to simultaneous tasks in any 5-minute interval in our time study, our results are only approximations if durations of simultaneous tasks differ significantly. Hence, we recommend the future project team allocate therapists’ care time within a less than 5 minutes interval to get a more robust assessment. Finally, we recommend the future project team collect a larger sample to validate our findings.

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