Does the introduction of an electronic nursing documentation system in a nursing home reduce time on documentation for the nursing staff?

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ABSTRACT

Purpose: To determine whether the introduction of an electronic nursing documentation system in a nursing home reduces the proportion of time nursing staff spend on documentation, and to use this information in evaluating the usefulness of the system in improving the work of nursing staff.

Methods: An observational work sampling study was conducted in 2009 and 2010, 2 months before, and 3, 6 and 12 months after the introduction of an electronic nursing documentation system. An observer (ENM) used a work classification tool to record documentation activities being performed using paper and with a computer by nursing staff at particular times for periods of 5 days.

Results: Three hundred and eighty three (383) activities were recorded before implementation of the electronic system, 472 activities at 3 months, 502 at 6 months, and 338 at 12 months after implementation. There was no significant difference between the proportion of time nursing staff spent on documentation 2 months before and 3 months after the implementation of the electronic system. Six months after implementation, the proportion of time on documentation increased significantly and after 12 months, settled back to original levels that were recorded in the paper-based system. Over half of the proportion of time on documentation at 6 and 12 months after implementation was spent on paper documentation tasks.

Conclusion: Introduction of an electronic nursing documentation system did not reduce the proportion of time nursing staff spent on documentation. This may in part have been a result of the practice of documenting some information items on paper and others on a computer. To reduce the use of paper documentation or to achieve a paper-free documentation environment in this setting, an in-depth understanding of nursing staff’s information needs, and documentation workflow is necessary.

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1. Introduction

The healthcare sector in various countries is today faced with issues surrounding quality, safety, efficiency, cost, and access to health and aged care services. Information and communication technology (ICT) holds promise for addressing these challenges [1,2]. The use of modern ICT in healthcare provides a tremendous opportunity for improved delivery of services through increased efficiency, reduced costs,
equitable health, and better care outcomes [3,4]. Hopes for such positive outcomes have motivated the development and implementation of electronic systems into healthcare settings [5,6].

In recent years in Australia, aged care organizations have introduced electronic documentation systems into nursing homes in an effort to reduce documentation load for the nursing staff [7,8], and allow them more time to care for seniors. These initiatives are also aimed at improving the quality of residents’ records in terms of legibility, completeness, and accuracy. Although there is evidence to suggest that electronic nursing documentation systems can improve quality of the residents’ records [9,10], there is a lack of evidence that such systems can reduce documentation efforts and time for the nursing staff in aged care facilities.

Several studies evaluating the relationship between the introduction of an electronic system and documentation efficiency have been undertaken in hospitals and their findings have varied. Some studies [11,12] have found a reduction in time, for example, an observation of nursing staff using either paper or electronic documentation system in the intensive care unit (ICU) of a surgical ward found a significant reduction in charting time, 6 months after implementation of the electronic system [11]. In the same year (2003) and setting, Bosman et al. [12] found a significant reduction in documentation time for the nursing staff after 7 months of using a computerized system to register patients.

However, some studies [13,14] have found an increase in documentation time. Saarin and Aho [13] found nurses took longer to document care using an electronic system than with a paper-based system, 2 years after implementation of the electronic system. In a randomized evaluation of a computerized system in a psychiatric ward, Ammenwerth et al. [14] found a significant increase in time on report writing and documentation of tasks, 7 weeks after implementation of the automated system.

Other studies [15,16] have found no changes in documentation time for the nursing staff. For example, Menke et al. [15] found no significant difference between manual and electronic documentation time, after the electronic system had been in use for 3 months in the ICU of a paediatric ward. An observation of nursing staff using either manual or electronic documentation systems in a surgical ward also found no significant difference in time on admission and routine documentation of care, 1 year after the introduction of the electronic system [16].

Thus, it is unknown whether investment in an electronic documentation system in a nursing home will reduce the proportion of time nursing staff spend on documentation, and allow them to spend more time on residents’ care [17]. This information is important in evaluating the usefulness of such systems in the work of nursing staff. In addition, the information is necessary in motivating nursing staff to adopt ICT solutions, and in encouraging the aged care sector to invest in ICT innovations. Therefore, the motivation of this study was to measure the effect of the introduction of an electronic nursing documentation system in a nursing home, on the proportion of time spend on documentation by the nursing staff.

2. Study context

2.1. Organizational setting

This work was carried out at an Australian nursing home between March 2009 and November 2010. The study is part of a larger investigation of the impact of an electronic documentation system on nursing staff activities in a residential aged care facility.

2.2. System details

A commercial Web-based electronic documentation system was implemented in May 2009. The system is used for residents’ demographic information, assessments, progress notes, and residents’ forms and charts. It is also used for incident and accident reports, care plans, funding of care, administrative and 24-h shift handover reports. Use of the 24-h report was introduced at the facility from 6 months after the implementation of the electronic system. The system is designed to automatically integrate information entered on forms, charts and progress notes into nursing care plans, calculation of funding and management reports.

The approach taken by the nursing home was to continue to use paper documentation for some types of information after implementation of the electronic system. These included information on medication, activities of daily living (ADL), summary shift handover report, and recreational activities. Memory aid notation, scheduled tasks, and awareness information were also captured on paper (Table 1). Continence information was documented and stored on paper for 3 months after the introduction of the electronic system, after which such information was entered and stored electronically.

2.3. Training of staff and system setup

Training sessions were held 3 months before the introduction of the electronic system. Each nursing staff member received a 30 min one-on-one training session. Subsequently, the newly employed nursing staff learned how to use the system from their peers with experience.

The system was installed in six desk-top computers. A username and password was assigned to each nursing staff member. Data entry into the system was through a combination of text using a keyboard, and ‘drop and click’ method using a structured drop-down menu.

2.4. Implementation of the system

The electronic system was implemented in three phases. Phase 1 was the introduction of progress notes in May 2009. Phase 2 followed 1 month later with the introduction of charts and forms, such as blood glucose chart and restraint chart. Phase 3 was the introduction of the nursing care plan in July 2009.
Table 1 – The types of information documented in computer or on paper after implementation of the electronic system.

<table>
<thead>
<tr>
<th>Type of information</th>
<th>3 Months after implementation</th>
<th>6 Months after implementation</th>
<th>12 Months after implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resident demographic details</td>
<td>Computer</td>
<td>Computer</td>
<td>Computer</td>
</tr>
<tr>
<td>Assessments</td>
<td>Computer</td>
<td>Computer</td>
<td>Computer</td>
</tr>
<tr>
<td>Progress notes</td>
<td>Computer</td>
<td>Computer</td>
<td>Computer</td>
</tr>
<tr>
<td>Resident forms and charts (excluding continence chart)</td>
<td>Computer</td>
<td>Computer</td>
<td>Computer</td>
</tr>
<tr>
<td>Incident and accident reports</td>
<td>Computer</td>
<td>Computer</td>
<td>Computer</td>
</tr>
<tr>
<td>Care plan</td>
<td>Computer</td>
<td>Computer</td>
<td>Computer</td>
</tr>
<tr>
<td>Funding of care</td>
<td>Computer</td>
<td>Computer</td>
<td>Computer</td>
</tr>
<tr>
<td>Administrative shift handover report</td>
<td>Computer</td>
<td>Computer</td>
<td>Computer</td>
</tr>
<tr>
<td>24-h shift handover report</td>
<td>Computer</td>
<td>Computer</td>
<td>Computer</td>
</tr>
<tr>
<td>Medication</td>
<td>Paper</td>
<td>Paper</td>
<td>Paper</td>
</tr>
<tr>
<td>Activities of daily living (ADL)</td>
<td>Paper</td>
<td>Paper</td>
<td>Paper</td>
</tr>
<tr>
<td>Summary shift handover report</td>
<td>Paper</td>
<td>Paper</td>
<td>Paper</td>
</tr>
<tr>
<td>Recreational activities</td>
<td>Paper</td>
<td>Paper</td>
<td>Paper</td>
</tr>
<tr>
<td>Memory aid notation</td>
<td>Paper</td>
<td>Paper</td>
<td>Paper</td>
</tr>
<tr>
<td>Scheduled tasks and awareness</td>
<td>Paper</td>
<td>Paper</td>
<td>Paper</td>
</tr>
<tr>
<td>Continence</td>
<td>Paper</td>
<td>Computer</td>
<td>Computer</td>
</tr>
</tbody>
</table>

* The report was not part of the information documented by nursing staff at this period of study.

2.5. Nursing staff and their role in documentation duties

2.5.1. Registered Nurses and Endorsed Enrolled Nurses
Registered Nurses (RNs) and Endorsed Enrolled Nurses (EENs) are professional nursing staff in Australia’s healthcare system [18,19]. These staff members have differing training and responsibilities. The RNs need to complete a 3 year baccalaureate program in a university, whereas EENs undertake an 18 months program conducted in a vocational training centre such as College of Technical and Further Education and then complete additional training on medication management. The RNs are the team leaders in a work shift, and the EENs work under RNs’ direction and supervision.

The RNs and the EENs were responsible for medication documentation, preparing shift handover reports, developing and updating residents’ care plans, and completing information on funding of care. However, administration and documentation of drugs of addiction was fully the responsibility of RNs. With the introduction of the electronic system, most documentation was automatically performed as indicated in Section 2.2 (system details).

2.5.2. Personal Carers
Personal Carers (PCs) in Australian nursing homes provide basic care to the residents, for example, showering. They work under the direction and supervision of a registered or enrolled nurse. The PCs were responsible for writing progress notes and completing charts and forms using the electronic system. They completed most of this documentation as they provide most direct care services in a nursing home [20].

2.5.3. Recreational activity officers
Recreational activity officers (RAOs) are responsible of planning, implementing and evaluating leisure and recreational programs for individual residents [21]. They work under supervision of a residential service manager. The RAOs manually charted the involvement of each resident in recreational activities. However, they documented in the electronic system whenever they were involved in direct care of residents, such as feeding.

3. Methods

3.1. Study design
This study was carried out using work sampling with an observational component. This technique was first developed by Tippett in 1935 for use in industrial engineering and management [22]. It requires a trained observer or a team of observers to use a pre-defined classification of activities in recording the specific activity being undertaken at a particular time, based on pre-defined or randomly selected time intervals.

3.2. Study flow
Following approaches taken by other researchers [23,24], the current investigation was conducted in four separate periods. The first period was 2 months before the introduction of an electronic documentation system. The second, third and fourth periods were at 3, 6 and 12 months after implementation of the system, respectively (Fig. 1). These periods of study represent the different stages of electronic system implementation [25]: the learning stage (after 3 months), early use (after 6 months) and when the system is fully integrated into routine practice (after 12 months). Each period of data collection was conducted in a day shift (6.45 am to 3.15 pm) and lasted 5 days (Monday, Tuesday, Wednesday, Saturday and Sunday).

3.3. Participants
All nursing staff working in a day shift including RNs, EENs, PCs and RAOs agreed to participate in the study. On a typical day shift, staff on the floor comprised one RN, one EEN, 12 PCs and one RAO. Nursing staff working on afternoon or night shifts were excluded from the investigation as well as staff on orientation, those on stand-by assisting with activities on the
floor, temporary employees from an employment agency and RNs assigned to administrative tasks.

3.4. Documentation activities

All possible documentation activities for the nursing staff, including paper-based and computer-based activities were identified from previously published instruments [12,26,27]. Details of procedures followed in validating these activities, including assessment of inter-rater reliability, are described by Munyisia et al. [28]. The resulting activities included taking records from the storage place, flipping through to identify the correct page, reviewing resident information/reading notes, writing progress notes/charts and forms, putting records back to the filing area, medication documentation, admission documentation, documentation to transport a resident to hospital, locating the correct window, inputting a username and password, typing progress notes/charts and forms, and closing the electronic system.

3.5. Observer

Observations were made by a Ph.D. candidate (ENM) who is an experienced observer and with practical knowledge of residential aged care work. These characteristics helped the observer to identify and record documentation activities.

3.6. Study procedures

Before the first period of data collection, the observer visited the facility on two separate days and was introduced by the residential service manager to the nursing staff in their handover shift meeting. The observer talked to the nursing staff and reassured them that the study was not meant to seek faults but to understand changes in the proportion of time they spent on documentation before and after the introduction of an electronic documentation system. This meeting enabled the observer to familiarize with the nursing staff, and also for them to become comfortable with the observer, which could potentially minimize the ‘Hawthorne effect’ and lead to an accurate recording of documentation activities for staff. The observer also explained the purpose and method of study to the nursing staff and invited them to participate in the investigation. An information sheet about the study was provided to each nursing staff member to read, understand and ask questions, before consent to their participation was sought.

During data collection, observations were made at an interval of 9 min/h. The observer started making observations from a fixed location in the nursing home. Following the same route on each round of observation, all documentation activities being undertaken by each staff member were recorded. Brief communication between the observer and a nursing staff member to clarify a documentation activity being undertaken was allowed when necessary. The observed activities for the nursing staff were recorded on a tabular data collection form using a unique code number allocated to each task. The tabular form contained information about the day and date of observation, and whether a nursing staff member under observation was an RN, EEN, RAO or FC. A dash (–) was used to denote a nursing staff member who was not observed during a given round of observation. The study methods and procedures remained the same for the four periods of data collection.

3.7. Analysis

Data were entered into MS Excel 2003 spreadsheet and exported to a Statistical Package for Social Sciences (SPSS) 17.0 for analysis. Any items with less than five data entries at a specific measurement period were excluded from the analysis. Unlike in time motion studies, where the exact time on an activity is measured, in this study occurrences of documentation activities were recorded. For ease of reporting this data, activity occurrences were converted into a percentage, and the main outcome variable of time reported as ‘percentage of time’. This format of reporting work sampling data has been validated by the previous studies [29,30].

The percentage of time spent on each documentation activity was calculated using descriptive statistics with 90%
confidence intervals (CI). We chose to use this CI because of our limited resources; a single observer (ENM) made observations for this study, unlike previous work sampling studies [12,31] with two or more observers. This situation might have reduced our sample size. Other researchers in healthcare have also used this CI in reporting their results [32].

Any significant differences in proportions of time across the four data points were identified using Pearson's chi-square test. Statistical significance was assumed when the p-value was less than 0.10. If a significant difference was identified, post hoc comparison of proportions of time between any two of the four periods of study was conducted using Pearson's chi-square test.

We also used Pearson's chi-square test to analyse the proportion of time spent on paper-based and on computer-based documentation tasks after the introduction of the electronic system. The proportions of time spent on paper or on computer documentation tasks across the three data points were compared. If any significant difference was identified, post hoc comparison of proportions of time between any two of the three data points was conducted. The proportions of time spent on paper-based and computer-based documentation tasks at the same data point were also compared to determine any differences amongst them.

4. Results

A total of 1695 documentation activities were recorded. Three hundred and eighty three (383) activities were recorded before the introduction of the electronic system, 472 at 3 months, 502 at 6 months, and 338 at 12 months after implementation of the system. Forty seven (47) nursing staff were observed before the introduction of the electronic system, 53 after 3 months, and 54, after both 6 and 12 months of using the electronic system (Table 2). Most of the observed nursing staff were PCs (73.1%).

There was no significant variation amongst the four data collection periods in the number of observed nursing staff in different job roles.

The recorded numbers of documentation activities for the RAOs were too few for analysis at all measurement periods. Thus, they were excluded from the analysis by level of nursing staff, but are included where the proportion of documentation for entire nursing staff is reported.

4.1. The proportion of time spent on documentation activities by nursing staff before and after the introduction of electronic nursing documentation

Table 3 shows the overall results of the changes in proportion of time on documentation activities before and after the introduction of the electronic system. In general, there was no significant variation in the proportion of time spent on documentation using the paper-based system and the proportion of time spent 3 months after implementation of the electronic system. Six months after implementation, the proportion of time on documentation increased significantly compared with the proportion recorded when the paper-based system was used (p = 0.02). The proportion of time on documentation returned to a level similar to that for the paper-based system 12 months after implementation of the electronic system.

We compared nursing staff's proportion of time spent on documentation after the implementation of the electronic system and the proportion of time spent on documentation in the paper-based system. At 3 months after implementation of the electronic system, RNs' and EENs' proportions of time spent on documentation reduced significantly from those recorded when they were using the paper-based system (p = 0.08 and p = 0.02, respectively). In contrast, the PCs' proportion of time spent on documentation in this period greatly increased (p < 0.01).

At 6 months after the introduction of the electronic system, the RNs' proportion of time on documentation increased considerably compared with the proportion when the paper-based system was used (p = 0.04). The EENs' proportion of time on documentation rose to a level similar to the proportion in the paper-based system. Personal Carers' proportion of time on documentation remained significantly higher than the proportion recorded when using paper-based methods (p < 0.01).

At 12 months into electronic documentation, RNs' and EENs' proportions of time spent on documentation reduced significantly compared with the proportions of time at 6 months after implementation. The RNs' proportion of time was not significantly different to the proportion recorded in the period prior to the introduction of the electronic system. The PCs' proportion of time on documentation continued to remain significantly higher than the proportion of time spent using the paper-based system (p < 0.01); however, this proportion was lower than that at three and at 6 months after the implementation of the electronic system (Table 3).

4.2. The proportion of time spent by nursing staff on documentation activities performed using paper and with computer

Analysis of the proportions of time spent by nursing staff on documentation activities performed using paper and with computer is presented in Table 4. Overall, slightly over half of the proportion of time on documentation at 6 and 12 months after implementation was spent on paper documentation activities. A majority of the proportion of time spent on documentation by both RNs' and EENs' involved use of paper-based records at each measurement period after the introduction of the electronic system (p < 0.01). The PCs spent a greater proportion of their documentation time working with computer than with paper across all the measurement periods after the implementation of electronic documentation (p < 0.01).

5. Discussion

This study examined the effect of introducing an electronic nursing documentation system in a nursing home on the proportion of time nursing staff spend on documentation. To our knowledge, this investigation is the first of its kind to be undertaken in the setting of a nursing home. Moreover, longitudinal measurement with four data collection points spanning 14 months is unique amongst studies conducted with a similar aim in other settings [11-13,15,16,33]. This
approach has led to findings that enrich our understanding of the dynamics in nursing staff’s proportion of time on documentation after the introduction of an electronic system; right from the learning period to when the system is more stable and integrated into routine practice [34].

It is widely anticipated that the introduction of electronic documentation in nursing practice will reduce time spent on documentation of care by nursing staff, through elimination of repetitive data entry processes in the paper-based system [2]. This expectation was not supported by this study. The proportion of time spent on documentation 3 months after implementation of the electronic system was similar to that when using the paper-based system. Six months after implementation, a greater proportion of time was spent on documentation compared with the initial proportion in the paper-based system. After 12 months of using the electronic system, the proportion of time on documentation dropped to a level similar to the proportion when the paper-based system was used.

One possible reason for the non-reduction in the proportion of time spent on documentation is nursing staff’s practice of documenting some information items on paper and others on a computer. Over half of the proportion of time on documentation at 6 and 12 months after implementation was spent on paper documentation tasks. There may be several reasons for the relatively high proportion of time spent on paper documentation. First, nursing staff not only charted certain information on paper (Table 1), but also used paper when it was more convenient and practical to do so because the information could not be captured on computer. For instance, they preferred documenting on paper in real time at the point of care to aid their memory. Nursing staff would note continuity information on a piece of paper at the time when they delivered care, then at some point, particularly at the end of a work-shift, enter the information into a computer. This action reveals the limitations of some computer systems.

In addition, nursing staff used paper to alert, notify or prompt their colleagues to take action based on new information. They used a diary or ‘communication book’ to pass essential information to their colleagues working on a different work shift. Such information included the need for early preparation of a resident to accompany his or her family members. Although this information could be recorded in a resident’s progress notes in the electronic system, it was charted on paper instead. The electronic system had no alert signal for new information, thus, paper was seen as a more

Table 2 – The number of nursing staff at different measurement periods.\(^a\)

<table>
<thead>
<tr>
<th>Type of nursing staff</th>
<th>2 Months before implementation n (%)</th>
<th>3 Months after implementation n (%)</th>
<th>6 Months after implementation n (%)</th>
<th>12 Months after implementation n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of RNs</td>
<td>6 (10.6)</td>
<td>5 (9.4)</td>
<td>7 (13.0)</td>
<td>7 (13.0)</td>
</tr>
<tr>
<td>Number of EENs</td>
<td>5 (10.6)</td>
<td>4 (7.5)</td>
<td>5 (9.3)</td>
<td>3 (5.6)</td>
</tr>
<tr>
<td>Number of PCs</td>
<td>40 (71.5)</td>
<td>40 (74.0)</td>
<td>38 (70.4)</td>
<td>38 (70.4)</td>
</tr>
<tr>
<td>Number of RAOs</td>
<td>3 (6.4)</td>
<td>3 (5.7)</td>
<td>4 (7.4)</td>
<td>6 (11.1)</td>
</tr>
<tr>
<td>Total</td>
<td>47 (100.0)</td>
<td>53 (100.0)</td>
<td>54 (100.0)</td>
<td>54 (100.0)</td>
</tr>
</tbody>
</table>

\(^a\) Numbers include double counts of some nursing staff. For example, in the study period 2 months before implementation, only two RNs worked on a morning shift, one was on duty for 3 days and another for 2 days.

Table 3 – The proportion of time nursing staff spent on documentation activities before and after the introduction of the electronic nursing documentation system.

<table>
<thead>
<tr>
<th>Nursing staff</th>
<th>Percentage of nursing staff time in documentation activity (90% confidence interval)</th>
<th>Chi square(^d)</th>
<th>p-Value(^d)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 Months before implementation</td>
<td>3 Months after implementation</td>
<td>6 Months after implementation</td>
</tr>
<tr>
<td>Nursing staff in general</td>
<td></td>
<td>18.410</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>RNs</td>
<td>10.7% (9.8–11.5)(^c) (n = 383)</td>
<td>11.7% (10.9–12.6)(^b) (n = 472)</td>
<td>12.5% (11.6–13.3)(^b) (n = 502)</td>
</tr>
<tr>
<td>EENs</td>
<td>20% (16.8–23.2)(^a) (n = 86)</td>
<td>15.6% (12.9–18.3)(^b) (n = 75)</td>
<td>26.2% (22.4–30.1)(^c) (n = 92)</td>
</tr>
<tr>
<td>PCs</td>
<td>32.3% (28.1–36.6)(^a) (n = 107)</td>
<td>23.8% (19.5–28.2)(^b) (n = 62)</td>
<td>30.1% (26.1–34.1)(^a) (n = 109)</td>
</tr>
<tr>
<td></td>
<td>6.5% (5.7–7.3)(^a) (n = 177)</td>
<td>10.3% (9.4–11.2)(^b) (n = 329)</td>
<td>9.2% (8.4–10.1)(^b) (n = 298)</td>
</tr>
</tbody>
</table>

\(n\) = number of observed recordings.
\(^1\) The same superscript letter between measurement periods represents no significant difference in the proportion of time spent on documentation. Different superscript letters between measurement periods denote a significant difference in the proportion of time on documentation.
\(^2\) Chi-square score across the four measurement periods.
\(^3\) Significance difference in proportions of time on documentation across the four measurement periods.
Table 4 – The proportion of time nursing staff spent on documentation activities performed using paper and with computer.

<table>
<thead>
<tr>
<th>Nursing staff</th>
<th>Documentation activities</th>
<th>Percentage of nursing staff time in documentation activity (90% confidence interval)</th>
<th>Chi-square†</th>
<th>p-Value‡</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3 Months after implementation</td>
<td>6 Months after implementation</td>
<td>12 Months after implementation</td>
</tr>
<tr>
<td>Nursing staff in general</td>
<td>Performed using paper</td>
<td>42.6% (38.8–46.3)¹</td>
<td>56.6% (52.9–60.2)²</td>
<td>50.6% (46.1–55.1)³</td>
</tr>
<tr>
<td></td>
<td>Performed with computer</td>
<td>57.4% (53.7–61.2)⁴</td>
<td>43.4% (39.8–47.1)⁵</td>
<td>49.4% (44.9–53.3)⁶</td>
</tr>
<tr>
<td>RNS</td>
<td>Performed using paper</td>
<td>68.0% (59.1–76.9)¹</td>
<td>78.3% (71.2–85.3)²</td>
<td>75.0% (66.8–83.2)³</td>
</tr>
<tr>
<td>EENs</td>
<td>Performed using paper</td>
<td>72.6% (63.3–81.9)¹</td>
<td>79.8% (73.5–86.1)²</td>
<td>67.4% (55.7–79.2)³</td>
</tr>
<tr>
<td>PCs</td>
<td>Performed using computer</td>
<td>27.4% (18.1–36.7)¹</td>
<td>20.2% (13.9–26.5)²</td>
<td>32.6% (20.8–44.3)³</td>
</tr>
<tr>
<td></td>
<td>Performed with computer</td>
<td>31.9% (27.7–36.1)⁴</td>
<td>41.3% (36.6–46.0)⁵</td>
<td>38.5% (33.1–44.0)⁶</td>
</tr>
<tr>
<td></td>
<td>Performed with computer</td>
<td>68.1% (63.9–73.3)⁷</td>
<td>58.7% (54.0–63.4)⁸</td>
<td>61.5% (56.1–66.9)⁹</td>
</tr>
</tbody>
</table>

n = number of observed recordings.

† The same superscript letter between measurement periods represents no significant difference in the proportion of time spent on documentation. Different superscript letters between measurement periods denote a significant difference in the proportion of time spent on documentation, and no superscript letters amongst the measurement periods denotes no significant difference in the proportion of time on documentation.

‡ Chi-square score across the three measurement periods. A single chi-square score represents documentation activities performed using paper and with computer as their analysis datasets were inverse of each other.

§ Significance difference in proportions of time on documentation across the three measurement periods. A single p-value represents documentation activities performed using paper and with computer as their analysis datasets were inverse of each other.

effective channel for passing this information than computer. The use of paper in this case provides useful information for improvement of the electronic system.

There was no difference in the proportion of time spent on documentation before and 3 months after the introduction of the electronic system. At this period, nursing staff were still learning how to use the electronic system in their work and their speed in data entry and searching the correct module was slow. This is evident from the relatively high proportion of time spent on computer-based documentation at this measurement period (57.4%, Table 4). Similar results were reached in an investigation undertaken 3 months after the introduction of an electronic documentation system in a hospital's paediatric ward [15].

The proportion of time spent on documentation at 6 months after implementation was higher than the proportion recorded in the paper-based system. This finding may be attributed to increased documentation requirements at this measurement period. Nursing staff were required to complete a 24-h shift handover report and continence information using the electronic system. This task appeared to take longer on computer than on paper. Our finding is contrary to those of previous studies [11,12] which reported a reduction in time at the similar period after electronic system introduction. The difference may be due to variations in study settings, the mix of study participants, study design, and documentation activities under investigation.

The proportion of time spent on documentation at 12 months after implementation was not different from the proportion when the paper-based system was used. Our finding at this measurement period is similar to results reported by Hakes and Whittington [16]. However, their finding was only for the activities of admission and routine documentation procedures in a surgical ward. A specific explanation for our current finding may be that after 1 year of using the electronic system, nursing staff had familiarized with the system, including documentation of continence information and shift handover report. Therefore, they could complete their documentation at a reasonable speed.

Despite the lack of a reduction in time on documentation after the implementation of the electronic system, care staff members seem positive toward the system because of its other benefits in their work. In our recent survey of the perceptions of the nursing staff members in the same facility about quality of information and benefits of electronic nursing documentation, nursing staff perceived this system had increased the accessibility, accuracy and legibility of the residents’ records. Repetitions in data entry were also reduced [9]. Such
benefits appear to motivate nursing staff to continue using this electronic system.

To improve efficiency of documentation, management of the nursing home is using the feedback from the study to identify strategies to improve management and usage of the electronic system. They are exploring the possibility of moving all paper forms on computer; for instance, computerizing medication documentation forms through the introduction of an electronic medication management system. They are also looking into the possibility of introducing mobile computing technology at the point of care to support documentation efforts of the nursing staff.

5.1. The proportion of time spent on documentation activities by nursing staff in different job-roles before and after the introduction of electronic documentation

5.1.1. Registered Nurses and Endorsed Enrolled Nurses
An electronic system is not only expected to support nursing staff in delivery of care, but also to free them from documentation duties and enable them to spend more time on direct care work [17]. Apparently, there was no conclusive evidence about a reduction in proportion of time on documentation for the RNs and the EENs in this study. The RNs’ proportion of time reduced only in the period after using the electronic system for 3 months, but not after 6 and 12 months. The EENs’ proportion of time reduced only after 3 and 12 months of using the electronic system, and not after 6 months.

The reduction in proportion of time on documentation at 3 months after implementation of the electronic system may be attributed to RNs’ and EENs’ positive attitude and enthusiasm to use a newly introduced system in their practice [35]. Such positive characteristics might have enabled RNs and EENs to quickly learn and apply the electronic system in their documentation practice. To aid their learning, the electronic system was user-friendly, with most documentation responsibilities completed automatically (Sections 2.2 and 2.5.1), based on data already entered into the electronic system by PCs (Section 2.5.2). This means that RNs and EENs did not have to create their documentation in the electronic system from scratch, as they were already recorded in the system. The positive characteristics of the users and the system might have contributed to the efficiency in documentation at this period.

The RNs’ and EENs’ proportion of time on documentation increased at 6 months after implementation compared with the proportion in the paper-based system. This increase may partly be attributed to increased documentation requirements. Apart from two handover reports completed on each work shift (summary report and administrative report, Table 1), an additional handover report covering all shifts in 24 h was introduced at this measurement period (Table 1). The 24-h report was comprehensive, with detailed description of the care provided to residents. Although a comprehensive nursing report is necessary in facilitating continuity of care, the process involved in completing such a report might have taken RNs and EENs longer time to learn and adapt in their daily work [36].

Paper-based workarounds created by RNs and EENs in the course of their duties may also account for the increase in the proportion of time on documentation. The RNs and EENs recorded and kept certain information on paper as well as in the electronic system, i.e., residents’ glucose levels. The paper-based copy was seen as easier to retrieve and share with other healthcare staff such as doctors. This copy also facilitated quick assessment and evaluation of a resident’s healthcare status because data were organized in a longitudinal format and thus, it was easier for viewing. The electronic system poorly supported this format of data; data were located in various sections in the system. Such information could be used to improve the electronic system, and potentially save nursing staff time on documentation [37].

The RNs’ and EENs’ proportion of time on documentation reduced significantly 12 months after using the electronic system compared with the proportion at 6 months after implementation. The RNs and EENs appear to have familiarized with both electronic and paper-based documentation system at this measurement period. Their skills and knowledge of applying the complex documentation system including paper workarounds seem to have increased at this period. Although EENs managed to achieve a remarkable reduction in proportion of time on documentation at this period compared to the proportion in the paper-based system, RNs’ proportion of time on documentation only reduced to a level similar to the value recorded when the paper-based system was used. Variations in RNs’ and EENs’ patterns of the proportion of time on documentation may be attributed to their differences in documentation practice as indicated in Section 2.5.1.

5.1.2. Personal Carers
The proportion of time PCs spent on documentation at all measurement periods after the introduction of the electronic system was significantly higher than the proportion in the period when the paper-based system was used. This increase may be a result of the slow typing speed observed in a number of these staff members. It is possible that they took longer to input a username, locate the correct module, and type progress notes, charts and forms, than writing on paper. In a study exploring barriers to adoption of information technology in Australia’s aged care settings, Yu and Comensoli [38] found limited computer skills to be a problem amongst older nursing staff. This group of staff members may have missed the opportunity to learn how to use computers in their nursing education. Indeed, Lee et al. [39] found old age of nursing staff to be associated with increased time spent on documentation when using an electronic system.

The high proportion of time on documentation may also be a result of the workflow and speed of the electronic system. The workflow in the electronic system (the process followed to accomplish a task) [40,41] may have contributed to increased proportion of time on documentation. The process followed by a nursing staff member to record a resident’s continence information provides an illustration. In the electronic system, a staff member is required to complete three structured drop-down menus by selecting appropriate continence information from a list, then type a password before closing a window for a resident’s continence chart. This process was repeated to complete another resident’s chart. The paper-based system required a single input in a resident’s continence chart, and a flip-over to complete another resident’s chart. The PCs perceived the procedure in the electronic system as more time
consumption compared with their previous workflow in the paper-based system.

In addition, one had to transition through a minimum of four screens to access and complete the continence chart. The PCs perceived time taken to navigate from one screen to another as slow. This situation is not only frustrating but also increases the amount of time in-front of the screen [5]. In an interview with nursing staff in a nursing home, Yu et al. [42] found nursing staff dissatisfied with the running speed of their electronic system. Another study in a hospital setting found similar results [6]. Thus, the speed of an electronic system is critical for users in healthcare and should never be undervalued [43].

5.2. Limitations of the study

This study was conducted in a single nursing home. It was framed by the particular organizational structure, culture, task allocation, work processes, and the electronic system used. This limits the generalisability of findings. The study was also confined to a day shift. The effect of an electronic system on documentation time for the nursing staff working in the afternoon and night shifts may be different. Therefore, the change in proportion of time on documentation following the introduction of the electronic system in the day shift may not be applicable to the proportion of time in the other two shifts.

Our investigation used a work sampling technique. This method is useful in evaluating time on activities in healthcare. For example, it allows many observations to be recorded in a short period, thus increasing the representativeness of data obtained. However, time obtained is an estimate and not the exact time on a given activity. There was no measurement of the PCs’ typing speed before and after the introduction of the electronic documentation system. Such measurement would provide useful data that increases our certainty about whether PCs’ increased time on electronic documentation was associated with slow typing speed.

This investigation used a single observer to record observations, which may incur personal bias. However, inter-rater reliability testing achieved a high score [28], suggesting the observer’s recording was trustworthy.

This study was limited to measuring the proportion of time on documentation up to 12 months after implementation. Measurements conducted after 12 months may have provided additional information that clarifies the recorded pattern in the proportion of time on documentation. Nevertheless, this study has provided longitudinal data that has not been found in the literature to date.

6. Conclusion

Findings of this study show that the introduction of the electronic documentation system in the nursing home did not reduce the proportion of time nursing staff spent on documentation. This could in part be a result of the nursing staff’s practice of documenting some information items on paper and others on a computer. An in-depth understanding of nursing staff’s information needs and documentation workflow is important before an attempt is made to redesign or update an electronic system to reduce use of paper or to achieve a paper-free documentation environment in a nursing home.

There was no conclusive evidence of reduction in proportion of time on documentation for the RNs’ and EENs’ following the use of the electronic documentation system. Further research is required to clarify the efficiency of an electronic system on the amount of time that RNs and EENs spend charting care. The PCs’ proportion of time on documentation increased during the electronic documentation period. This may suggest the need for continuous training on basic computer skills and use of the electronic system, as well as regular system updates.

Individuals planning to introduce an electronic system in a nursing home with the aim of reducing documentation time should consider other factors that may influence the achievement of this goal. These include speed of the system, users’ familiarity with the system, and their speed of typing. Measurement of the PCs’ typing speed is necessary in monitoring their progress in achieving computer skills. Longitudinal research in other nursing homes is needed to validate findings of this study.

Ethical considerations

All procedures used in this study were approved by the Human Research Ethics Committee, University of Wollongong, Australia, and complied with the National Health and Medical Research Council National Statement on Ethical Conduct in Research Involving Humans, 1999.

Authors’ contribution

Esther Naliaka Munyisia contributed toward study design, development and validation of the work sampling instrument, acquisition of data, statistical data analysis, data interpretation and manuscript preparation; Ping Yu was responsible for study conceptualization and design, validation of the work sampling instrument, statistical data analysis, data interpretation, revising the paper for important intellectual content and final approval of the version to be submitted; David Haley contributed toward data interpretation, revising the paper for important intellectual content and final approval of the version to be submitted.

Conflict of interest

The authors have no conflict of interest.

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