Time Savings:

Evaluating the effects of integrating a new automated vital signs documentation system into a Skilled Nursing facility

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Abstract:
Vital signs documentation was the focus of this case study, because clinician time is an increasingly valuable resource within Long Term Care. This study compared the time efficiency of manual-entry vital signs documentation to workflows that use the DS smart™ Platform to automatically transfer vital signs assessments from a bedside vital signs device into the electronic medical record. The study found that using the DS smart™ Platform was faster and produced a time savings of more than 22% to collect each vital sign assessment at a .01 significance level.

In May 2018, a team from Aurora Health Management's Long View Healthcare Center, a Skilled Nursing facility in Manchester, MD welcomed a team from Direct Supply® for its first visit to campus. The goal was to validate the expected results of using a new technology, the DS smart™ Platform, when connected to the Attendant® Vital Signs Monitor.

Aurora and Direct Supply identified three sources of potential value to test:
- Time Savings: Will this platform save clinicians' time, and how much of it?
- Data Availability: How much sooner will the vitals data be available in the EMR?
- Brief Training: Was a 5-minute training session sufficient to prepare the nursing staff to use the platform?

Why validate?

A peer-reviewed article in the Journal of Healthcare Information Management makes the point perfectly: "Healthcare providers are often told that a new piece of equipment will be safer for patients and a time saver for staff, only to find out that the system has a steep learning curve or takes more time than the 'old way'"[i] Heeding this advice, Aurora sought a well-supported trial environment, and the Direct Supply team sought evidence that its platform lived up to their development aspirations in a live environment.

The Direct Supply team modeled the case study after the time and motion study documented by Meccariello, Perkins, Quigley, Rock and Qiu in the Journal of Healthcare Information Management. That study determined the time savings generated by switching to an automated vital signs documentation system in a medical/surgical setting. Direct Supply sought verified time savings in a post-acute setting, using the DS smart™ Platform.

Time Savings

The primary objective for the Aurora case study was to measure the time savings realized by Long View's staff by switching from using traditional methods of vital sign

assessment collection and documentation to using the DS smart™ Platform for collecting and submitting vital sign assessments to the EMR. If nurses can complete the same required tasks in less time, it benefits the entire facility – most importantly residents – by giving caregivers more time to spend on other tasks. In today's operating environment, clinician time is one of the most valued resources in Senior Living. "A recent time-and-motion study showed that nurses spent 35.3 percent of their working time completing all types of documentation."[ii] "Because vital sign measurement in hospitalized patients is a frequently performed procedure, investigating the potential of cost containment in this practice is clearly warranted."[iii] Similarly, vital sign measurement is also a frequently performed procedure in many post-acute units and therefore a worthy exploration.

Data Availability

Direct Supply sought to understand how much sooner the data could be available in the EMR. How long does it typically take for clinicians to input the collected vitals data using a traditional method? In other words, how long is the lag between the acquisition of the vital sign measurements and the final documentation into the EMR via computers?

Immediately-uploaded vitals data provides a variety of benefits. First, more rapidly available vitals in the EMR enables clinicians to access data quicker by changing existing workflows. As a nurse prepares to administer medications, all of the necessary vitals obtained by a CNA are already in the EMR, eliminating delays in traditional documentation due to common interruptions in CNA workflows. Secondly, vital sign data is time stamped to reflect the actual time vitals are obtained and entered into the EMR. Accuracy of the time can impact clinical confidence when using the data to make clinical care decisions. In a separate pilot run by Direct Supply, clinicians noted that prior to implementing DS smart™, time stamps attached to vital signs could have a potential gap in documentation of up to 8 hours. This creates a situation where redundant vitals could occur regularly. Further, some types of analysis are not possible with such systematic ambiguity around actual vital collection times. Also note, these benefits suggest time savings that users of the DS smart™ platform would likely experience, but were not expected to be quantified for this case study.

Training

An elegantly simple system is significantly more valuable to the clinicians using it and the staff hoping for both quick adoption and rapidly realized time savings. The objective for this case study was to solicit feedback from frontline clinicians on the efficacy of the train-the-trainer model deployed. In this model, a trainer, in Aurora's case the Nurse Educator, was trained using a 20 to 30 minute Learning Management System (LMS) module. That trainer then used only the learning from the LMS module to train the frontline users of the DS smart™ platform via roughly 5-minute demonstrations. Representatives from Direct Supply provided some in-person support to the Nurse Educator, but did not conduct any formal, direct training of frontline clinicians at the Long View facility.

Research Design
Time Savings and Data Availability
A quasi-experimental design was used to gather data pre- and post-inclusion of the DS smart™ platform. This study included a review of current procedures, observations of current practices and a workflow analysis as it relates to vital sign capture and documentation.

The study compared automated documentation workflows with the manual-entry documentation workflow currently in use on the unit. The factor evaluated was a workflow time study.

Process
Time Savings and Data Availability
Time and motion studies were chosen for obtaining more precise times for each activity.[iv] Although this method was more time-intensive, it was necessary to deliver the most accurate results. According to Finkler, Knickman, Hendrickson, Lipkin and Thompson, the work-sampling approach may not provide an acceptably precise approximation. Aurora generously provided the necessary access for time and motion.

Research documentation sheets were created for recording observations and to ensure reliability across observers. For the purpose of this study, a set of blood pressure, pulse, respirations, temperature and oxygen saturation is considered as one set of vitals.

Setting: The study was conducted at Aurora Health Management's Long View Nursing Home – a 108-bed skilled nursing facility – from May 2018 through June 2018. Observations for the time and motion study were collected during two three-day visits, for a total of six days. Observations were made during all three shifts, typically during or near the first hour of each shift – 7:00 am to 8:00 am; 3:00 pm to 4:00 pm; 11:00 pm to 12:00 am. The facility's leadership approved the study prior to enrolling any subjects. As required, informed consent was obtained from the participating residents and unit staff prior to performing any study-related procedures.

Training
Brief, 1-minute interviews were conducted with clinicians to gather feedback on the training efficacy. Interviewed clinicians included RNs, LPNs, CMAs and CNAs. Each clinician was asked if the 5-minute training offered by their nurse educator prepared them to use the Bluetooth-connected VSM and platform with residents. If the clinician responded in the negative, the interview was completed and the clinician was scored at a "1." If the clinician responded affirmatively, that they were prepared to use the VSM and platform, a follow-up question was asked. The follow-up question was "were you confident or still a little nervous?" An answer of "nervous," "I still needed some time" or similar answers were scored at a 2, and answers of "confident," "I still need to get my hands on it, but I'm sure I'll be fine" or similar answers were scored at a 3.

Sample
Time Savings and Data Availability
A convenience sampling of unit clinicians was invited to participate. There were no repercussions for not participating.

A convenience sampling of residents was invited to participate. In order to be included in the study, willing residents had to be capable of giving informed consent.

The registered nurses, licensed practical nurses, and nurse's aides were observed, and time studies were completed during vital sign assessments on consenting residents. Fifteen clinicians and 41 residents participated in the time and motion study.

Training
A convenience sampling of clinicians participated. There were no repercussions for not participating. Out of roughly 90 total clinicians on staff, 41 clinicians were interviewed regarding the training efficacy. No clinicians chose not to participate. Any non-participants did not work or were not reached during the three-day window during which interviews were conducted.

Methods
Time Savings and Data Availability
The study compared the time efficiency of:
→ The current unconnected Attendant® Vital Signs Monitor (VSM) and manual documentation workflow.
   This involved using the VSM to collect blood pressure, temperature, pulse and oximetry readings. Respiration rates were obtained manually. Pen and paper were used to record the vital sign assessments, which were manually input into the electronic medical record, PointClickCare, using computers in the hallway or at the nearest nursing station.
→ The Attendant® Vital Signs Monitor connected via Bluetooth connection to the DS smart™ platform, and some manual documentation.
   The DS smart™ platform was accessed through a tablet computer affixed to the VSM stand. The clinician used his/her EMR credentials to access the platform application, and the patient was selected from a pull-down menu. The VSM was used to collect blood pressure, temperature, pulse and oximetry readings. Respiration rates were obtained manually. The clinician had the opportunity to verify the vital sign readings and then press a button to send the results to the electronic record. The DS smart™ application automatically transferred the four vital sign results to the EMR. Since the DS smart™ platform's capability to collect respiration rate was still under development, clinicians had to manually record respiration rate and input those rates into the electronic medical record using computers in the hallway or at the nearest nursing station.

Statistical Methods
Following computation of descriptive statistics for total and stage-wise times within each phase, the normality of total time each phase was checked using a one-sample Kolmogorov-Smirnov test. This test was chosen for its (i) nonparametric nature and (ii) its sensitivity to differences in both location and shape of the empirical normal cumulative distribution.
   Total times from both phases – via manual or via machine – were non-normal, so we compared means using the Mann-Whitney U test, which relaxes the normality assumption stricturing the popular two sample t-test. Means were chosen over medians to capture the effect of outlying times, which is more representative of "real life," or a setting that isn't designed as a quasi-experiment.

Testing and comparing means was based on the .01 significance level. All data analysis was conducted in R, an open-source programming language for statistics and computation.

Results

Time Savings

To identify the time savings, Direct Supply compared the time required to collect and enter vitals with an unconnected VSM with the time required to collect and enter vitals with a connected VSM that utilized the DS smart™ Platform.

The unconnected VSM average time to enter and collect vital signs, $M = 172$ seconds, $SD = 63$, 99% CI [141, 202], was slower than those aided by the DS smart™ Platform by an average of 38 seconds, $M = 38$ [26, 51], or 19 - 25%. Those using the platform took an (pseudo) average of $M = 133$ seconds and $SD = 41$, 99% CI [115, 152]. A Wilcoxon Signed-Ranks Test (with continuity correction) indicated that this 38-second machine speed advantage is statistically significant, $W = 840$, $p < .01$.

Data Availability

Using the VSM, the average lag time between collecting and entering the vital sign assessments was $M = 33.6$ minutes, $SD = 29.0$ minutes, 99% CI = [17.4, 41.8]. In other words, the lag captures the average time between the moment a vital sign assessment was captured and when the clinician began entering that individual vital sign assessment into the EMR, typically using the computer at the nurse's station.

Training

Using the responses of 41 respondents, $M = 2.9$, $SD = 0.3$. Of the 41 respondents, 37 clinicians responded that after just the 5-minute demonstration with the nurse educator, he/she was confident and prepared to use the platform with residents. No one responded that they were unprepared to use the platform with residents.

Key Learnings

Time Savings

This case study sought measurable effects of using the DS smart™ Platform in a long-term care setting. The results of the time and motion study uncovered significant, tangible time savings benefitting clinicians at Aurora today. Moreover, this study tells a larger story of responsive product development and creates a clear roadmap for nearly doubling those expected savings by applying the observed learnings: offering a tympanic thermometer on the VSM and remotely engineering the respiration rate into the DS smart™ application.

Using the DS smart™ Platform took an average of 22% less time to collect and document each vital sign assessment. All of the 38 seconds in savings per vital collection and documentation was a result of quicker documentation times. As noted earlier, during this time and motion study, the platform did not yet have the capability to collect respiration rate. By adding the respiration rate capability and switching the thermometer from oral to tympanic, the Direct Supply researchers expect Long View's time savings to increase to 67 seconds, or a 39.7% savings for each assessment.

First, switching out the oral thermometer VSM for a VSM with a tympanic thermometer is already delivering time savings to the Long View team. The team at

Aurora chose the oral thermometer for the pilot. But during the time and motion study, Long View's front-line clinicians voiced a clear preference for tympanic thermometers. Several considerations motivated this choice, including ease of use for both clinician and resident. Throughout the observations, Direct Supply's researchers observed that during more than 50% of vital signs assessments, clinicians and residents could not achieve a valid reading from the oral thermometer, even though nothing was malfunctioning on the product. Some of the typical challenges with using oral thermometers are documented in the literature.[v] But, in Long View the observed errors added an additional estimated 17 seconds. Responding quickly, the Aurora team was consulted and opted to switch to tympanic thermometer VSMs at Long View. This responsive selection from the Aurora team is predicted to save Long View's clinicians an average estimated 8.5 additional seconds on each vital sign assessment. By making a simple swap, the time savings has already likely moved from the observed 38 seconds and 22% to a predicted 46.5 seconds or 27.4% savings.

Second, respiration rate is committed on the official engineering roadmap. Adding this capability to the DS smart™ application will remove the need for clinicians to spend any time manually documenting the primary vital sign assessments: blood pressure, temperature, pulse, respiration rate and oximetry readings. After this capability is remotely added from Milwaukee, WI, at no cost to customers, researchers expect clinicians will save an additional 16 seconds each time they collect a vital assessment. This prediction is an easy calculation –all savings come from removing the manual entry step. Adding the respiration rate to the application will move the predicted time savings from 38 seconds or 22% per vital assessment to 54 seconds or 31.7%.

In conjunction, these two improvements are predicted to deliver a combined, additional time savings of 24.5 seconds per vital assessment. At the end of that roadmap, the time savings will move from an observed savings of 38 seconds, or 22% per vital assessment, to a predicted savings of 62.5 seconds or 39.7%. This study also tells a 21st century story of how clinicians and residents in Manchester, MD, can enjoy incremental benefits from remote engineering changes made via computers in Milwaukee, WI, to add the respiration capability to their platform., Direct Supply researchers are excited to return to Manchester, MD, and the wonderful team at Long View to verify the predicted savings in coming months.

Data Availability
This case study delivered limited learning about when data would be available in most facilities. The observed average lag of 33.6 minutes between a clinician collecting a vital sign assessment and entering it into the EMR is not believed to be representative of a typical facility. Clinicians at other facilities predicted a many-hour lag for their own facilities. It's not uncommon for clinicians to be frequently side-tracked prior to documenting the vital signs assessments into the EMR, or to regularly document the vital signs assessment along with other charting completed at the end of their shift. There are other reasons for skepticism. First, the Hawthorne effect, or observer effect, is likely artificially lowering this result. The Hawthorne Effect suggests that individuals modify an aspect of their behavior in response to their awareness of being observed.[vi] The primary Direct Supply researcher noted that many clinicians vocalized a desire to make observations more convenient for him, and so the clinicians would immediately enter vital sign assessments after collection. The time lag data also suggests the observers impacting clinician behavior. The average lag was significantly longer on the second

visit to Long View than the first visit. This suggests that as clinicians became more comfortable with the researchers, their behavior changed. Secondly, Direct Supply's researchers noted during their visits that Long View displays many indicators of being a tremendously well-run facility. Accordingly, top-tier performance on this metric may not represent expectations of most facilities.

Training
The results of clinician interviews spoke to the efficacy of the train-the-trainer model deployed. But the full story speaks even more strongly to the ease of the platform and limited training necessary. Initially, the Direct Supply team intended for all clinicians to go through the 20-minute Learning Management System in addition to an individualized 5-minute hands-on tutorial with the nurse educator. However, after initial feedback from the first few clinicians that the LMS was unnecessary, the strategy was altered. Instead, the nurse educator reviewed the LMS herself and then delivered 5-minute demonstrations to groups of 2 to 5 clinicians at a time. Using this new strategy, front-line clinicians did not view the LMS. The initial frontline clinicians who had viewed the LMS were not included in the study. Only clinicians who went through the modified program, consisting of only the 5-minute demos, were included in the clinician feedback scores. And given the high levels of participation and generally very high scores, the efficacy of the training cannot be easily explained by any characteristics of specific nurses.

Future Research
There are several areas of interest for future research, both further observations at Long View and case studies at other sites. Regardless of location, the goals will be validating sources of value for customers.

Data Quality
Were the vital sign assessments significantly different when transmitted through the platform as compared to assessments entered manually by caregivers? For example, were error rates decreased or are there other differences that give clinicians evidence justifying greater faith in data transmitted through the platform than in data manually input by overworked human hands. To arrive at verifiable insights, many factors would have to be controlled for, including patients and clinicians.

Data Availability
The research team is interested in capturing the data availability improvements in a different setting. As noted above, there are reasons to have concerns about the results captured at Long View being representative of other facilities.

Verify Predicted Time Savings at Long View
Direct Supply's data researchers and scientists are confident in the estimations and predictions captured in this case study. But prediction is not a perfect substitute for the validation provided by actual observation. Nonetheless, given their confidence in the estimation and predictions, the research team is excited to return to Manchester and verify the predicted savings for the clinicians and residents at Long View.

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