Transforming Nursing Workflow, Part 1

The Chaotic Nature of Nurse Activities

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Objective: To quantitatively measure workflow and computer use, the activities of 27 medical-surgical RNs were recorded through direct observation.

Background: Previous studies have shown how nurses spend their time but have not documented the pattern, duration, or frequency of activities. The absence of this information is problematic for leaders charged with improving performance and staff development.

Methods: Observers recorded nurse activities and location in real time using predefined lists. More than 98 hours of observations were recorded.

Results: Assessment, charting, and communicating were the most frequent activities, consuming 18.1%, 9.9%, and 11.8% of nurse time, respectively. The duration of 40% of the activities was less than 10 seconds. Timelines revealed that nurses constantly switch activities and locations in a seemingly random pattern.

Conclusion: The results indicate that there is little “flow” in nurse workflow. The chaotic pace implies that nurses rarely complete an activity before switching to another. The opportunity to use critical thinking and engage in planning care is severely limited under these circumstances. The implications for cognition and role transformation are discussed. Part 2 of this research explores the impact of new technology on nurse activities and workflow.

Many quality improvement approaches prompt organizational leaders to examine nursing activities and workflow with the intent of enabling more efficient and effective processes. The workflow of nurses is key to understanding efficiency and improving resource planning and is useful in productivity and technology initiatives. Lean design is an emerging influence in healthcare, and notions of “value-added care” and process improvement are critical to management processes. Knowledge of nurse workflow provides a foundation for understanding how the role of the nurse needs to evolve.

Critical to understanding nurse workflow is determining how work is defined and measured. A small set of broad categories, such as direct versus indirect care, allows broad understanding of how nurses spend their time but does not provide the detail necessary for process improvement or evaluation. That level of understanding requires a large set of work categories to assess the sometimes subtle effects that technology, policies, or regulations may have on nurse workflow. Intended for use as an improvement tool, the Institute for Healthcare Improvement’s Transforming Care at the Bedside protocol defines more than 70 categories of activity. This provides a “high-resolution” view of what nurses do. Most researchers, however, do not partition work into such small pieces. Other examples include lists of 5 work categories, 12 work categories, and 17 work categories. The benefit of a large number of categories is greater detail. The downside is the risk of losing a sense of the whole while focusing on the parts.
Previous workflow studies looked at the time spent in various activities. Although important, this is insufficient for leaders concerned about complexity and cognitive load.\textsuperscript{13} Few professionals are required to perform as many functions and tasks in as many locations, often “on the fly.” With experience, nurses become accustomed to this situation, and it becomes part of the routine. However, constant switching and juggling takes a toll on performance, especially on work processes requiring complex decision making or reasoning.\textsuperscript{12} According to the American Organization of Nurse Executives,\textsuperscript{14} nurses will increasingly be called on to perform as knowledge professionals, using skills such as analysis, synthesis, and cross-disciplinary coordination.\textsuperscript{11,15} The frequent switching, often caused by unanticipated and urgent demands, creates stress and impacts performance.\textsuperscript{16,17} Research in cognitive psychology has long established that performance is best when an individual can remain focused and undisturbed, especially with demanding work. Applications of cognitive research to nursing and healthcare are just beginning but show promise in enabling a better understanding of process and performance.\textsuperscript{15-18}

There were 4 objectives to our research. The first was to establish the amount of time that nurses spent on the computer and in other activities. The second was to establish a baseline of activities before the introduction of new software, which was scheduled for implementation shortly after the study. A third objective was to document the pattern, flow, and sequence of nurse activities. The final objective was to quantify the nature of nursing work as part of a program for care model and nurse role redesign. The protocol and instruments received approval from the institutional review board (IRB) of the health system and the university. All researchers were IRB trained and certified.

**Methods**

**Participants**

Registered nurses were observed on 2 medical-surgical units in a 209-bed acute care, general hospital. The sample included 27 nurses with a mean (SD) age of 40.6 (12.5) years. Nursing experience ranged from 6 months to 41 years, with a mean (SD) of 14.5 (10.8) years. Employment at the hospital ranged from 6 months to 29 years, with a mean (SD) of 6.5 (7.6) years.

**Instruments**

Studies differ in the detail of their activity definitions, reflecting the goals of the research. Potter et al\textsuperscript{11,12} were interested in broad activity categories and used the 5 steps in the nurse process. Transforming Care at the Bedside\textsuperscript{10} is focused on process improvement and requires a fine resolution to discern the impact of incremental process changes. It uses a list of 70 items. In between these extremes is Hendrich et al\textsuperscript{3} a recent study using 12 items, and Upenieks,\textsuperscript{4} a study using 41 items. Drawing from prior research and considering the needs of the organization, a team of nurse leaders, staff nurses, and researchers developed a list of 29 activities (Figure 1). These provided sufficient detail and defined activities that were readily identifiable and understandable to staff.

The activities were mutually exclusive and exhaustive and were behaviorally based, enabling observers to record without interrupting the nurse. During a session, the researchers used a personal digital assistant to record the nurse’s activity. This provided a continuous recording of the onset, duration, and sequence of nurse activities. Location was similarly recorded and included patient room, hallway, nurse’s station, computer on wheels, break room, medication cart, treatment room, computer room, and auxiliary. The mobility of the personal digital assistant and the simplicity of the interface allowed observers to record continuously in a standardized manner.

**Procedure**

In work sampling studies,\textsuperscript{3,7,8,10} nurses periodically report their activity when cued by a pager. This results in a large sample but misses the detail of the flow, sequence, and demand of work. Direct observation provides greater detail but is data intensive. As a result, studies using direct observation include smaller samples. For example, Potter et al\textsuperscript{11,12} included one 10-hour observation, whereas Tucker and Spear\textsuperscript{16} observed 11 nurses for 10 hours each. For this study, a relatively large sample of 27 nurses was observed for 3- to 4-hour blocks of time.

Two observers were used, and observations occurred on 2 medical-surgical units. Nurses were randomly selected from those available on the unit at the time of the observation. Nurses were informed of the goals of the observation, assured anonymity, and informed of their right to stop the observation at their discretion. Demographic data were then recorded and the observation began.

Once a session started, the observer did not interact with the nurse unless the activity was unclear or if the nurse had a question. To avoid confidentiality issues and comply with IRB wishes, observers did not follow nurses into patient or treatment rooms. Instead, they asked nurses about activities before the nurse entered the patient room. Thus, they knew of the care taking place and its duration but did not observe it directly. No information on patients was seen or recorded by the observers. Observations
occurred between 7:00 AM and 7:00 PM, Monday through Friday.

Results

Activity Time

A total of 98.2 hours of observation were collected over a 4-week period. During this time, 8,621 distinct events were recorded. The frequency of occurrence and total time spent on each activity are shown in Table 1. The activity “assessment/treatment” consumed the most time, accounting for 18.5% of the 98.2 hours. The 4 communication activities were next, consuming a total of 12.0% of the time. “Personal time,” “electronic charting,” and “walking” followed, accounting for 11.4%, 10.1%, and 8.1%, respectively, of the time. The time per task dropped quickly beyond the 7 most frequent activities. The 12 least observed activities accounted for less than 7% of the total. Their low frequency does not imply low importance, but it does suggest that a smaller activity list is warranted.

Figure 1. Activity list and definitions.
Total time on the computer is the combination of 4 activities: electronic charting, electronic information retrieval, navigation, and other computer use. These 4 activities sum to 15.4%, with charting providing two-thirds of the total.

Activity Frequency
Of the 8,621 events, “walking” was the most frequently observed, accounting for 1,736 of the total (20.1%). “Walking” was recorded when it was the only visible activity. For example, walking with a colleague and discussing a patient was recorded as “communication with nursing team.” The 10 least frequent activities accounted for a total of 3.3% of the events.

Activity Duration
Most activities were of very short duration. As shown in Figure 2, 40% of the 8,621 events were less than 10 seconds. Nearly 77% of the activities were less than 30 seconds. Approximately 5% of the events lasted longer than 2 minutes, and personal breaks accounted for most of this time. These results clearly illustrate the frantic nature of nursing—nurses shift activities constantly. Reported here are behavioral shifts, observable by the researcher. Cognitive shifts such as reprioritization, reviewing, and synthesizing

<table>
<thead>
<tr>
<th>Activity</th>
<th>Total Time</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admission—new patients</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Admission—transfer</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Assessment/treatment/family</td>
<td>18.1</td>
<td>18.5</td>
</tr>
<tr>
<td>Code blue</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Collecting/gathering materials</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>Discharge</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Electronic charting</td>
<td>9.9</td>
<td>10.1</td>
</tr>
<tr>
<td>Electronic information retrieval</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Housekeeping</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>MAR</td>
<td>5.3</td>
<td>5.4</td>
</tr>
<tr>
<td>Medication administration</td>
<td>6.3</td>
<td>6.4</td>
</tr>
<tr>
<td>Medication preparation</td>
<td>4.3</td>
<td>4.4</td>
</tr>
<tr>
<td>Miscellaneous/other/notes</td>
<td>4.1</td>
<td>4.2</td>
</tr>
<tr>
<td>Navigation</td>
<td>3.5</td>
<td>3.6</td>
</tr>
<tr>
<td>Nonpatient paperwork</td>
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<td>0.3</td>
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<tr>
<td>Other computer use</td>
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</tr>
<tr>
<td>Paper brain</td>
<td>3.1</td>
<td>3.2</td>
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<td>Paper chart</td>
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<tr>
<td>Personal time</td>
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<td>11.4</td>
</tr>
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<td>2.5</td>
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<tr>
<td>Shift change</td>
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</tr>
<tr>
<td>Transporting patients</td>
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<tr>
<td>Waiting</td>
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<td>0.7</td>
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<tr>
<td>Walking</td>
<td>7.9</td>
<td>8.1</td>
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<tr>
<td>With family</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>With nonnursing team</td>
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</tr>
<tr>
<td>With nursing team</td>
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<td>7.9</td>
</tr>
<tr>
<td>With physicians</td>
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<td>0.5</td>
</tr>
<tr>
<td>Entire sample</td>
<td>98.2</td>
<td>100</td>
</tr>
</tbody>
</table>

Abbreviation: MAR, medication administration record.
*No activity recorded during the observational period.

![Figure 2. Distribution of activity duration.](image-url)
patient information and decision making may also be frequent but are not discernible behaviorally.

The mean and standard deviation of the activities are shown in Table 1. The standard deviations were high vis-a-vis the means, reflecting high variability in the workflow. The data in Table 1 do not indicate the time to complete an activity, but the average time spent on an activity before switching to another. For example, 119 seconds is the average time on an assessment activity before switching to a separate activity. This back-and-forth nature of nursing work demonstrates that activities are rarely completed without interruption and switching.

Workflow Patterns
Observational data were graphed to provide a visual representation of the flow of work. Plotting activity over time, these charts reveal the patterns of work. Figure 3 shows a 3-hour observational session. Each up or down shift in the trace represents a switch from one activity to another. Sustained performance on an activity is indicated by a horizontal line. The density of the vertical lines provides a qualitative sense of the workflow for this nurse. Figure 3 shows the nurse moving from room to room, primarily administering medications and assessing patients. At one point, the nurse stops to study the chart and the medication record. Later, notes are transcribed from the nurses “paper brain” (pocket paper notes) into the computer.

Figure 4 illustrates how the computer was typically used. Although encouraged to do real-time charting, nurses typically use the computer in “batch mode,” accumulating patient data and later entering it on the computer. Thus, computer use is not yet part of the ongoing flow of nurses but is accessed periodically. Should real-time charting occur, the data would reveal the nurse accessing the computer after or during each patient interaction. This finding has significant implications to patient care safety and effectiveness.

A nurse completing patient rounding is shown in Figure 5. The nurse spends several minutes with a patient and then moves to the next patient, with little time in between. Frequently, the nurse has short interactions with other nurses in the hallway. Quick referrals to personal notes and telephone calls were also observed. As in Figure 4, this nurse uses the computer in batch mode.
These diagrams are representative of the patterns observed across all 27 sessions and illustrate 4 key behavioral patterns. First, activity switching is frequent, as would be expected given the data in Figure 2. Not all workflow diagrams had the same density of shifting, but clearly, nurses are moving rapidly. Second, most computer work is done in batch mode. Rarely was a nurse observed charting in real time. Third, most interactions with other nurses were serendipitous and of short duration. Often, communication occurred as nurses walked by one another, rarely even stopping. And finally, the longest duration activities were when nurses were with patients. This is shown in the data in Table 1 but reflected in the diagrams as well.

**Discussion**

The total time spent using the computer (15.4%) was less than expected based on anecdotal remarks from nurses before the study. This could be due to several factors. First, computer use was a new experience for many. Its newness could have led some to overestimate and verbalize concerns about the time spent entering data. Second, the operational definition of “computer use” meant that the nurse was actually using the computer, not just collocated with it. Talking to a colleague while at a computer might be recalled by a nurse as “time spent on the computer” but here would be recorded as “verbal communication with a nurse.” A third factor influencing self-reports is that, as a whole, nurses spent more time on the computer than in other activities such as medication and communication. Only “assessments/treatments” exceeded computer use in total time (18.5% vs 15.4%). Perceptions may change over time as proficiency increases and as computer use becomes more ingrained in day-to-day activities (eg, planning and coordination of care will require computer-based tools). As the nurse’s role transforms to include greater accessing and synthesizing of electronic information, computers will be seen as essential rather than additional.

The second objective of the study was to establish a baseline of activity durations and workflow patterns. Even with 98 hours of observation, the variability in the data was extreme. This was demonstrated in the standard deviations and the timelines. Conclusions about the length of time to
complete an activity cannot be reached, as nurses rarely completed an activity without interruption. Regarding workflow, 4 general patterns of behavior were observed: quick switching, batch use of the computer, serendipitous communication, and relatively long-duration activities with the patient. More complex patterns are likely present in the data but require more sophisticated analytical tools such as conditional probabilities and Markov Chains to identify. This will be explored in future analyses.

The third and fourth objectives were to document the patterns and behavior of nurse workflow. Figures 3, 4, and 5 provide a sense of the chaotic pace of work, illustrating how rapidly nurses switch from one activity to another. Clearly, there is no “flow” to nurse workflow as recorded using these 29 activities. Instead, work is characterized by abrupt switching. With 40% of the observations less than 10 seconds in length (Figure 2), rarely is an activity completed without a switch. This has a significant impact on cognition\(^1\),\(^6\),\(^19\) slowing performance and increasing the probability of error.

Additional research should consider the root causes of activity switching. Several potential causes were suggested here. One is situational. It is difficult, if not impossible, for nurses to control and/or adequately predict when patients or others will need them. Frequent communication with colleagues is necessary and valuable but is also unpredictable. The second is workload. Nurses typically cannot afford to spend time waiting, so rather than stand idly, they switch to another activity. A third contributor is cognitive load. If an activity is not cognitively demanding, switching and multitasking are not problematic. However, if an activity is cognitively demanding, of a critical nature, or complex and multifaceted, switching can be detrimental to performance. Regardless of the cause, frequent switching results in nurses monitoring numerous “in-process” activities simultaneously. This circumstance needs to be addressed and resolved in care model redesign work.

With care complexity increasing, the nondemanding aspects of nursing practice need to be challenged and removed from the nurse’s responsibility, perhaps transferring them to other team members trained in task-based care. Attempts across the last decades to delegate nonessential tasks have met resistance in some cases and been successful in others. Fundamentally redesigning work processes, based on evidence and outcomes, enables the nurse to

![Figure 5. Workflow diagrams—rounds.](image-url)
focus on priorities relative to the care outcomes of the patient. Of critical importance to care design is consideration of the cognitive implications of constantly shifting between activities. Further studies on task switching and multitasking and their impact on performance, stress, fatigue, and satisfaction are necessary.

The frequency and duration of unplanned verbal communication with fellow nurses are important findings. Most of these episodes occurred in hallways, often while nurses walked by one another. These serendipitous interactions were a key factor in performing work. The frequency of interaction reinforces the importance of social capital and tacit knowledge. Even with access to an abundant supply of digital data, nurses still need access to one another for support and information exchange. Communication with nurses and physicians should be examined closely with the introduction of new technology.

Implications
As the role of the registered nurse continues to evolve, nurses will be involved in even more cognitively demanding work. Higher demand activities require concentration, focus, and control over interruptions. These data indicate that this is unlikely to happen under the current conditions found in a hospital medical-surgical unit. However, through a combination of lean design, new technology, and role redefinition, activities can be altered or reallocated and nurses could obtain the time and control necessary to perform in a new role. Until such redesign happens, these data suggest that the current situation is likely to lead to frustration, inefficiencies, and suboptimal performance, including error.

References