# MSc Digital Transformation

# for the Health and Care Professions

# BMDS7005

Evaluation of Nursing Documentation in Welsh Critical Care: Quality, Efficiency, Accessibility, and Improvement Opportunities

Dissertation submitted in partial fulfilment of the award of

Master of Science in Digital Transformation for the Health and Care Professions

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**Declaration**

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

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# Chapter 1. Introduction

This project evaluated current documentation in critical care health services in Wales from a nursing perspective, particularly the current state of nursing documentation quality, time taken to find certain data items, and time taken to complete nursing documentation within critical care. This allowed the identification of areas where improvements can potentially be achieved using a clinical information system. The nursing perspective was chosen due to the researchers' clinical experience and background as a critical care nurse. The potential digital intervention will be the introduction of a clinical information system within critical care with the support of any improvements identified.

The evaluation covered the current state of documentation prior to the development and deployment of the Welsh Intensive Care Information System (WICIS). The WICIS system is being developed using the Digistat technical platform created by ASCOM as outlined by Digital Health and Care Wales (2020) in an article about the clinical information system. There were several aims set out in 'A Healthier Wales' (2018), a Welsh Government strategy, with one aim looking at using technology to support high-quality, sustainable services. Digital Health and Care Wales discussed with Vaughan Gething, Minister for the Economy of Wales (2020), that the WICIS system will also allow clinicians more time to care for patients, thus enhancing the delivery of patient care. The Welsh Government have supported the development of the WICIS system with health boards and the Critical Care Trauma Network. Once developed, the system will be deployed to all 13 adult critical care units across Wales (Digital Health and Care Wales, 2024). The system will replace current paper documentation processes apart from 3 units, which currently have a system that will be replaced by the new clinical information system (Digital Health and Care Wales, 2024).

Critical Care Clinical Information System (CCCIS) was the original name used throughout procurement prior to it being renamed WICIS. The expected functionality and key requirements of the system at the point of procurement were outlined in the Prior Information Notice (Bidstats, 2018) and the Tender Notice (Bidstats, 2019). The aim of procuring this system was to help with data collection from the various medical equipment in use in critical care using automatic collection where possible. This is to support the documentation burden experienced within critical care where the clinical environment involves a large quantity of rich data collection. As part of the contract award (Bidstats, 2021), it was stated that the system should lead to a complete transition to digital documentation and data capture from the current position at the time of contract award of paper-based processes in the majority of critical care units in Wales.

The identification of the potential benefits of a digital intervention in healthcare was measured through the utilisation of three research questions:

1. Are there areas of nursing documentation within critical care where quality can be improved by implementing a clinical information system?

2. Are there any areas where ease of access to information within critical care can be improved by implementing a clinical information system?

3. Does the current time taken for nursing documentation have the potential to be improved through the implementation of a clinical information system?

The effect was measured through data collection based on the current state of documentation. Documentation quality was assessed taking into consideration the latest Nursing and Midwifery Council (2009) guidelines regarding documentation standards. This was undertaken to look at the current state of documentation to provide a benchmark before a clinical information system was developed and deployed. An assessment of the current time taken was undertaken to find certain data items, and the data was analysed for areas where improvement could be achieved. The potential effect of the digital intervention is focused on only one group of clinicians within critical care: nurses. This is due to nurses being the largest clinical group involved in documentation in critical care as well as the largest clinical group within the critical care workforce, as identified within the Guidelines for Provision of Intensive Care Services by The Faculty of Intensive Care Medicine and Intensive Care Society (2022). A data collection plan was developed and then reviewed once a literature review had been undertaken. This was to ensure best practice was undertaken and ensure any lessons learnt from previous studies were considered prior to data collection commencing. A timeline for this research has been created and can be found in Appendix 1.

Therefore, this research activity had the following objectives set out prior to discussion of methodology and data collection:

1. Understand the current quality of nursing documentation within critical care.

2. Understand the time taken to complete nursing documentation currently within critical care.

3. Understand the time taken to find certain data items within critical care.

4. Identify areas for improvement in documentation quality within critical care when a clinical information system is introduced.

5. Identify areas of potential improvement in the time taken to complete nursing documentation within critical care

6. Identify areas of potential improvement in the accessibility of information within critical care.

# Chapter 2. Literature Review

As part of this research, a literature review was undertaken to support the answering of the three specific research questions. As there are three objectives of the study, a different literature search was conducted for each objective. This was done to provide a wide range of literature to support the three specific research questions and help inform the methodology of the service evaluation. A limit on the search was introduced so that only articles from 2013 would be returned due to the first purpose-built critical care clinical information system being developed in 2003, as identified by De Georgia et al. (2015). This was done to provide a sufficient time frame for research to be undertaken and literature published based on clinical information systems within critical care. The focus of the literature review looked at peer-reviewed articles in the English language. Once the literature review was completed, the same strategy was used to look for results from grey literature.

The first literature search looked for literature to support the initial question: 'Are there areas of nursing documentation within critical care where quality can be improved by implementing a clinical information system?'

The second literature search looked for literature relating to the research question: 'Are there any areas where ease of access to information within critical care can be improved by implementing a clinical information system?'

The final literature search was based on the final research question: 'Does the current time taken for nursing documentation have the potential to be improved through the implementation of a clinical information system?'

## 2.1 Literature Review Screening

Cumulative Index to Nursing & Allied Health (CINAHL) was the first database to be searched. The first literature search looked for all text for the terms "clinical information systems", "AND documentation", and "AND quality". This provided a total of 203 results returned. The second literature search performed using CINAHL looked for all text containing the terms "clinical information systems", "AND access", and "AND critical care or intensive care or icu" again with a publication start date of January 2013 and a filter to only show peer-reviewed results in the English language. This returned a total of 131 results. The third search performed using CINAHL looked for all text containing the terms "clinical information systems" and "AND documentation time", which returned 8 results. The final search looked for generic literature relating to the research questions using the search criteria of "nursing documentation" and "AND critical care", which returned 19 results.

The next database used as part of the literature review was the National Library of Medicine PubMed. The first literature review searched for the terms "clinical information systems", "AND documentation quality", and "AND critical care". This returned 138 results based on these search parameters. The second search looked

for the terms “clinical information systems”, “AND access”, and “AND intensive care, which returned 196 results. The third search again changed the terminology searched for to “clinical information systems”, “AND documentation” and “time” which returned 15 results. The final search performed looked at the terms “nursing documentation” and “AND critical care” which returned 29 results.

The Cochrane Library database was searched as the third separate database, looking solely at Cochrane reviews. All articles within the Cochrane Library are automatically translated into the English language, so the filter option of articles only in the English language was unavailable. The first search looked for articles with the term filters of “clinical information systems”, “AND documentation quality”, and “AND critical care”, which returned 1382 results. The additional filters of “NOT paed*” and “NOT Child*” were added which reduced the search results to 162. The next search looked for the terms “clinical information systems”, “AND access”, and “AND critical care, which returned 156 results. The third search looked for the terms “clinical information systems”, “AND documentation”, and “AND time”, which returned 2764 results. Like the first search, the filters “NOT paed*” and “NOT child*” were added, which did not reduce the results again, returning 2764 results. The search was refined to “clinical information systems”, “AND documentation time”, “NOT paed*”, NOT child*” and “AND critical care”, which returned 1384 results. The search criteria were reviewed, and a search performed based on title abstract keyword of “clinical information system” and “AND documentation time” which returned 23 results. The final search looked for records containing “nursing documentation” and “AND critical care” which returned 103 results.

The last database to be searched as part of the literature review was Library Search @ UWTSD. The first search looked for the exact phrases “clinical information system”, “documentation”, and “quality”, which returned 33 results. The second search filtered results by the search criteria with the exact phrases of “clinical information systems”, “access”, and “critical care” which produced 8 results. The next search to support the third research question looked at the exact phrases of “clinical information system” and “documentation time” which returned zero results. The search criteria was then broken down into “clinical information system”, “documentation”, and “time” which returned 28 results. The final search through Library Search @ UWTSD looked for the exact phrases of “nursing documentation” and “critical care” which returned 23 results.

On completion of the above literature search, a total of 1275 articles were found. The results retrieved from the Cochrane Library databases were reviewed to ensure they were not reviews of literature found in the results returned from other databases. On review, there were no relations identified between the Cochrane reviews and literature found from other databases. When the results were collated and reviewed, 336 results were removed due to being duplicate records found across the different databases. The remaining 939 records were then screened to identify if any could be excluded based on the article title and abstract, which led to 801 records being excluded. This reduced the total number of records down to 138 records sought for retrieval. When the records were sought for retrieval, 130 records were able to be retrieved ahead of being assessed in detail to assess their suitability and relevance. These records were assessed for eligibility, with 54 records being excluded due to them not being relevant

to adult critical care and relating to a different clinical setting. A further 68 records were excluded as they were not relevant and able to support the answering of the research questions identified previously, leading to a final quantity of 8 records to be analysed and reviewed in further detail.

The four identified databases were utilised to support the initial literature review. However, outside of these databases, websites, organisations, and citation searching were used to identify further literature to support answering the identified research questions. A further 18 records were found through citation searching, no records were found during website searches, and 1 organisation record was found with all these records able to be retrieved. These 19 records were reviewed, and none of them were excluded as they did not meet the criteria for exclusion.

## 2.2 Finalised Screening

This review of the literature led to a final quantity of 8 records, which were identified through the databases searched. A further 19 records were identified through alternate searching of websites, organisations or citation searching. In Figure 2.1, the PRISMA flow diagram (Page *et al*., 2021) demonstrates a summary of the literature screening and the strategy used. The section that displays the identification of new studies via other methods is related to databases, websites, organisations, and citation searching mentioned in the exclusion criteria section above.

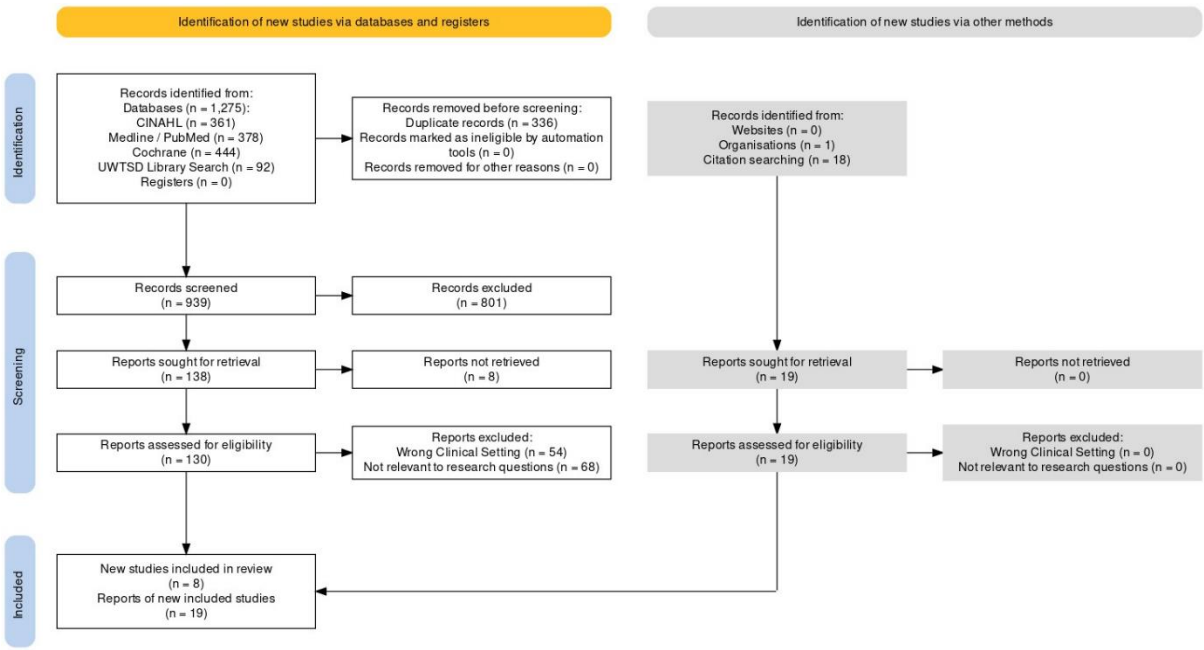



Figure 2.1 - Summary of literature screening using a PRISMA flow diagram

Therefore, a total of 27 records will now be classified and scored based on their relevance to the three research questions. In Table 2.1, the literature has been

reviewed, and a quality rating has been determined using the principles of the Cochrane GRADE approach by Schünemann *et al*. (2013).

Table 2.1 – Grading and Relevance of Articles

| **Reference** | ***Related to -*** *Are there areas of nursing documentation within critical care where quality can be improved by implementing a clinical information system?* | ***Related to -*** *Are there any areas where ease of access to information within critical care can be improved by implementing a clinical information system?* | ***Related to -*** *Does the current time taken for nursing documentation have the potential to be improved through the implementation of a clinical information system?* | **Quality Rating** |
|---|---|---|---|---|
| Bail *et al*. (2021) | Yes | No | No | High |
| Brundin-Mather *et al*. (2018) | Yes | Yes | No | High |
| Courtney and Wilson-Van Meter (2022) | Yes | No | Yes | Moderate |
| De Georgia *et al*. (2015) | Yes | No | Yes | Moderate |
| Ferdousi *et al*. (2021) | Yes | No | No | Moderate |
| Fraenkel, Cowie and Daley (2003) | No | No | Yes | Low |
| Guyer *et al*. (2022) | Yes | No | No | Moderate |
| Hammond *et al*. (1991) | Yes | No | No | Moderate |
| Hermon *et al*. (2015) | Yes | No | No | Moderate |
| Huang (2021) | Yes | Yes | No | Low |
| Joseph *et al*. (2020) | Yes | No | Yes | Moderate |
| Lin *et al*. (2019) | Yes | No | No | High |
| Mador and Shaw (2009) | No | No | Yes | High |
| Martich, Waldmann, and Imhoff (2004) | Yes | No | Yes | Moderate |
| NHS England (2023) | Yes | No | No | Moderate |
| Pabst, Scherubel, and Minnick (1996) | No | No | Yes | Moderate |
| Pierpont and Thilgen (1995) | No | No | Yes | Low |
| Poissant *et al*. (2005) | No | No | Yes | Moderate |
| Reese *et al*. (2018) | No | Yes | No | Moderate |
| Saarinen and Aho (2005) | No | No | Yes | Low |
| Sado (1999) | No | Yes | No | Moderate |
| Schnock *et al*. (2021) | Yes | No | No | Low |
| Stevens (2017) | Yes | No | No | Moderate |
| Su, Dufendach, and Wu (2019) | Yes | No | No | Moderate |
| Varon and Marik (2002) | Yes | Yes | No | Moderate |
| Yang *et al*. (2019) | Yes | No | No | Moderate |
| Yusof (2015) | Yes | No | Yes | Moderate |

The literature from the finalised screening was considered in further detail in relation to the three research questions. Also, the literature was reviewed to help inform the data collection questionnaires to be completed by the clinicians and inform the evaluation results.

## 2.3 Are there areas of nursing documentation within critical care where quality can be improved by implementing a clinical information system?

As part of the literature review, 19 reports were identified as supporting the answering of the first research question. Hammond *et al*. (1991) compared the differences between current paper practice and a clinical information system. They identified that digital documentation, compared to handwritten notes, improves the accuracy and quality of the documentation. Bail *et al*. (2021) did a comparison study examining both a paper and digital documentation system within critical care. They found that completeness was slightly improved in a digital system compared to paper, but both processes have similar failings in relation to documenting clinical reasoning. However, they found that digital systems, if developed properly, had better scope to improve clinical reasoning documentation. Brundin-Mather *et al*. (2018) compared data collection between manual or electronic processes of a critical care information system. They found that the electronic process improved data quality, but their study was more focused on data management and extraction from a clinical information system. Courtney and Wilson-Van Meter (2022) looked at a different approach again to the previous studies. As part of their study, they looked at an existing electronic health record and how it could be improved with the aim of reducing the documentation burden and, in turn, providing better quality documentation within the system. This highlighted that although the implementation of a clinical information system can improve documentation quality, it can cause side effects such as an increase in documentation burden or a higher volume of data to be inputted without improving documentation quality. This will be used as a consideration when evaluating the results of the pre- and post-implementation period and its relationship with documentation quality.

De Georgia *et al.* (2015) identified the importance of documentation quality and its relationship with data acquisition from medical devices. They found that documentation quality can be improved if data acquisition is utilised, which will, in turn, reduce transcription errors, but this leads to the additional complication of ensuring the correct equipment is utilised. Joseph *et al*. (2020) also looked at the benefits of interoperability between a clinical information system and medical devices, particularly infusion pumps. They found that interoperability improved the accuracy of clinical data, which in turn improved documentation quality. Ferdousi *et al.* (2020) found that documentation was one of seven areas that clinical information systems impact. They found that a common cause of whether documentation was improved or not through the introduction of a clinical information system related to the design of the system but also if they were easy to use and navigate. Guyer *et al*. (2022) study looked solely at allergy and adverse reaction recording. However, they identified that the quality of documentation of allergies and adverse reactions could be improved through clinical information systems and that for documentation quality to improve, it must be done through structured, coded entries with common allergies being grouped together and easily searched using pick lists. Additionally, if free text entries were used for documenting allergies, then there would be little to no improvement between digital

and paper processes. However, Su, Dufendach, and Wu (2019) found that free text entries were easier for clinicians to record, and while it may improve the quality and readability in comparison to paper documentation, this limits the quality and readability of the data for secondary uses due to the lack of structure.

In a limited study in a small unit as part of a quality improvement programme, Hermon *et al*. (2015) found that the implementation of a care bundle for documentation within a clinical information system improved compliance and completeness of documentation in comparison to the equivalent paper process. The care bundle was implemented into the workflow of an existing clinical information system, which they found led to seamless integration and did not cause any additional documentation pressure on the clinicians. Huang (2021) looked at the unseen work during the implementation of clinical information systems and identified that although documentation quality and accuracy may improve post-implementation, the clinician's perception of the system and any improvement is extrinsically linked to the burden placed on them by technological issues and downtime. Lin *et al*. (2019) performed a systematic review looking at clinician performance in relation to digital systems. They found that the quality of any decision made was improved through a clinical information system, but there was a gap in the literature looking at human factors which affect clinician decision-making and support. Stevens (2017) also undertook a review of electronic nursing documentation and showed documentation quality could be improved, but it was reliant on the appropriate policies and procedures to be in place to ensure care quality is being impacted and where practice gaps occur.

Martich, Waldmann, and Imhoff (2004) looked at the different risks and rewards associated with critical care clinical information systems. They found that documentation was more complete in a clinical information system and removed the limitations of paper, where only one person at a time can access the patient's records. NHS England (2023) developed an implementation guide to support clinical decisions within clinical information systems. They stated that integration of decision support with electronic observations allowed best practices to be promoted and ensured the clinical pathway was the most suitable for the patient. Current paper practices do not allow for decision support, which is, therefore, an additional benefit of clinical information systems that can improve documentation quality. Schnock *et al*. (2021) reviewed patterns within nursing documentation of an existing clinical information system in relation to patient deterioration. They found that the digital system allows the nurses to document clinical deterioration events and actions taken more clearly, which demonstrates that a clinical information system has the capability to improve the quality of documentation. Varon and Marik (2002) also found that a clinical information system could improve documentation practice and quality, but a limitation is adoption by clinicians due to a change in how they document and the level of detail they need to document. Yang *et al*. (2019) identified that critical care collates large volumes of clinical data. They identified that all the data collected needs to be processed and drawn together, and current paper practice limits this. They identified that clinical information systems help with the processing of this information and are able to assess and see patterns and trends within the patient record more easily. Yusof

(2015) undertook an evaluation of clinical information systems in critical care and found that although documentation quality may improve, there are many socio-technical factors, such as clinical workload, user attitude, and system ease of use, which contribute to the improvement other than the actual system implementation.

### 2.4 Are there any areas where ease of access to information within critical care can be improved by implementing a clinical information system?

Five reports were identified as being related to this research question as part of the literature review. Brundin-Mather *et al*. (2018) study compared data collection between paper and electronic processes. They found that electronic data was easier to access both in terms of the quantity of data accessible but also the time taken to find this information. Huang (2021) also identified that access to information was improved within a clinical information system but identified that there are also limitations that can affect the ease of access. They identified that the information was accessible so long as the system was accessible itself. Therefore, they identified that if there were issues with the network or the devices, the information would be harder to access. Reese et al. (2018) found that ease of access can be improved, but the ease of access is related to the design of the system. They found that if the information were grouped appropriately when developed, the information would be in the expected place when the clinicians are searching for it. This, therefore, means that system design can influence the ease of access to information. Sado (1999) identified an issue with current paper charts, which showed that accessibility was dependent on various factors such as legibility, correct filing, and correct storage. They found that a clinical information system reduces the lack of accessibility by mitigating some of these factors and by creating a central patient record that is fully legible. Additionally, Varon and Marik (2002) found that paper documents were not easily accessible, which in turn could create extra document burden, repeated testing, and referrals. They agreed with Sado (1999) that a clinical information system creates one single source of truth for data with wide accessibility to all clinicians involved in the patient's care.

### 2.5 Does the current time taken for nursing documentation have the potential to be improved through the implementation of a clinical information system?

Finally, 15 reports from the literature were identified that would contribute to the answering of the final research question. Mador and Shaw (2009) looked at all literature relating to time spent on documentation. As part of their review, they found contradictory reports of whether clinical information systems affect the time taken for documentation. This was due to a range of factors that could affect the time taken, such as system design, data quantity and quality, flow of information, and user processes. Courtney and Wilson-Van Meter (2022) found that documentation time can be reduced with a clinical information system implementation. However, they highlighted that this can only be achieved if the design is correct, and the documentation burden is not increased in comparison to current paper practices.

Fraenkel, Cowie, and Daley (2003) performed a limited observational study which looked at the implementation of a clinical information system and showed that nursing perception of time spent on documentation was less post-implementation than it was pre-implementation. The time taken to document routine information was also reduced post-implementation.

De Georgia *et al*. (2015) detected that a potential time-saving for documentation could be supported through device data acquisition, which in turn reduces the amount of transcribing required by the clinician. Joseph *et al*. (2020) also supported device data acquisition as a way of improving the time taken for documentation and that integration with medical devices, in turn, reduced time spent documenting the same information on paper documents. For physicians, the implementation of a clinical information system increases time spent on documentation (Martich, Waldmann and Imhoff, 2004). However, this was likely due to the computer itself and the design of the system. Therefore, the design and flow of the system is a key determining factor in whether the implementation has any effect on the time taken for documentation (Martich, Waldmann and Imhoff, 2004). Pabst, Scherubel, and Minnick (1996) stated that documentation time was reduced through the implementation of a clinical system, which provided an additional benefit for clinicians who had more time for direct patient care. Pierpont and Thilgen (1995) conducted a small study which looked at the effect of a digital clinical system and showed significant reductions post-implementation in time spent on documentation with the additional benefit of increased time with patients as the computers used were within the patients' rooms.

Time savings can be achieved with a clinical system, according to Poissant et al. (2005). However, they need to be looked at in the context of efficiency of time and tasks being performed rather than specific documentation timings. Saarinen and Aho (2005) considered that the implementation of a clinical information system increased time spent on documentation. However, they recognised their study had limitations due to the design and lack of automation and data capture within the system. They felt that with further changes made, documentation time would likely improve. In a case study evaluation of the adoption of a clinical information system, Yusof (2015) reported that most nurses found that the implementation provided them with more time to spend with their patients due to the reduction in documentation time.

## 2.6 Tabular Analysis

When reviewing the literature, it can be summarised by how it supports the research question and any conflicting research findings can be identified in Tables 2.2, 2.3 and 2.4.

Table 2.2 – Summary of Literature Review Results for “Are there areas of nursing documentation within critical care where quality can be improved by implementing a clinical information system?”

| **Reference** | **How does it support the research question?** | **Any conflicting research findings?** |
|---|---|---|
| Bail *et al*. (2021) | Digital documents more often rated as complete. Interventions to address risk documented more in digital. | Failure to capture and communicate clinical reasoning is evident in both paper and digital processes |
| Brundin-Mather *et al*. (2018) | Electronic data acquisition provides higher quality and is less susceptible to the data quality being diminished | There was agreement that the quality of data obtained both manually and electronically received from a data warehouse was exactly the same for the majority of data points. |
| Courtney and Wilson-Van Meter (2022) | Ongoing evaluation of a current EHR is key to ensure a high standard of documentation quality | Although an EHR may improve documentation quality, it may increase documentation burden |
| De Georgia *et al*. (2015) | Documentation captured within a clinical information system provides more richer data | Although data acquisition improves documentation quality, further work is needed to provide further improvements and refinements |
| Ferdousi *et al*. (2021) | Clinical information systems can improve quality of documentation through good design | Design of the system is a key factor as poor design will decrease the quality of documentation. |
| Guyer *et al*. (2022) | Quality of documentation of allergies within an EHR is improved due to the improved legibility | Quality improvements are directly related to the design of the system, layout and data points being captured |
| Hammond *et al*. (1991) | Accuracy and quality of documentation is improved through a clinical information system | Although documentation quality improved, quantity of documentation increased. |
| Hermon *et al*. (2015) | Electronic checklists enhance document process and quality | The improvement was only achieved due to continuous bedside teaching which could lead to a reduction of accuracy of completion and checklist fatigue |
| Huang (2021) | Documentation quality is improved through digital system | The user spends more time on the computer due to an increase in the documentation required to be completed |
| Joseph *et al*. (2020) | Automatic data integration with clinical system improves documentation quality within systems | Items may not be documented within the patient record if the users forget to document drugs being administered that do not go through a pump |
| Lin *et al*. (2019) | Quality of decisions made, and documentation of decisions were improved within clinical information systems | Human factors which affect decision making was not taken into consideration |
| Martich, Waldmann, and Imhoff (2004) | Documentation quality was improved due to being more complete. | Although documentation quality was improved, it had an adverse effect on time spent on documentation |
| NHS England (2023) | Guideline identified that decision support as part of any system will support improvement of documentation quality | If a system is designed without decision support, then any planned improvements in documentation quality will be minimal or a reduction in quality |
| Schnock *et al*. (2021) | Digital system improved documentation of patient deterioration and actions taken | Improvement in documentation was due to the design of the flow sheets. With poor design, this benefit would not have been achieved |
| Stevens (2017) | Quality of documentation can be improved through the use of clinical information systems | Quality is not improved through increasing the quantity of documentation |

| | | |
|---|---|---|
| Su, Dufendach, and Wu (2019) | Free text entries provide clinicians the ability to enter data easier | Lack of structure could affect the quality of the data and the ability to use it for secondary purposes |
| Varon and Marik (2002) | Increase in quality in particular charting documentation in line with current standards | Although quality can be improved, quality control measures are required to achieve this |
| Yang *et al*. (2019) | Clinical information systems help make the collation of data easier | The data collection requires clinicians to include statistical thinking in addition to their current day to day practices |
| Yusof (2015) | Documentation time is reduced which improved nurses' happiness with the system as it provides them with more time to care for the patient | There are many socio-technical factors that influence any improvement in documentation quality |

Table 2.3 – Summary of Literature Review Results for "Are there any areas where ease of access to information within critical care can be improved by implementing a clinical information system?"

| **Reference** | **How does it support the research question?** | **Any conflicting research findings?** |
|---|---|---|
| Brundin-Mather *et al*. (2018) | Digital systems are more efficient allow improved speed and volume of data available | Although data can be accessed more efficiently, these benefits could be eroded by the quantity of data |
| Huang (2021) | Documentation is more accessible compared to paper practices | The user may spend more time resolving issues with the computer and if unable to access the system leads to inaccessibility of information |
| Reese *et al*. (2018) | Access was made easier due to set groupings of common workflows | If the workflows are not designed correctly, data may be more difficult to find due to it not being where users expect it to be |
| Sado (1999) | A central legible documentation record Is available within a clinical information system creating wider accessibility | Although the record can be more accessible, it must be structured in a way to make data access easier |
| Varon and Marik (2002) | Information within the patient medical record can be shared and discussed both now at the patient bedside and remotely | Access to the information is dependent on adequate computers and access can be affected by computer malfunctions and incompatibilities |

Table 2.4 – Summary of Literature Review Results for "Does the current time taken for nursing documentation have the potential to be improved through the implementation of a clinical information system?

| Reference | How does it support the research question? | Any conflicting research findings? |
|---|---|---|
| Courtney and Wilson-Vanmeter (2022) | Documenting within a EHR is one of the most time-consuming activities a nurse performs but documentation time can still be reduced compared to paper processes | Although documentation time can be reduced, it is dependent on the system design and no increase in documentation burden |
| De Georgia *et al*. (2015) | Data acquisition from medical devices supports with a reduction in time taken to document in comparison to paper processes | Although there is a reduction in documentation time, it can be improved further with further advances and improvements to data acquisition models |
| Fraenkel *et al*. (2003) | Survey of nurses found they felt that time spent on documentation had decreased | Limitation of no time and motion studies and reliance on just surveys |
| Joseph *et al*. (2020) | Real time data transfer reduces the manual time spent entering the same information | Any interruptions in this flow may mean data is lost and increase time for checks and then manual data input |
| Mador and Shaw (2009) | Various studies found documentation time was reduced through the implementation of a clinical information system | Some studies found documentation time was not reduced and this was due to factors such as design, data quality and data quantity |
| Martich, Waldmann, and Imhoff (2004) | Time taken for nursing documentation was reduced due to better access to the patients record | Physician documentation time was increased and was likely due to design of the system |
| Pabst, Scherubel, and Minnick (1996) | Documentation time was reduced when an automated documentation system was in use | An increase in standby time was reported with required further analysis of how this time could be spent |
| Pierpont and Thilgen (1995) | Documentation time was reduced when using computerised charting | Manipulation of the computerised data neutralised any reduction in documentation time when added to data entry time |
| Poissant *et al*. (2005) | Time savings in general can be achieved through a clinical information system | When looking at time efficiency, it should be in the context of wider tasks than specific documentation timings |
| Saarinen and Aho (2005) | Time spent on documentation increased following implementation of a clinical implementation system | Design and lack of automation and data capture proved to be limitations to the study |
| Yusof (2015) | Nurses felt they spent more time with their patients due to a decrease in time spent on documentation | The system must fit with the user requirements and design is critical in achieving intended time savings |

The literature provides some common themes which influence the outcome of any service evaluation utilising the research questions. The most common theme was the design of the solution has the greatest impact on any intended benefits (Ferdousi *et al*. 2021; Schnock *et al*. 2021; Saarinen and Aho 2005; Sado 1999; Guyer *et al*., 2022; Poissant *et al*., 2005; Reese *et al*., 2018) and that poor design contributed to a lack of fit with user requirements and lack of automation and reduced the intended benefits or created no improvement (Brundin-Mather *et al*., 2018; De Georgia *et al*., 2015). Another common theme identified was that a clinical information system sometimes increased the quantity of documentation (Mador and Shaw, 2009; Hammond *et al*.,

1991; Stevens, 2017; Brundin-Mather *et al*., 2018; Courtney and Wilson-Van Meter, 2022). Although this improved the quality of documentation, this was to the detriment of the time spent on documentation and increasing that time spent (Martich, Waldmann, and Imhoff, 2004; Joseph *et al.*, 2020; Poissant *et al*., 2005). Considering the technology used during and post implementation, it was commonly identified that access would be improved. However, it was dependent on the technology meeting the requirements needed of the system as well as being as robust as possible to limit any downtime and system malfunction (Huang, 2021; Varon and Marik, 2002).

The identified findings of the literature review and thematic analysis were used to support the research as part of the service evaluation. The findings were utilised to develop the data collection plan from the methodology used to structuring any surveys as part of the data collection plan.

## Chapter 3. Methods

As mentioned, the project is an evaluation of current documentation before development and deployment of a clinical information system. Therefore, the evaluation was in the form of a process and formative evaluation style which looked at the current processes and identify any areas where a potential impact and improvement is likely to be achieved. BetterEvaluation (2022) classified a formative and process evaluation as a form of evaluation used to inform development which looks specifically at processes. As part of this, there was a requirement to collect data based on the current state to provide an initial baseline and the data analysed for areas where a potential improvement can be made. The data to be collected is outlined in the below data collection plan. The data collection plan focused on answering the three research questions while also considering the findings and themes from within the literature review. All data was collected from the adult critical care unit at The Grange University Hospital within Aneurin Bevan University Health Board (ABUHB). The data looking at the current state of documentation was collected over an 8-week period between September and October 2023.

There was no patient identifying data collected. Due to the confidential nature of clinical records and the sensitivity of patients' data, ethics approval has been sought. The guidelines of Aneurin Bevan University Health Board were followed with ethics approval received in June 2023 with a letter of access issued in August 2023. Also, the University of Wales Trinity St David guidelines were followed with ethical approval received in August 2023.

## 3.1 Are there areas of nursing documentation within critical care where quality can be improved by implementing a clinical information system?

An evaluation of the quality of nursing documentation was undertaken to support the answering of the initial research question. The standards outlined by the Nursing and Midwifery Council Code of Practice (2018) were used to support the evaluation and create a document audit proforma. The document audit proforma consisted of 24 questions with a copy of the questions found in Appendix 2**.** To ensure accuracy the questions were written as clear and concise statements. This ensured accuracy was maintained when completing the audit based on current documentation. The audit proforma and statements were assessed and followed for each patient record, with no patient-identifying data collected. A total of 50 patient records were reviewed over the 8-week period between September and October 2023, and the level of care the patient was receiving, as seen in Table 3.1 as defined by the Intensive Care Society (2021), was also captured.

Table 3.1 - Levels of Care as defined by the Intensive Care Society (2021)

| | |
|---|---|
| Level 1 | • Patients requiring more detailed observations or interventions, including basic support for a single organ system and those 'stepping down' from higher levels of care.<br>• Patients requiring interventions to prevent further deterioration or rehabilitation needs which cannot be met on a normal ward.<br>• Patients who require on going interventions (other than routine follow up) from critical care outreach teams to intervene in deterioration or to support escalation of care.<br>• Patients needing a greater degree of observation and monitoring that cannot be safely provided on a ward, judged based on clinical circumstances and ward resources.<br>• Patients who would benefit from Enhanced Perioperative Care |
| Level 2 | • Patients requiring increased levels of observations or interventions (beyond Level 1), including basic support for two or more organ systems and those 'stepping down' from higher levels of care.<br>• Patients requiring interventions to prevent further deterioration or rehabilitation needs, beyond that of Level 1.<br>• Patients needing two or more basic organ system monitoring and support.<br>• Patients needing one organ systems monitored and supported at an advanced level (other than advanced respiratory support).<br>• Patients needing long term advanced respiratory support.<br>• Patients who require Level 1 care for organ support but who require enhanced nursing for other reasons, in particular maintaining their safety if severely agitated.<br>• Patients needing extended post-operative care, outside that which can be provided in enhanced care units: extended postoperative observation is required either because of the nature of the procedure and/or the patient's condition and co-morbidities.<br>• Patients with major uncorrected physiological abnormalities, whose care needs cannot be met elsewhere.<br>• Patients requiring nursing and therapies input more frequently than available in Level 1 areas. |
| Level 3 | • Patients needing advanced respiratory monitoring and support alone.<br>• Patients requiring monitoring and support for two or more organ systems at an advanced level.<br>• Patients with chronic impairment of one or more organ systems sufficient to restrict daily activities (co-morbidity) and who require support for an acute reversible failure of another organ system.<br>• Patients who experience delirium and agitation in addition to requiring Level 2 care.<br>• Complex patients requiring support for multiple organ failures, this may not necessarily include advanced respiratory support. |

The level of care was used as part of the analysis of data when comparing current practices, and it was also used to identify if there were any trends or similarities. This was then used as the benchmark to support answering this research question. An audit proforma has been used as Benjamin (2008) identified the use of proforma can be created easily when used in conjunction with current guidelines and regulations. Benjamin (2008) also identified that data collection is easier when using a proforma. The National Institute for Health and Clinical Excellence (NICE) (2002) guidelines also identified that the use of a proforma can support with improving the accuracy of the data collected.

### 3.2 Are there any areas where ease of access to information within critical care can be improved by implementing a clinical information system?

As part of the eight-week period of data collection, an assessment of certain data points was undertaken. This was in the form of a time and motion study looking for 10 common data entries within critical care in each patient record. A time and motion study was used as it was identified by Zheng, Guo, and Hanauer (2011) as a tool in healthcare to reliably assess the impact on clinical work caused by clinical information system implementation. They also proposed an initial standard to support consistency when time and motion studies are utilised.

The data items looked at can be seen in Appendix 3 and include admission height, admission weight, current height, current weight, reason for admission, allergy status, past medical history, highest temperature in last 24 hours, lowest mean arterial pressure in the first 24 hours since admission, and urine output in last 24 hours. These data points were chosen due to being current data items monitored as part of the Intensive Care National Audit and Research Centre (ICNARC) Core Dataset (2022).

As part of the review of 50 patient records, each data item was looked at separately to provide accurate timings to assess the ease of access of information. The level of care the patient is receiving as defined by the Intensive Care Society (2021) was also captured to highlight any trends or similarities in terms of ease of access of information.

The data gathered within this time and motion study was considered alongside data captured during the document audit proforma. This was done to highlight any correlation or causation effect between the quality of documentation and ease of access to documentation.

### 3.3 Does the current time taken for nursing documentation have the potential to be improved through the implementation of a clinical information system?

The data collected to support answering this research question did not look at patients' records but instead was in the form of a digital questionnaire utilising Microsoft Forms aimed at nursing staff, which can be found in Appendix 4. The digital questionnaire

was directed to nursing staff working in critical care at the Grange University Hospital within ABUHB. This was done with the purpose of obtaining the critical care nursing workforce's viewpoint of nursing documentation and the time spent on documentation. The questionnaire was developed utilising questions that reflected the data being assessed as part of the time and motion study. The finalised questionnaire was then shared with the nursing leads in the critical care unit for dissemination to all nursing staff. Due to the shift patterns of staff and to ensure all staff have the opportunity to complete the survey, the questionnaire was open for a 14-week period from August to November 2023. This was to allow initial staff awareness of the survey and ongoing staff awareness during the data collection period.

The questionnaire was 12 questions long and captured the nurses' years of experience working within ITU within ABUHB. This questionnaire was broadened to nursing staff's critical care experience within the health board. This was to ensure an accurate representation of the experience due to staff relocating from older units in the health board to a single central critical care unit in 2020. The years of experience were captured in ranges to ensure no data and responses could be attributed to an individual. Despite them providing anonymous responses, staff could still be identified based on their years of experience due to the size of the nursing workforce. Ong and Weiss (2000) found that allowing anonymous responses was a proven method to get the respondents to provide more honest answers and also led to a reduction in respondents requesting for their data to be removed. The years-of-experience data was categorised into: 0 to 3 years, 4 to 7 years, 8 to 11 years, 12 to 15 years, 16 to 19 years, 20 to 23 years, and 24 years or more. The last option for experience has no upper limit due to clinical information systems being used in critical care since 2003, as identified by De Georgia *et al*. (2015). This means that anyone with 24 years or more experience may have experience of a clinical information system if working in an area which was an early adopter of a system.

The questionnaire was also used to identify nurses' viewpoints, which may support the answering of all 3 research questions. The nurses were asked to rate the quality of nursing documentation, completion of nursing documentation and ease of access to the data points being benchmarked as part of the above time and motion study. The data points used in the questionnaire were grouped together to ensure the user did not have to complete too many questions. This was supported by the findings by Sharma (2022) where they found that the more questions a survey contains, the quality of the responses deteriorates, and participants are more likely to speed up to get to the end of the questionnaire. Therefore, the data points were admission height and weight, current height and weight, reason for admission, allergy status, and past medical history. The rating system used allowed staff to document their opinion to these questions as Poor, Below Average, Average, Good and Very Good. A 5-step method of rating was used to allow the user to provide a neutral answer if they deemed it appropriate.

The nurses had the opportunity, in the form of a free text box, to answer their opinions on current nursing documentation and completion of nursing documentation in an unstructured manner. They were also asked to document their opinion on how many minutes, on average, they spent on documentation in a 12-hour shift. The questionnaire finished by asking for any other comments on nursing documentations. This was included to identify any areas and themes that had not been captured by this questionnaire, the time and motion study, or documentation audit proforma. The data was assessed to determine whether there was any correlation between time spent on documentation, opinions of quality, and years of experience working within critical care.

The time and motion study and documentation audit proforma were undertaken with data recorded on separate data collection spreadsheets. The option of using paper documentation collection forms was considered but found to likely create more of an administration burden, possible transcription errors, and risk of data loss in comparison to a spreadsheet. Tate and Smallwood (2021) agreed with this approach and found that electronic data capture was better due to less errors occurring and being a more practicable method. The time and motion study spreadsheet did have an initial column where the data items were recorded. The researcher was then able to document the date the observations were undertaken in the 2$^{nd}$ column and the level of care the patient required following assessment by a senior staff member. This was prior to documenting the time taken to find the data item in the same column but adjacent to the relevant data item. The timings undertaken were recorded as minutes, seconds, and milliseconds to improve the accuracy of timings. The document audit proforma followed the same template as the time and motion study, with the date and level of care documented in each column. The statements were in the initial column and then adjacent to this they were marked as ‘yes’ to indicate there was evidence that the statement had been met; ‘no’ to indicate that the statement had not been met; or ‘not applicable’ if there was no evidence to support whether the statement had been met or not. The option of not applicable was only an option to be recorded where the statement related to alterations and amendments as these are not found in all patient records.

The data collected included quantitative and qualitative data which was structured using a convergent design. This meant the data was collected in parallel with two separate data sets but was then merged into a singular data set as outlined by Klassen et al. (2012). The design was chosen as Creswell *et al.* (2011) identified that convergent design allows the various types of data to be collected in a manner which results in a broad understanding when answering the research questions. The data collection plan and its relation to the research questions can, therefore, be summarised as seen in Table 3.2.

Table 3.2 - Data Collection Plan in Relation to Research Questions

| Research Questions | Documentation Quality Audit Form | Time & Motion Data Collection | Clinician Viewpoint on Nursing Documentation Survey |
|---|---|---|---|
| Are there areas of nursing documentation within critical care where quality can be improved by implementing a clinical information system? | Yes | | Yes |
| Are there any areas where ease of access to information within critical care can be improved by implementing a clinical information system? | | Yes | Yes |
| Does the current time taken for nursing documentation have the potential to be improved through the implementation of a clinical information system? | | Yes | Yes |

# Chapter 4. Results

## 4.1 Documentation Quality Audit Form

An audit of current nurse care plan documentation was conducted, looking at 50 different records and assessing them against a set criteria in line with the latest Nursing and Midwifery Council (2009) guidelines for documentation. The 50 different records were categorised with a total of 17 Level 1 patient records assessed, a further 17 records were of Level 2 patients, and another 16 records were of Level 3 patients with the level of care as defined by the Intensive Care Society (2021). The patient records were chosen based on availability over the 8-week period for those currently admitted to the Critical Care Unit within ABUHB, with no patient-identifying information captured.

The first assessment criteria looked at was whether the nursing record was written legibly. As identified in Figure 4.1, 45 nursing records were written legibly, and five were not written legibly. The records deemed as not legible were classified as the handwriting not being able to be read and understand what the author had documented.

The second and third assessment criteria looked at whether the nursing records were objective and whether the records were relevant to the individual and patient-centred. The records were deemed to have been written objectively if there were clear aims and goals documented and deemed to have been relevant to the individual and patient-centred if they contained aims and goals specific to the patient, their condition and plan of care. The records which were assessed for these two criteria found that 50 of the records were deemed to have been objective, relevant to the individual, and patient-centred.

The fourth assessment of the nursing care plan documentation was whether the records contained relevant entries about care planning in relation to the patient's relative / carer. As seen in Figure 4.1, 47 records contained relevant entries about care planning in relation to the patient relative / carer, while three did not.

Based on the above criteria and in relation to the research question regarding areas of nursing documentation where quality improvement can be achieved, Figure 3 shows that there is limited area for improvement. The only area where a slight improvement in quality can be achieved is the legibility of records.

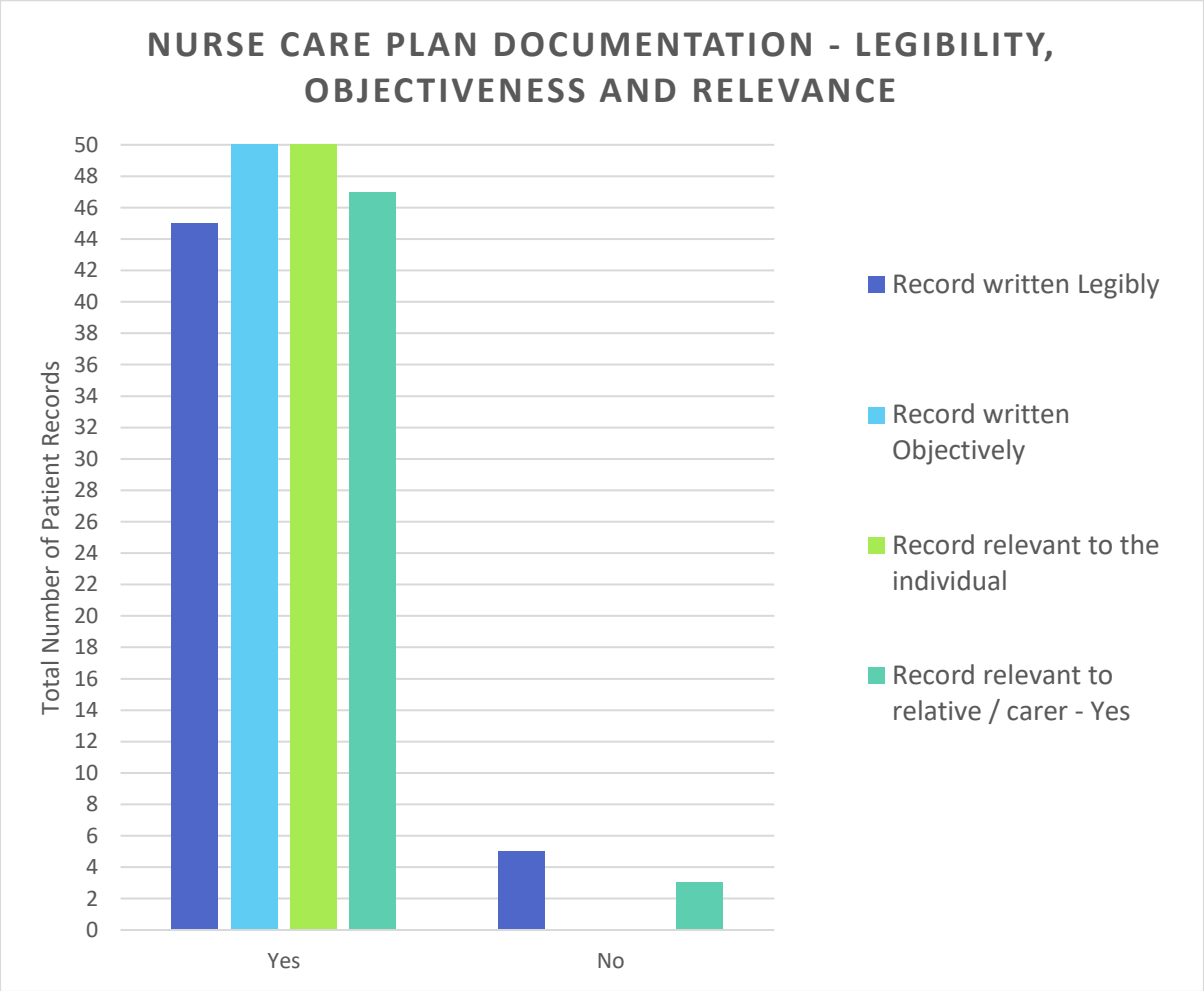



Figure 4.1 – Responses on whether the nursing record is written legibly, objectively, and relevant to patient and relative / carer.

As part of this assessment of the nurse care plan documentation, it was assessed to see whether appropriate clinical risk assessments had been completed and whether there was clear evidence of care planning in line with the Nursing and Midwifery Council Standard of Proficiency for Registered Nurses (2018). The care plans were then assessed to ensure that the patient goals documented were measurable, appropriate, and achievable. Finally, they were assessed to identify if there was clear evidence of documentation of care given and any changes to the patient's condition. It was found that all 50 records demonstrated evidence of the seven criteria, as seen in Table 4.1. The reason for all records meeting these standards is that they are part

of one of the main pillars of the Nursing and Midwifery Council Standard of Proficiency for Registered Nurses (2018).

It can be observed from this data, there were no areas of nursing documentation where an improvement to quality can be achieved by implementing a clinical information system.

Table 4.1 - Assessment of Records on whether there were appropriate clinical risk assessments completed, clear evidence of care planning and evidence of measurable, appropriate, and achievable outcomes, and documentation of care given and changes in the patient's conditions.

| | Yes | No |
|---|---|---|
| Appropriate clinical risk assessments completed | 50 | 0 |
| Clear evidence of care planning | 50 | 0 |
| Measurable goals | 50 | 0 |
| Appropriate goals | 50 | 0 |
| Achievable goals | 50 | 0 |
| Documentation of care given | 50 | 0 |
| Documentation of change in patients' condition | 50 | 0 |

The documentation was also assessed to identify whether communication with family had been undertaken and it was clearly recorded. As recorded in Table 4.2**,** 41 of the records documented communication with family with details of information passed on to the family. However, nine of records did not contain this information. The records were also checked to establish whether next of kin/carer and contact details were recorded within the nursing documentation. Table 4.2 shows 39 records had next of kin / carer and contact details recorded with 11 not having this recorded.

Table 4.2 - Assessment of Records for documentation of Communication with Family and Next of kin/carer and their contact details recorded.

| | Yes | No |
|---|---|---|
| Communication with family documented clearly | 41 | 9 |
| Next of kin/carer and contact details recorded | 39 | 11 |

Considering the responses for these data items together, there were 12 records where at least one of the two questions were recorded as No in the same record assessed. Figure 4.2 shows that in one record, communication with family was not documented clearly despite the next of kin/carer contact details being recorded within the patient record. The next of kin/carer contact details were not documented in 11 patient records, which likely contributed to eight of those records. Also, there was no documentation of communication with the family about details of information passed on to the family. However, documentation of communication with the family with details on information passed on to the family was recorded in three records where no next of kin/carer and contact details were documented. This shows that although there is a

relationship between these data items, there can be no correlation drawn between them as there is no dependency on either to be contained within the record for the other data item to also be present. A clinical information system could improve the quality of documentation through dedicated fields and prompts to ensure this information is captured. However, it has the same potential to be missed or not documented as current paper processes.

Therefore, the results provide evidence to suggest that this area of nursing documentation has the potential for the quality to be improved by implementing a clinical information system.

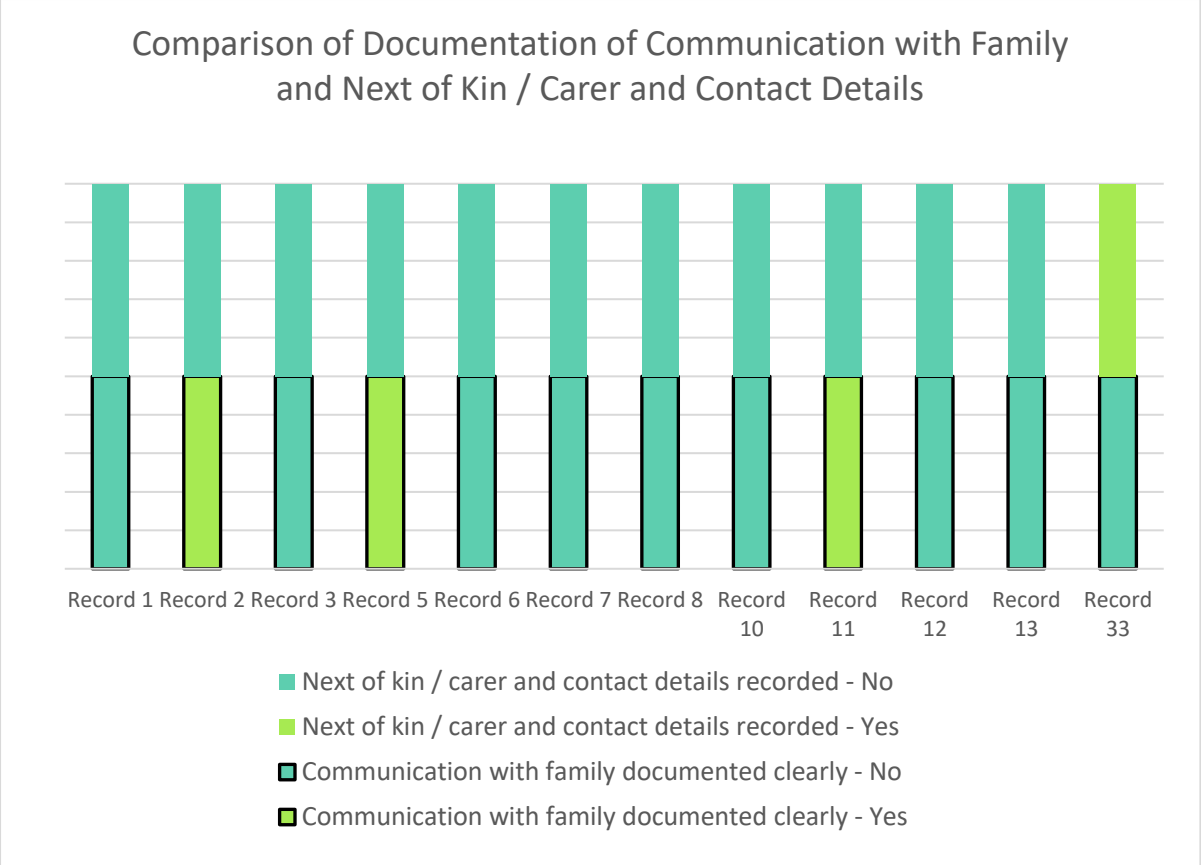



Figure 4.2 – Comparison of Documentation of Communication with Family and Next of Kin / Carer and Contact Details where at least one assessment was recorded as No

The next area of the nursing care plan documentation that was assessed was whether there was a visible name and signature for all records. The Nursing and Midwifery Council Code of Conduct (2018) maintains that all entries made should be attributed to the nurse writing the document. However, as seen in Figure 4.3, when the records were assessed, only 22% of records written contained a visible name and signature on all nursing entries within care plan documentation. This means that 78% of documentation did not contain both a visible name and signature, and even though most of the documentation did have a visible signature, there was no visible name associated with the signature.

The Nurse Care Plan documentation was also assessed for quality of record keeping in line with the Nursing and Midwifery Council code of conduct (2018) and whether the

patient details were fully recorded on each page. It was found that 88% of records did not have the patient details fully recorded on each page of care plan documentation (Figure 4.4**)**. Only 12% of records had the patient details fully recorded, which meant that if the paper documents were split from the current book format, then some records would not be able to be attributed to a patient and form part of their care record.

This is, therefore, another area where the quality of nursing documentation could be improved through the implementation of a clinical information system. This is due to a clinical information system requiring a user to be logged in to the system to document within the patient record. However, this creates a potential issue of a user remaining logged in and another clinician documenting, thus causing the incorrect author to be assigned to the documentation.

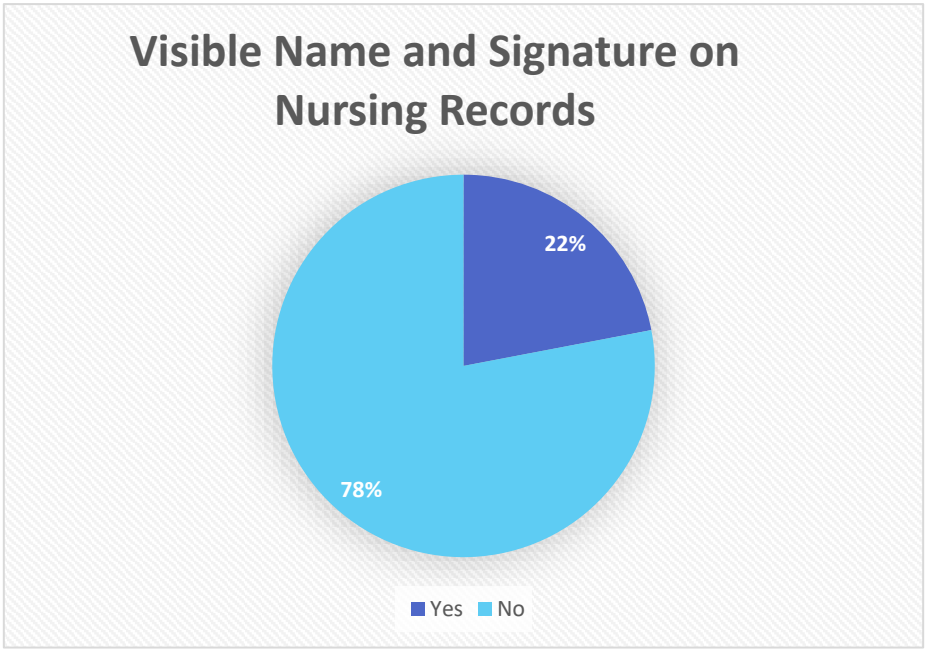



Figure 4.3 – Responses for documentation containing a visible name and signature.

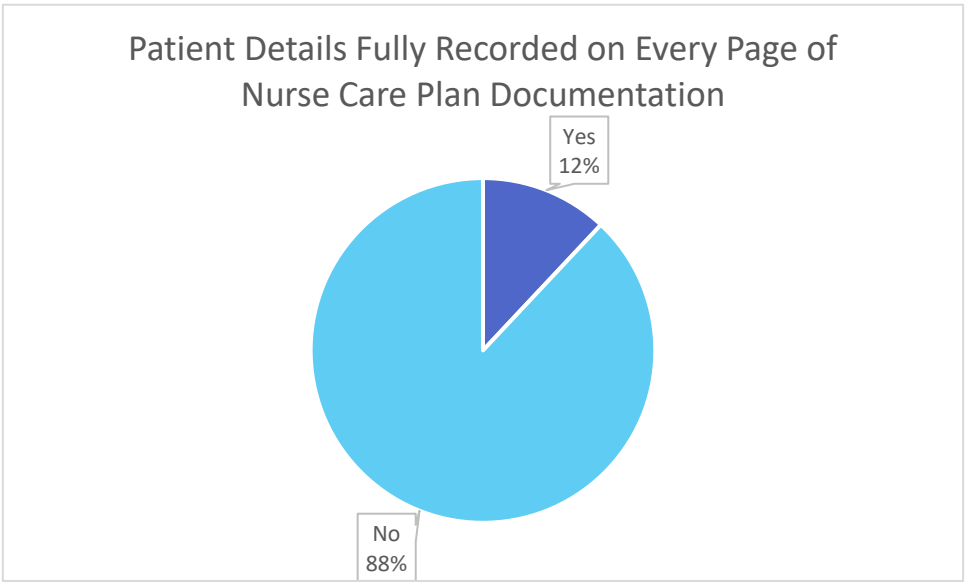



Figure 4.4 – Responses on whether patient details were recorded on all pages of nurse care plan documentation.

Table 4.3 – Responses on whether entries are accurately dated, accurately timed, and entries written in consecutive time order.

| | Yes | No |
|---|---|---|
| Entries accurately dated | 20 | 30 |
| Entries accurately timed | 48 | 2 |
| Entries written in consecutive time order | 49 | 1 |

The next assessment of the nursing documentation was whether the entries were accurately dated, timed, and written in consecutive order. As seen in Table 4.3, 20 entries within nurse documentation were accurately dated. However, Table 4.3 shows that two entries were not accurately timed. It was noted that when observing the documentation, the date would only be documented with the first entry, and every entry thereafter had just an accurate record of the time of the entry but not a new record of the date. Despite this, Table 4.3 shows that the entries were written in consecutive time order, which was likely supported by the amount of documentation containing accurate time stamps for the documentation recorded in the nursing care plan. As a clinical information system automatically adds a time and date stamp, this is another area of documentation where quality can be improved.

Table 4.4 - Total Number of Records with Alterations Scored with Single Line, User making amendments being visible, and the amendment date and time recorded.

| | Yes | No | NA |
|---|---|---|---|
| Alterations Scored with Single Line | 13 | 7 | 30 |
| User making amendments visible | 3 | 17 | |
| Amendment Date Recorded | 1 | 19 | |
| Amendment Time Recorded | 1 | 19 | |

The next assessment of the documentation looked at amendments to the documentation. As part of these assessments, the records were broken down into responses of Yes, No and Not Applicable, as not all records will contain amendments. Table 4.4 shows that 20 records assessed contained some amendments to the documentation. These alterations were assessed, and only 13 records marked alterations with a single line, and another seven struck through the record in a manner which rendered it difficult to see what was struck through. The 20 records with alterations were then assessed, and as seen in Table 4.4, only 3 of these records were able to see visibly the user making amendments. This is likely due to space constraints of documentation on lined paper with limited room to document users making amendments as well as the date and time. This identifies another area of documentation where quality can be improved by implementing a clinical information system. We can also see from Table 4.4 that only one of the records with amendments had a visible date and time of alteration recorded. It was noted that the only entry with amendments had both the date and time of alteration; therefore, the date and time entry was isolated to this one set of documentation assessed. A clinical information system automatically captures the user making changes as well as the date and time

of alteration. The alteration is also noted with a single strikethrough, so the data can still be read if needed.

The next element of care plan documentation, as part of the observation, was to determine whether the records were stored in an appropriate place and appropriate access could be maintained. Storage of and access to records were assessed in line with the Nursing and Midwifery Council Record Management Policy (2023), which states that records should be stored in a manner where information is prevented from being lost or destroyed and kept secure. As seen in Table 4.5, all records were deemed to be stored safely, with mechanisms to ensure that the records could be accessed by those who require access to them.

Table 4.5 - Data collected to assess whether records are stored and able to be accessed appropriately.

| | Yes | No |
|---|---|---|
| Records Stored Appropriately | 50 | 0 |
| Appropriate Access to Records | 50 | 0 |

## 4.2 Time and Motion Data Collection

A time and motion study was undertaken to support the answering of the research question. A total of 50 records were reviewed, and time recordings were conducted to find out the time taken to find the 10 separate data points. A total of 17 records reviewed were of Level 1 patients, a further 17 records were of Level 2 patients, and another 16 records were of Level 3 patients with the level of care as defined by the Intensive Care Society (2021) and as identified in the methods section.

As identified in Table 4.6, admission height and weight took the longest time to find, with average time taken nearly two times longer than the third highest average time which was searching for the reason for admission. In comparison, allergy status took the shortest time to find, which was nearly twice as fast as the second quickest data item, which was the highest temperature in the last 24 hours.

In the patient records, current height and current weight took half of the time to be found compared to admission height and admission weight due to this being provided on more recent documentation and the fact that this documentation was less likely to be filed in the patient's records. However, admission and past medical history took close to half the time to find than admission height and weight. Although these are documented at the point of admission, the reason for admission is documented in a specific document with clearly defined fields, unlike admission height and weight.

The highest temperature in the last 24 hours, lowest mean arterial pressure in the first 24 hours since admission and urine output in the last 24 hours all took a similar length of time to find when looking at current documentation. This can be attributed to the highest temperature and urine output in the last 24 hours being on the same chart and in clearly identified fields on the observation charts. The lowest mean arterial pressure

in the first 24 hours since admission is a data point collected at admission. However, unlike admission height and admission weight, this data is collected as part of the Intensive Care National Audit & Research Centre (ICNARC) reporting dataset (2022) and is collected on a dedicated form in addition to being recorded on the observation chart. As it is in a dedicated form, the information can be accessed more easily than if it was searched for on the observation chart at the point of admission.

Allergy status was the quickest to find, but this can be attributed to allergies being required to be recorded on medicine prescription charts, as can be seen in an example chart by All Wales Therapeutics and Toxicology Centre (2022). As can also be seen, height and weight are documented on the medicine prescription charts. However, there is no indication that this data is either current height or weight, admission height or weight or a recording between these two data points.

Table 4.6 – Time and Motion Study of Total and Average Time Taken to Find Certain Data Points

| | Total | Average |
|---|---|---|
| Admission Height | 57:21.8 | 01:08.8 |
| Admission Weight | 57:51.2 | 01:09.4 |
| Current Height | 29:32.7 | 00:35.5 |
| Current Weight | 29:49.0 | 00:35.8 |
| Reason for Admission | 31:26.6 | 00:37.7 |
| Allergy Status | 10:44.4 | 00:12.9 |
| Past Medical History | 25:17.1 | 00:30.3 |
| Highest Temperature in Last 24 hours | 18:34.2 | 00:22.3 |
| Lowest Mean Arterial Pressure in First 24 Hours since Admission | 19:20.9 | 00:23.2 |
| Urine output in last 24 hours | 19:11.7 | 00:23.0 |

In Table 4.7, the data was broken down into the Level of Care the patient was classified as. Again, admission height and weight took the longest time out of all data items. However, there was a noticeable difference between average time based on the level of care the patient was classified as.

The average time taken to find admission height and weight was within 1 second of the average of all records. The average time is longer than that of a patient classified as a Level 3 patient but shorter than that of a patient classified as Level 2. As found during the time and motion study, Level 1 patients require minimal support and can also be classified as being ready for discharge to ward-based care. The documentation was found to be filed ready for when a bed was available on a ward, and easier to navigate to the details of height and weight at admission.

In contrast with Level 2 care, the average time was more than 20 seconds higher than the overall average. As defined by the Intensive Care Society (2021), Level 2 patients do not receive complex care and multi-organ support but are also not suitable for ward-based care. Level 2 patients are also more likely to have been admitted to critical care for a prolonged period as a Level 3 patient before step-downing to becoming a Level 2 patient as identified within the Guidelines for Provision of Intensive Care Services by The Faculty of Intensive Care Medicine and Intensive Care Society (2022).

As shown in the time and motion studies, Level 2 patients had extensive paper documentation, which made the admission height and weight harder to identify and find, thus creating a higher-than-average time to find these data items. This data point was found quickest in Level 3 patient records, which can be attributed to a dedicated field at the top of all the observation charts for height and weight. As the patient is Level 3, they are more likely to be recently admitted to critical care and, therefore, have less extensive documentation of their stay in comparison to a Level 2 patient based on the researchers' clinical experience. It can also be seen that the average time taken to find entries in Level 2 patient records was always higher for seven out of 10 data points, especially in comparison with Level 3 patient records, where it took twice as long on average to find the data point. However, there were similar average timings for the highest temperature in the last 24 hours, the lowest mean arterial pressure in the first 24 hours since admission and urine output in the last 24 hours when compared to both Level 3 and Level 1 patients.

Table 4.7 – Time and Motion Study of Total and Average Time Taken to Find Certain Data Points based on Level of Care

| | L1 Total | L1 Average | L2 Total | L2 Average | L3 Total | L3 Average |
|---|---|---|---|---|---|---|
| Admission Height | 19:28.3 | 01:08.7 | 25:03.4 | 01:28.4 | 10:57.6 | 00:41.1 |
| Admission Weight | 19:28.4 | 01:08.7 | 25:03.4 | 01:28.4 | 11:11.6 | 00:42.0 |
| Current Height | 10:00.4 | 00:35.3 | 11:25.5 | 00:40.3 | 05:28.8 | 00:20.5 |
| Current Weight | 10:16.8 | 00:36.3 | 11:25.5 | 00:40.3 | 05:28.8 | 00:20.5 |
| Reason for Admission | 10:01.8 | 00:35.4 | 15:19.0 | 00:54.1 | 04:28.0 | 00:16.7 |
| Allergy Status | 03:18.0 | 00:11.6 | 04:24.1 | 00:15.5 | 01:56.6 | 00:07.3 |
| Past Medical History | 06:47.9 | 00:24.0 | 11:58.7 | 00:42.3 | 05:18.1 | 00:19.9 |
| Highest Temperature in Last 24 hours | 06:17.6 | 00:22.2 | 06:32.9 | 00:23.1 | 03:28.0 | 00:13.0 |
| Lowest Mean Arterial Pressure in First 24 Hours since Admission | 06:28.9 | 00:22.9 | 06:36.1 | 00:23.3 | 03:31.7 | 00:13.2 |
| Urine output in last 24 hours | 06:11.7 | 00:21.9 | 06:34.1 | 00:23.2 | 03:25.2 | 00:12.8 |

When looking at the data in further detail, Figure 4.5 shows the time taken to find the admission height for Level 1, 2 and 3 patients. The average for Level 1 and Level 2 patients is higher due to records 4 and 5 of Level 1 patients and records 4, 5 and 6 of Level 2 patients. The Level 1 data points are 2.6 times higher and 1.8 times higher than the third longest time taken to collect this data. Also, the Level 2 data points are 1.8, 2.1 and 2.2 times higher than the fourth longest time taken to collect this data. When compared with Figure 4.6 for admission weight, there is a similar pattern where the average for Level 1 and Level 2 patients is also higher due to records 4 and 5 of Level 1 patients and records 4, 5 and 6 of Level 2 patients. The Level 1 data points are 2.9 and 2.1 times higher than the third longest time taken to collect this data. Also, the Level 2 data points are 1.8, 2.1 and 2.2 times higher than the fourth longest time taken to collect this data.

As there was more variation at the earlier data points collected for admission height and weight, it is likely that the researcher collecting the data became more familiar with the documentation as the data collection progressed. However, when looking at Figures 4.5 and 4.6, the five data points which are higher for admission height and weight than the remaining records were collected between the 20 and 30% mark of the 50 records reviewed. Therefore, we would expect these data anomalies to appear in the first 20% of data collection and not later. This means the cause is likely to be due to the patients having a vast quantity of documentation that the researcher had to search through to find these data items.

We can also see from Figure 4.5 that the average time for finding admission height was similar for Level 1 and 2 patient records but significantly less for Level 3 patient records. When the average times are compared, it took nearly twice the time to find the same data item in a Level 1 patient record than it did in a Level 3 patient record. This is similar to the findings for admission weight in Figure 4.6, with the highest average time being for Level 1 patients and the lowest average time for Level 3 patients. When looking at the average time for admission height in Figure 4.5, it shows that 4 Level 1 records, 5 Level 2 records and 3 Level 3 records were above the average time with the same results found in Figure 4.6 for admission weight.

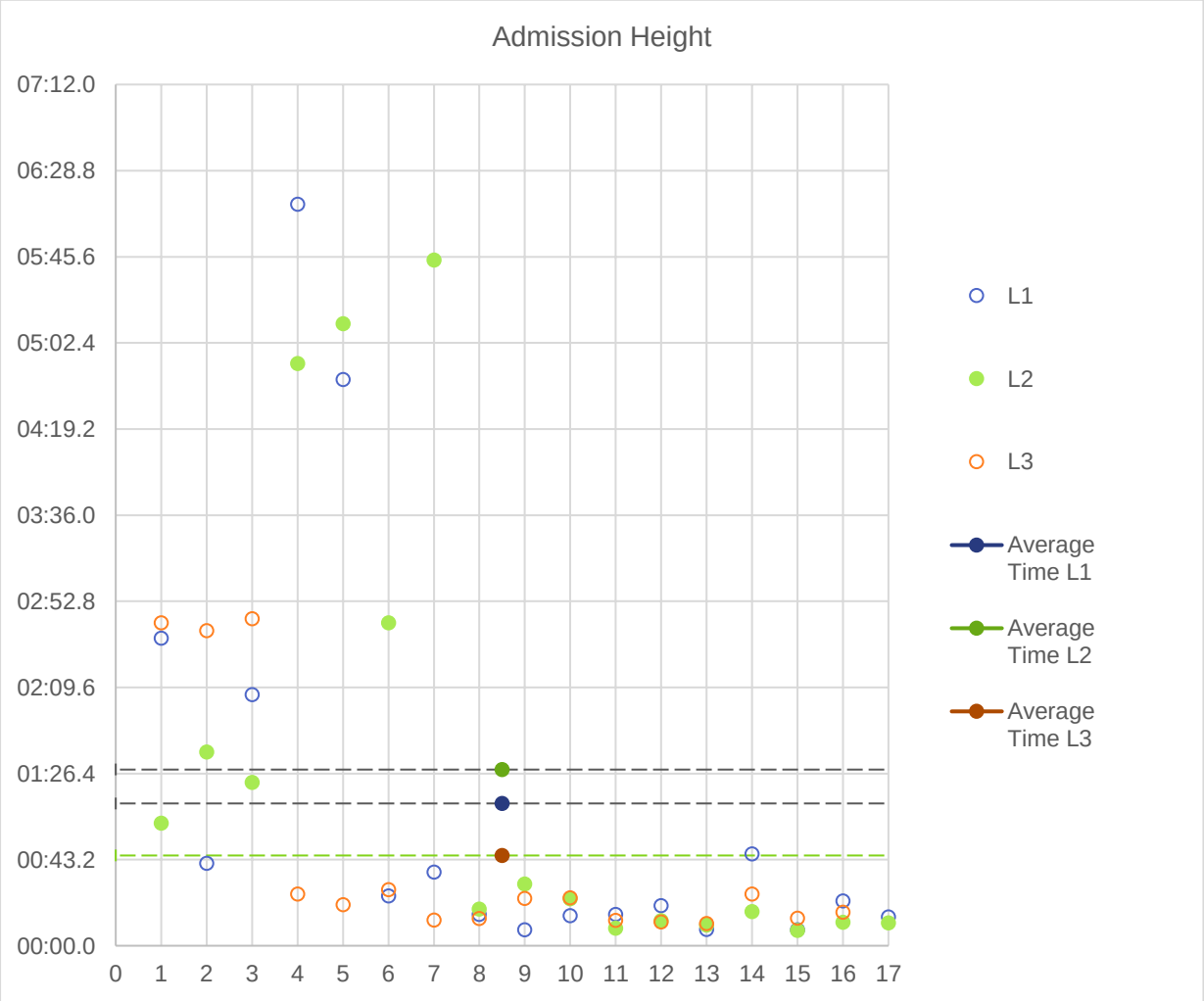



Figure 4.5 - Time and Motion Study for Admission Height where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

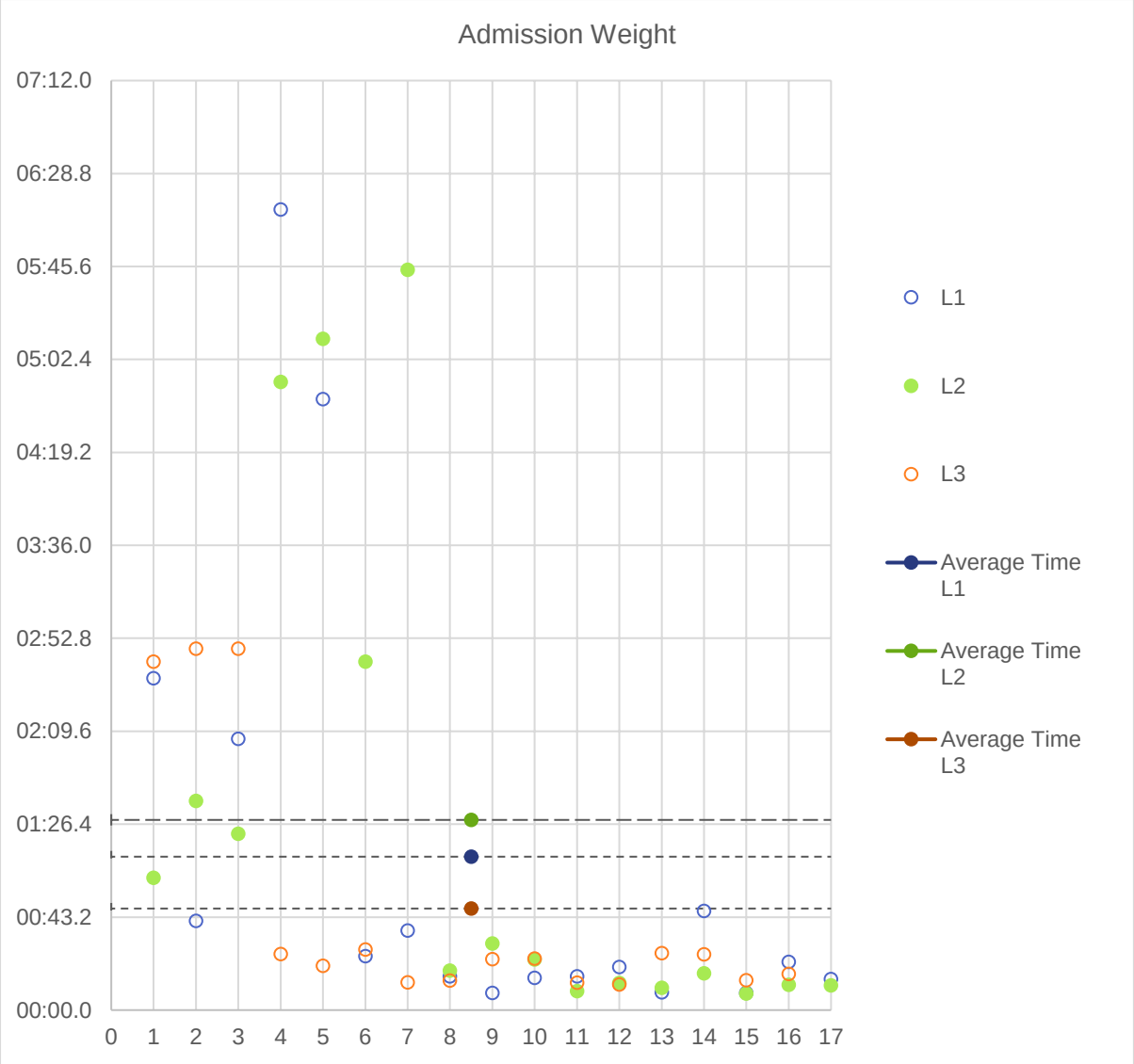



Figure 4.6 - Time and Motion Study for Admission Weight where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

Considering the data for current height and weight in Figures (4.5 and 4.6), a similar trend to the time taken for admission height and weight with the average time to find the current height and weight being longer for Level 1 and 2 patients than Level 3 patients is noted. However, the average time taken to find the current height and weight only had a difference of 0.1 seconds, and both averages were 1.5 times longer than the Level 3 average for current height and 2.8 times longer than the Level 3 average for current weight.

Figure 4.7 shows that the time taken to find the current height was again higher for the first five data points for Level 1 records, the first 7 data points for Level 2 records, and the first three points for Level 3 records. In Figure 4.8, there is a similar pattern for current weight with the first five data points for Level 1 records, the first seven data points for Level 2 records, and the first three data points for Level 1 records.

There is a similarity between the admission height and weight and current height and weight, with both having more variation in the earlier records. However, unlike with

admission height and weight, all these higher records occurring at the start of the data collection for current height and weight. Therefore, it is likely that the initial data for current height and weight was higher due to the researcher collecting the data.

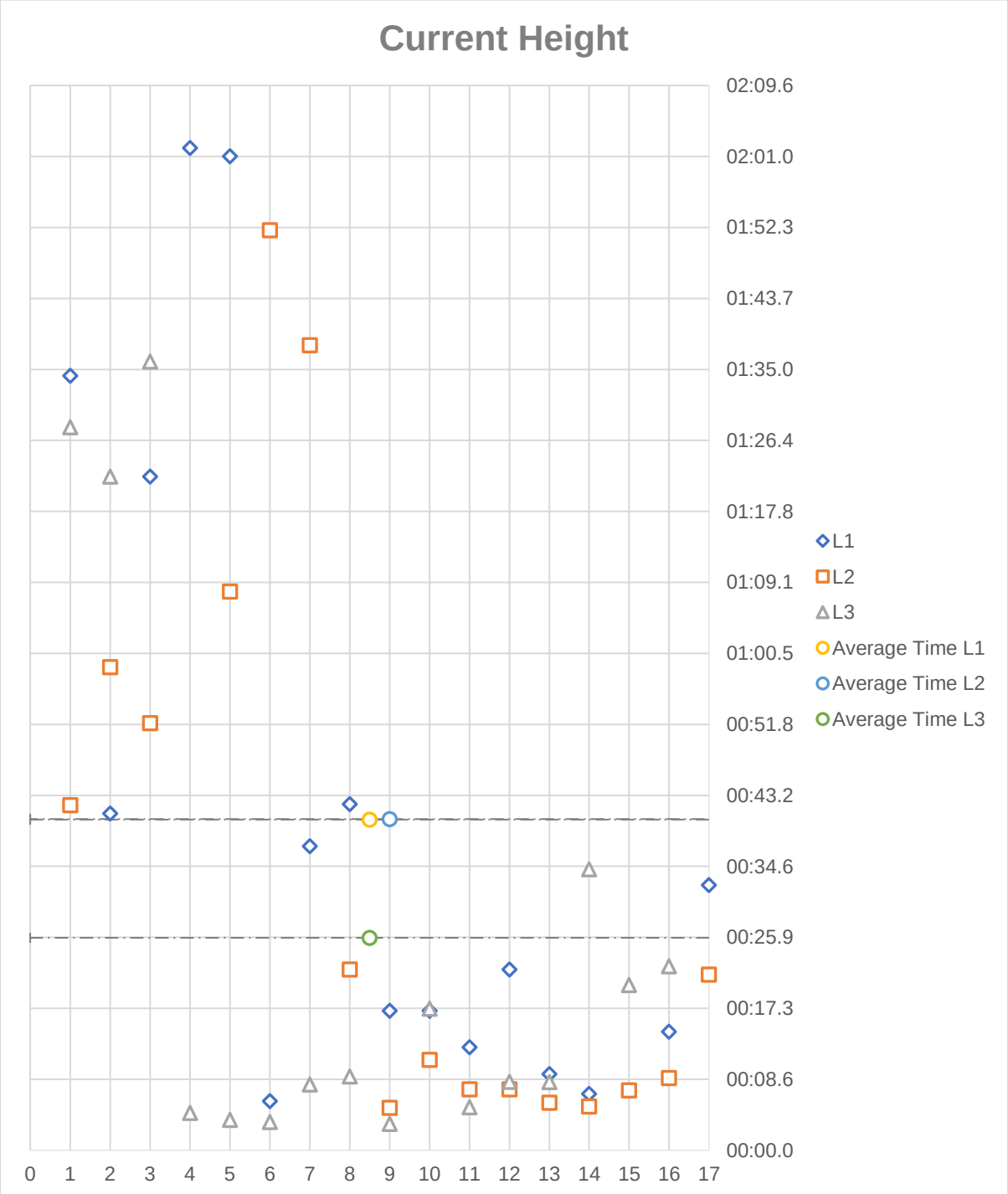



Figure 4.7 – Time and Motion Study for Current Height where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

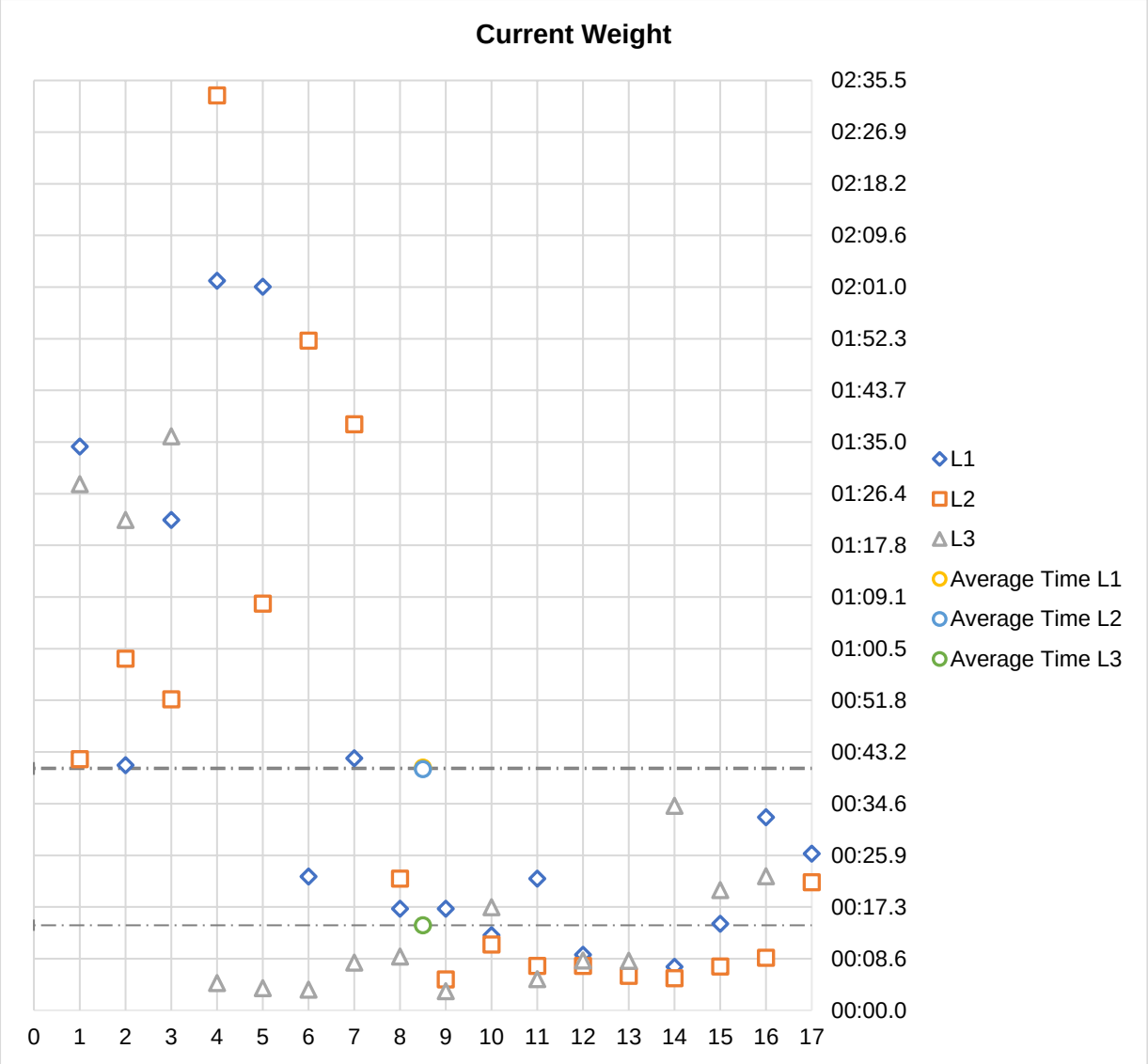



Figure 4.8 – Time and Motion Study for Current Weight where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

When the time taken to find both the admission height and current height is compared, it is noted in Figure 4.9 that the lowest average time to find the admission height was still higher than the highest average time to find the current height. A repeat of this pattern is noted in Figure 4.10 for admission and current weight. However, when looking at the average time it takes to find admission or current weight, the lowest average time for admission weight is still 3.3 times higher than the lowest average time for current weight.

The time taken to find the admission and current height and weight can, therefore, have the potential to be improved as well as improve ease of access to the information through the introduction of a clinical information system. The cohort of patients where this is most likely to see a larger improvement would be Level 1 patients, and a similar improvement for Level 2 patients.

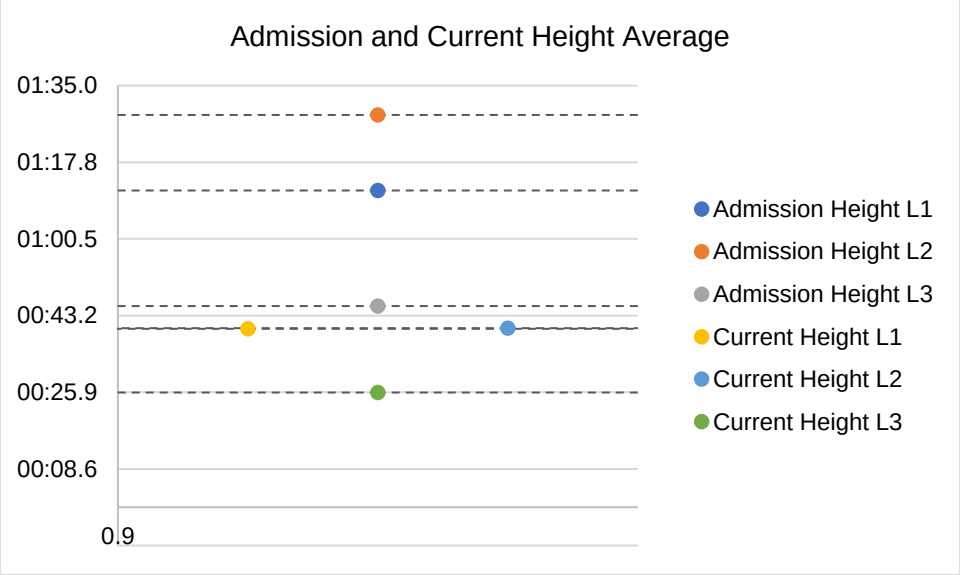



Figure 4.9 – Average Time Taken to find Admission and Current Height where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

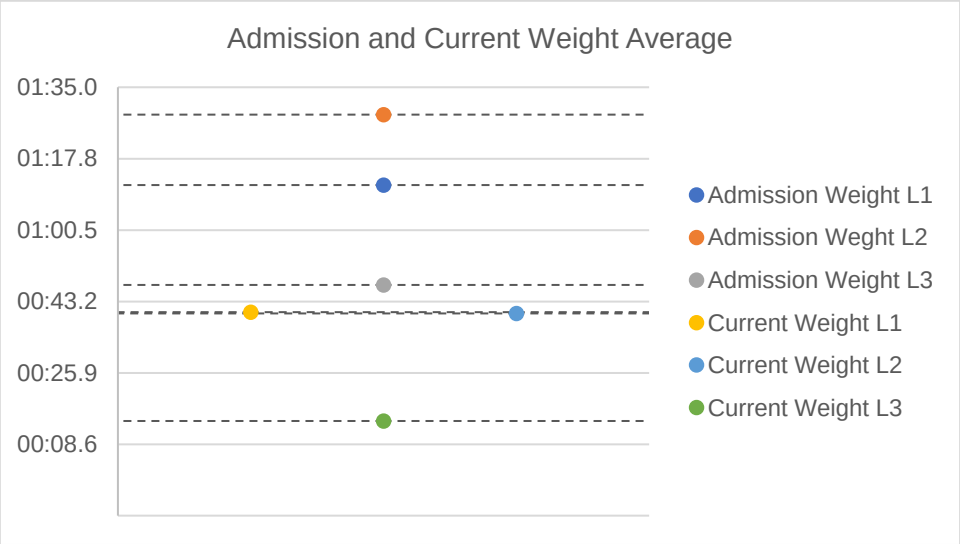



Figure 4.10 – Average Time Taken to find Admission and Current Weight where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

When looking at the average time taken to find the reason for admission within the medical documentation, Figure 4.11 shows that Level 3 records had the shortest time and Level 2 records the longest time. It took 2.7 times longer on average to find the reason for admission between Level 3 and 2 records, and Level 1 records took 1.9 times longer on average than Level 3 records. The reason for this is likely due to Level 3 patients being newly admitted with less documentation to search through and Level 1 patients awaiting discharge having their documentation filed away. Also, Level 1 patients will likely have the reason for admission documented within their discharge documentation, which they will use for other day-to-day care documentation. Figure 4.12 shows that the time taken to find the reason for admission for Level 3 patients was consistent, apart from the first 3 records. This could be again due to the researcher being unfamiliar with the paperwork at the start of data collection. However, we can see that for Level 2 patients, the time taken was consistently higher than

average for records two through to seven. Also, records three through to five for Level 1 patients were higher than the average. Therefore, it is likely that the results higher than average are likely accurate recordings and not related to the researcher's familiarity with the documentation.

By introducing a clinical information system, it may be possible to enhance both the ease of access to the information and the time required to find the reason for admission. Level 2 patients are the patient cohort most likely to show a greater improvement, while Level 3 patients are likely to see an improvement on par.

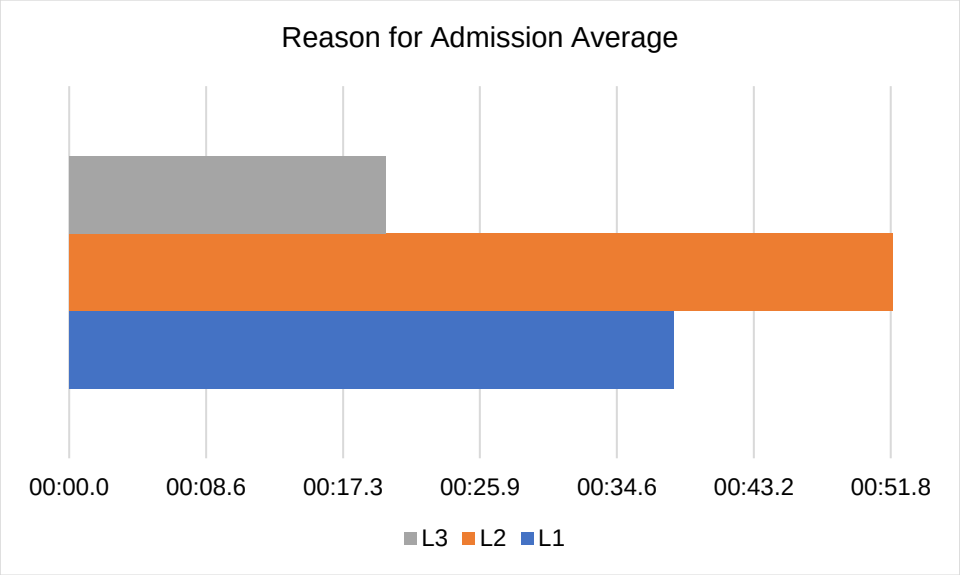



Figure 4.11 – Average Time Taken to Find Reason for Admission where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

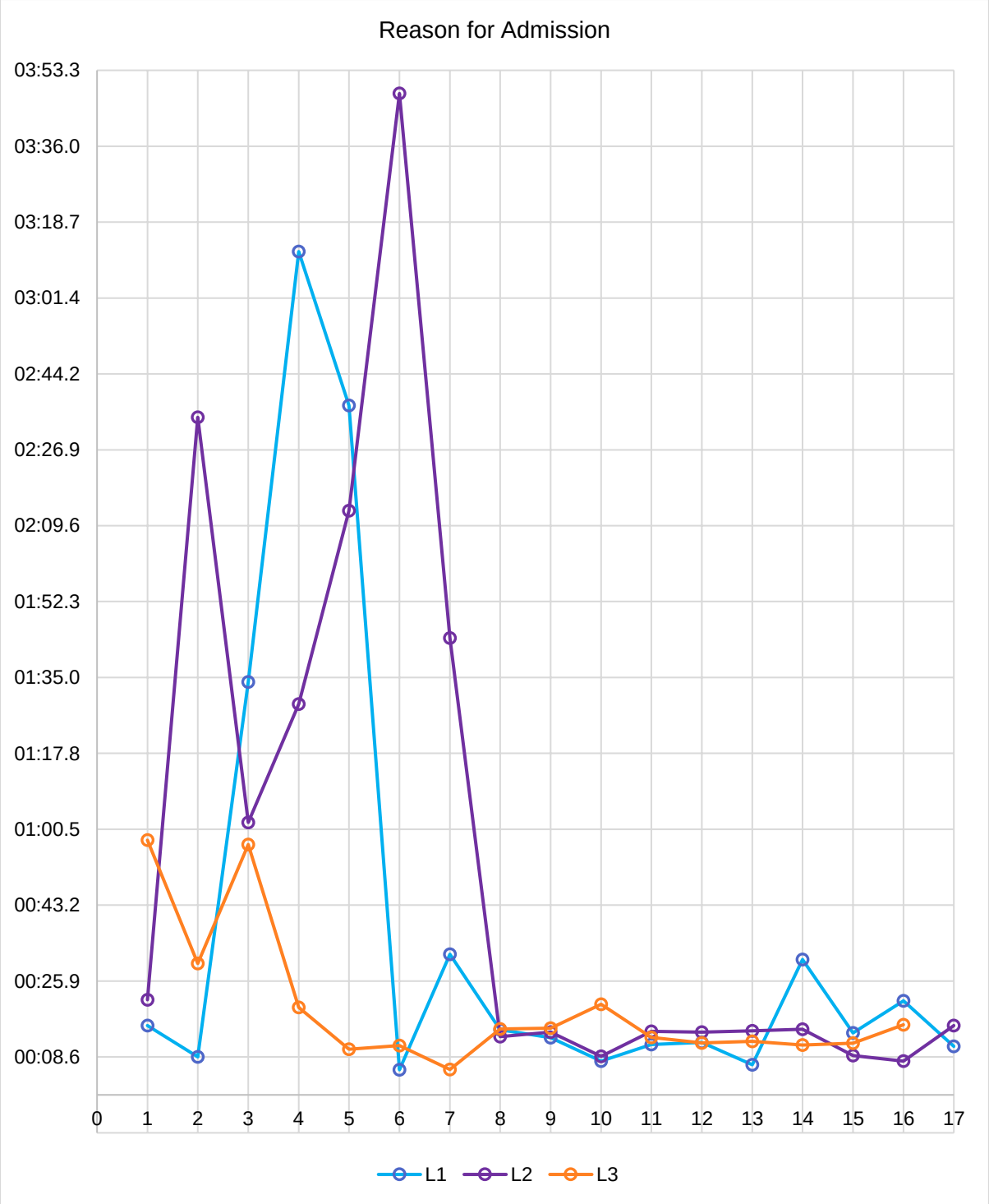



Figure 4.12 - Time Taken to Find Reason for Admission where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

The next data collected was the time taken to find the patient's allergy status. Allergy status is routinely documented on the top of the All-Wales medication chart (All Wales Therapeutics and Toxicology Centre, 2022). As seen in Figure 4.13**,** with the exception of the first record, it took no longer than 12.8 seconds to find the allergy status of Level 3 patients. The average time taken to find Level 3 patients' allergy status was 9.8 seconds. However, if the first Level 3 data point is removed, the average is reduced to 7.5 seconds. As this data point was isolated, it is likely that the patient's allergy

status was not clearly documented on the medication chart, and the researcher had to look through other documentation to find the patient's allergy status. With the exception of the first data point, it took between 3.5 and 12.4 seconds to find the Level 3 patient allergy status. It took longer, on average, to find the allergy status for Level 1 and 2 patients. However, this was due to data points 2,4, 5, and 6 for Level 2 patients and data points 3, 4, and 7 for Level 1 patients being nearly twice as high as the average time for Level 1 and 2 patients. Again, similar to the Level 3 patients, this could be higher due to the allergy status not being recorded on the medication chart, thus requiring the researcher to look through additional documentation to find the patients' allergy status.

As this is currently recorded and found in a timely manner, this would be one area where there would be little improvement in ease of access and time taken to find the patients' allergy status. However, depending on the design of the system, this is an area where there could be greater visibility as it can be contained in the whole patient record and not one single document.

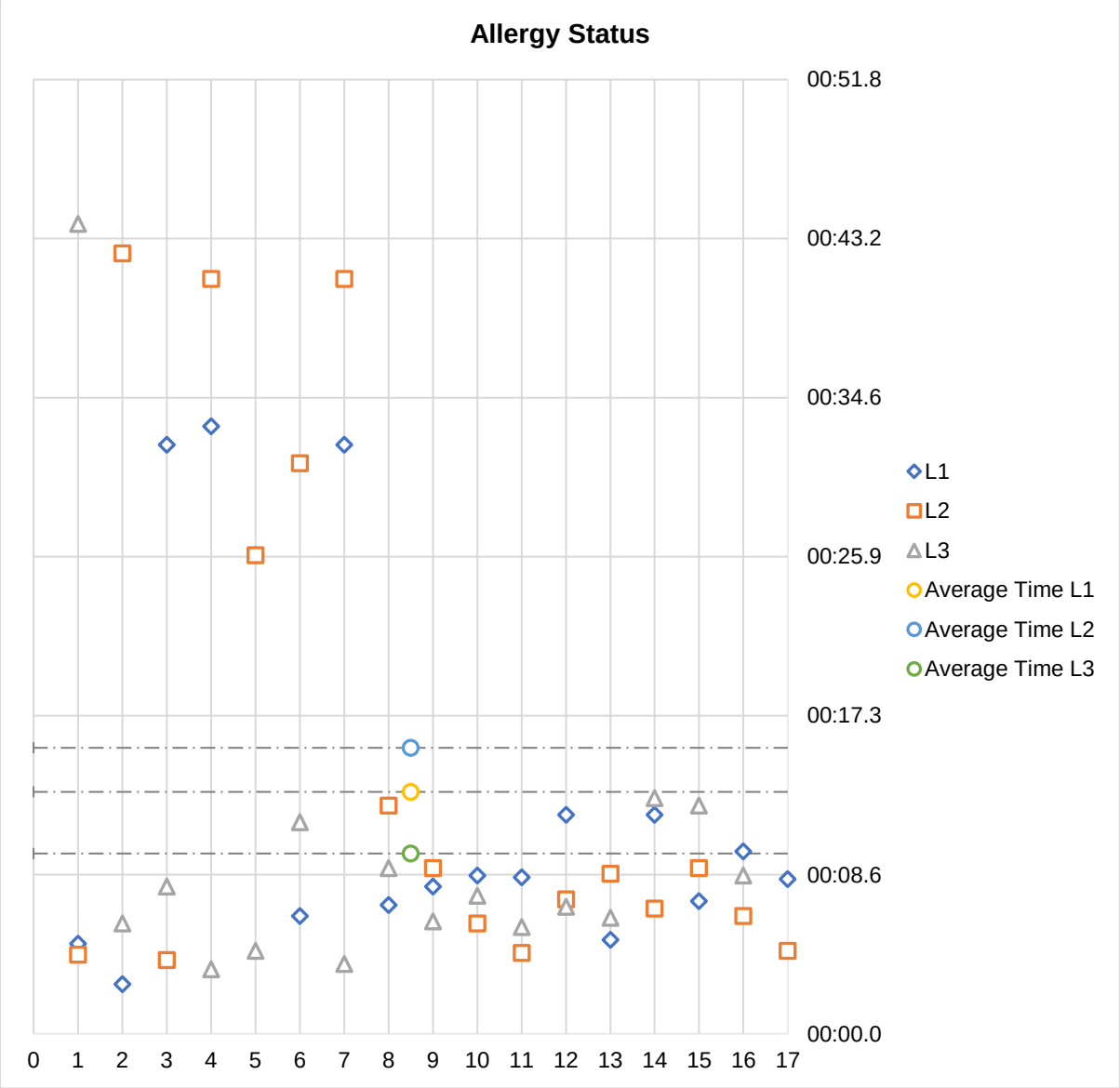



Figure 4.13 – Time Taken to Find Allergy Status where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

The time taken to find the patients past medical history for Level 1, 2 and 3 patients was also collected. As shown in Figure 4.14, with the exception of data points 1,2 and 3 for Level 3 patients, the time taken is consistently between 5.8 and 17.5 seconds. If the first 3 data points were taken out, then the average time to find the past medical history of level 3 patients drops in half from 22.2 seconds to 11.1 seconds. It can also be seen in Figure 4.14 that there were 5 data points higher than the Level 1 average, 5 data points higher than the Level 2 average, and 3 data points higher than the Level 3 average. The Level 2 data that were above average were found at data points 3 to 7, and for Level 3, those that were above average were found at data points 1, 3, 5, and 7. When the data points were above average and not included, for Level 2 patients, it took between 6.7 and 32.7 seconds and for Level 3 patients, it took between 8.4 and 24.5 seconds. Figure 4.14 shows that there was only a difference between the average time taken to find the patients' Past Medical History for Level 1 and Level 3

patients of 4 seconds. The average time, however, for Level 2 patients was 1.9 times longer than for Level 3 patients and 1.6 times longer than for Level 1 patients.

Hence, the implementation of a clinical information system may enhance the speed at which the past medical history is found and provide easier access to it. Level 1 patients are the patient cohort most likely to experience a greater improvement and a comparable improvement, respectively.


Figure 4.14 – Time Taken to Find Past Medical History where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

The last three data points looked at with the aim of supporting this research question all relate to data found on the patient observation chart. The three data points searched for on the observation chart were the highest temperature in the last 24 hours, the lowest mean arterial pressure in the first 24 hours since admission and urine output in the last 24 hours. This data is collected as part of the ICNARC reporting dataset (2022). However, the data collected for all patients was from the main

observation charts and not from ICNARC reporting forms. This was to ensure that all data collected across all data points was from the same source of documentation and ones used by nursing staff. As seen in Figure 4.15, the average time taken to find the highest temperature for the last 24 hours for Level 1 and 2 patients was 1.6 and 1.4 longer than for Level 3 patients. The average for Level 1 patients was 1.1 times longer than for Level 2 patients. The reason the average was significantly lower for Level 3 patients was due to the patients being continually monitored with their observations recorded hourly on a large A2 size chart.

Level 1 patients, however, are mostly discharged with their paperwork filed away and receiving less continuous observation monitoring. Also, a factor in the longer time for Level 1 patients was a separate digital system being used within the health board to record Level 1 patients' observations awaiting a bed on a ward. Level 2 patients still remain on the large A2 size charts, but it was found that the temperature was recorded less frequently than Level 3 patients. However, when looking at the minimum and maximum time taken for each Level in Figure 4.16**,** it shows the minimum time taken to find the highest temperature was between 7.2 seconds for Level 1 patients and 9.1 seconds for Level 2 patients, with Level 3 patients taking 8.9 seconds. This reveals that in some cases for Level 1 patients, there were some records where the data was quickly found. However, when looking at the longest time, it took 52.6 seconds for Level 1 patients, 48.0 seconds for Level 2 patients, and 47.0 seconds for Level 3 patients. This indicates that the higher average for Level 1 patients was influenced by the higher range between the quickest and slowest time of 45.4 seconds. The range between the quickest and slowest time for Level 2 patients was 38.9 seconds, and for Level 3 patients was 38.1 seconds. The similar range for Level 2 and 3 patients is also likely influenced by the observations being recorded on the same size chart and not digitally documented in another system.

In Figure 4.17, for Level 1 and Level 3 patients, the average was similar to the median time of all data collected on those patients. This shows that the average is more representative of all data collected for Level 1 and Level 3 patients and is unlikely to be caused by a large variance in the time taken. However, for Level 2 patients, there is a difference of 9.7 seconds between the median and average time taken. As seen in Figure 4.15, data collected for Level 2 patients at points 2 through to 7 was between 1.9 and 1.3 times longer than the next highest value in the data collected. This is the likely cause of the larger difference between the median and average time for Level 2 patients due to these data points.

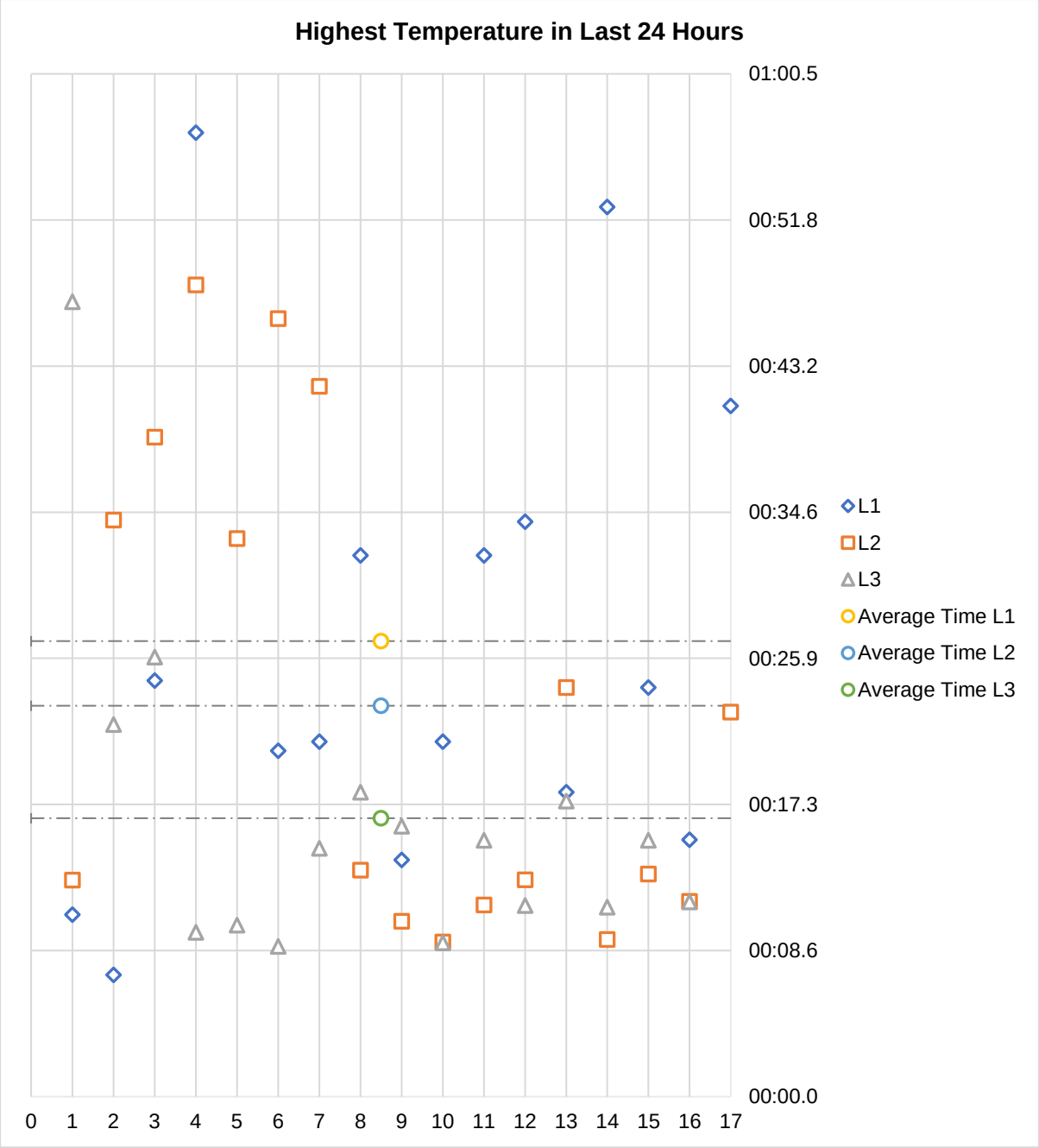



Figure 4.15 – Time Taken to Find the Highest Temperature in the last 24 hours where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

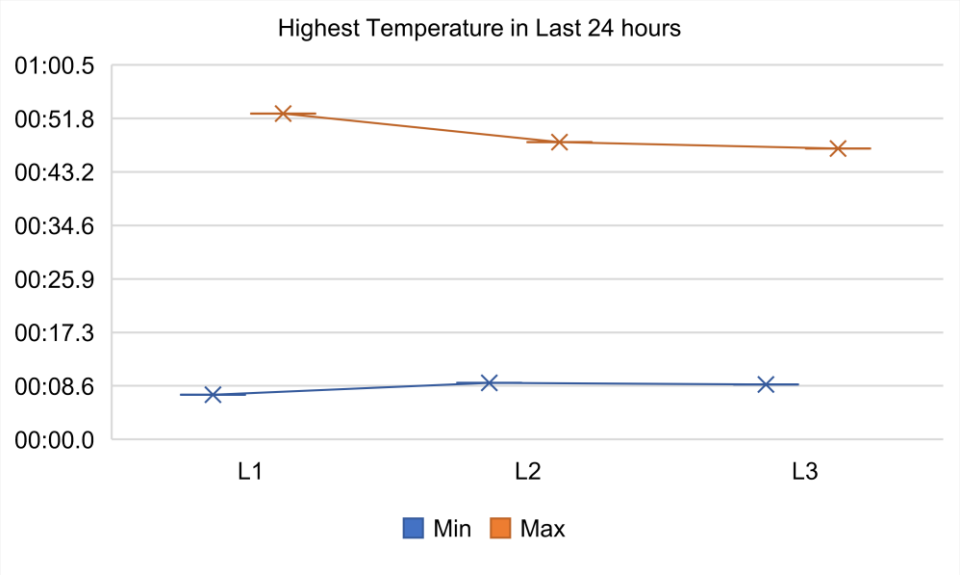



Figure 4.16 – Minimum and Maximum Time Taken to Find the Highest Temperature in Last 24 hours where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

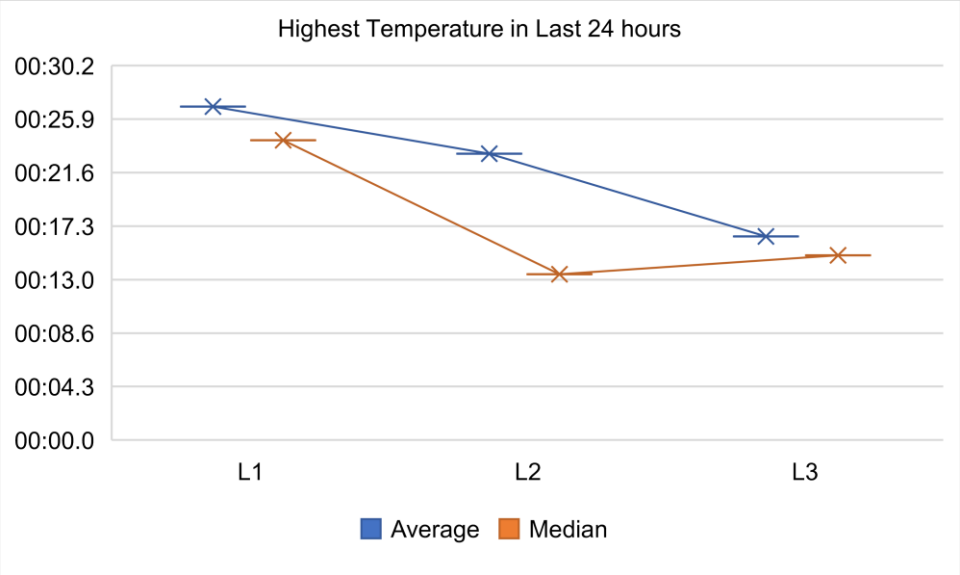



Figure 4.17 – Comparison of Median and Average Time Taken to Find Highest Temperature in Last 24 hours where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

Looking at the next observation of the lowest mean arterial pressure within the first 24 hours since admission, Figure 4.18 shows similar data trends for the highest temperature in the last 24 hours. The average time for Level 3 was the lowest, and the average time for Level 1 records was 1.5 times longer, and for Level 2 records was 1.2 times longer. However, the average time for Level 3 was 1.09 times longer than when searching for the highest temperature in the last 24 hours. This is likely due to the data being from the first 24 hours since admission rather than within the last 24 hours.

When looking at Figure 4.19, it can be seen that the higher average for Level 1 patients was influenced by the difference between the maximum time taken, 57.0 seconds, which was 5.0 times longer than the shortened time taken, 11.0 seconds. In Figure

4.19, it can also be seen that the data for Level 2 and Level 3 patients both had a 5.2 times difference between the minimum and maximum time taken. When comparing the average with the median time taken in Figure 4.20, it can be seen that Level 1 had the largest difference between the average and median, with the average being 1.6 times higher than the median. As noted in Figure 4.18, this difference is likely due to data collected at points 4, 14, and 17, which were between 1.2 and 1.6 times longer than the next longest time.

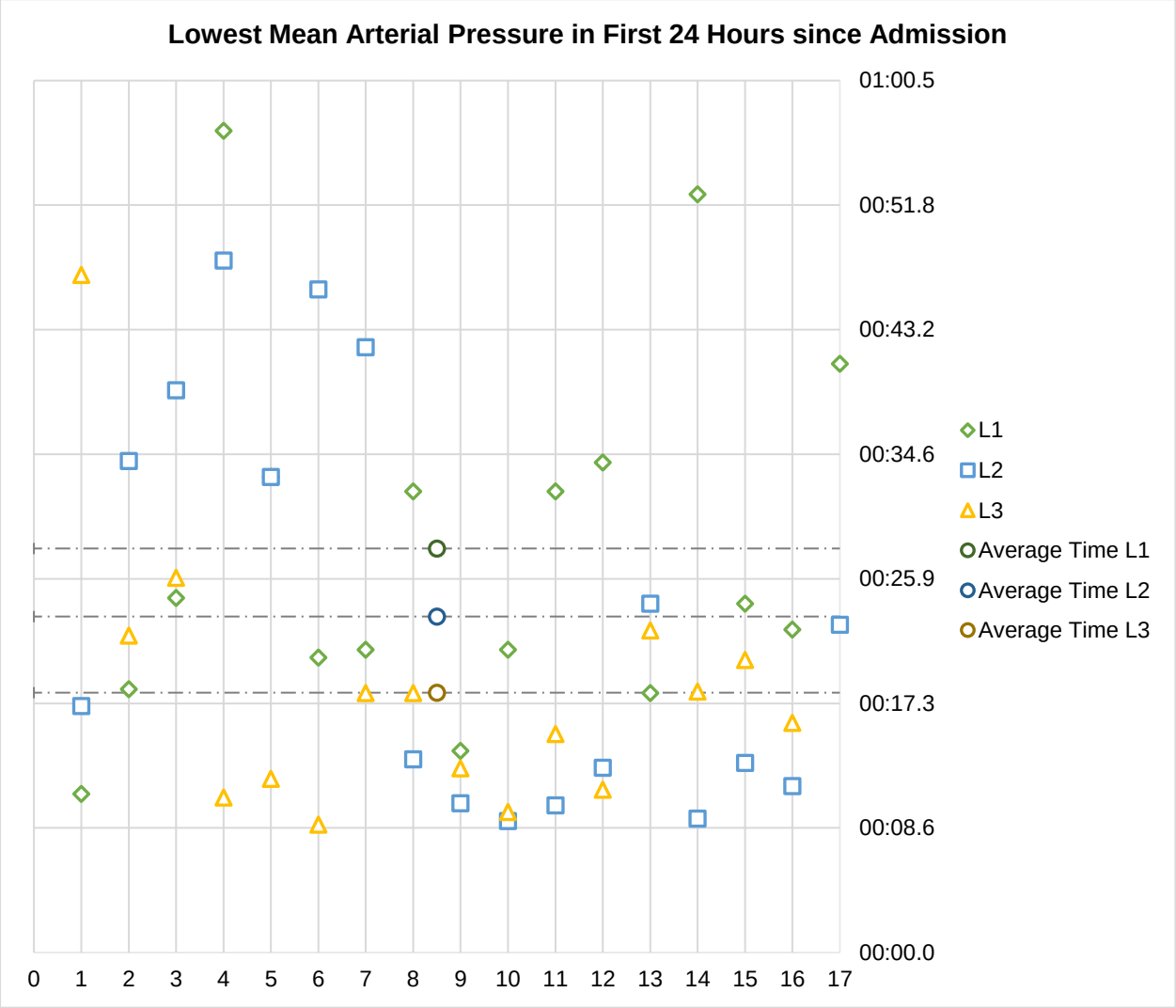



Figure 4.18 – Time Taken to Find the Lowest Mean Arterial Pressure in First 24 hours since admission where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

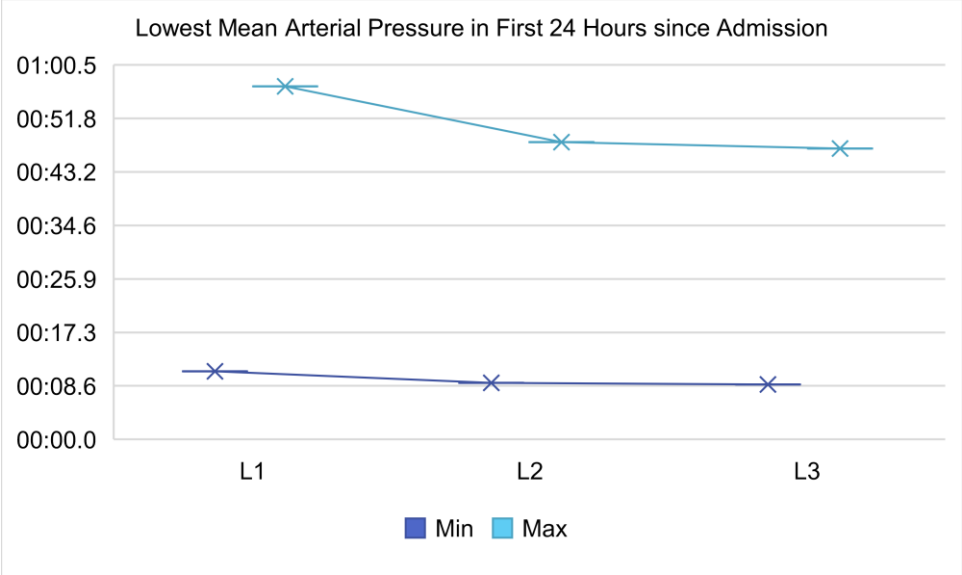



Figure 4.19 - Minimum and Maximum Time Taken to Find the Lowest Mean Arterial Pressure in First 24 hours since admission where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

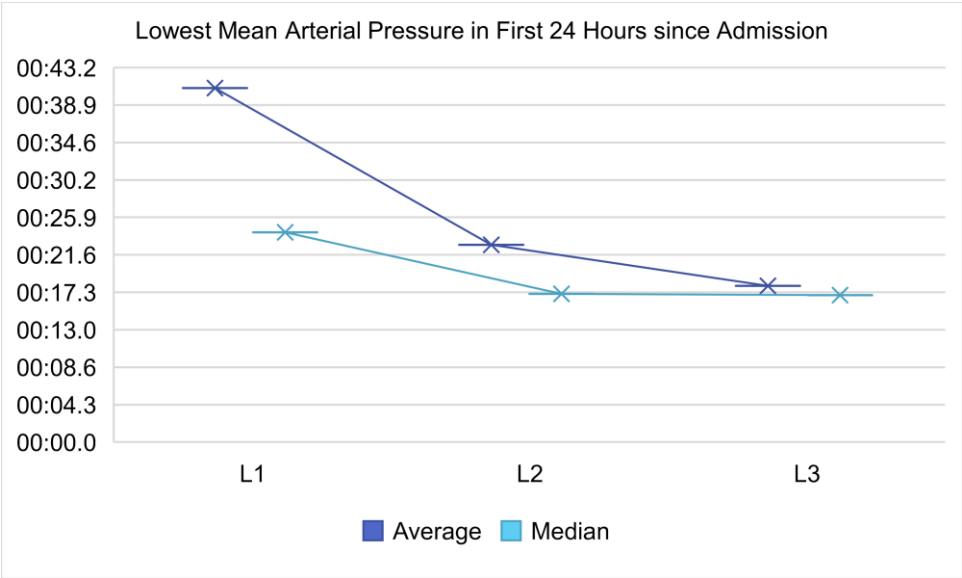



Figure 4.20 – Comparison of Median and Average Time Taken to Find Highest Temperature in Last 24 hours where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

The last set of data observed from the observation chart was urine output in the last 24 hours. In Figure 4.21, data collected from Level 3 patients has the lowest average time. However, the average for Level 3 patients is higher than the other data collected from the observation chart. It can also be noted in Figure 4.22 that the average time taken for the Level 1 patient was the lowest average for data collected from the observation chart. This is likely due to urine output being a more commonly measured data point for patients across all three levels of care within critical care, unlike the more unique observations within critical care of mean arterial pressure. From Figure 4.22, it is noted that the average time for Level 1 patients was 1.3 times longer than the average time for Level 3 patients. Also, Level 2 patients were 1.2 times longer than the average time for Level 3 patients. These are the closest average time taken out of the three data points collected from the observation chart.

When looking at the minimum and maximum time taken to find the data points in Figure 4.22, it is noted that the difference was again largest for Level 1 patients. The difference between the minimum and maximum time taken was similar for Level 2 and Level 3 patients. The maximum time taken for Level 1 patients was 12 times longer than the minimum time taken, whereas, for Level 2 patients, it was 5.2 times longer and 7.3 times longer for Level 3 patients. However, Figure 4.23 shows that for Level 1 patients, the average time taken is only 0.5 times longer than the median time. Also, the median time and average time for Level 3 patients is within 0.1 seconds of each other. For Level 2 patients, the average time is 1.7 times longer than the median time. The average time is likely influenced by data points 2 through 7, which are between 1.3 and 1.9 times longer than the next highest data point. These are also between 1.4 and 2.0 times longer than the average time taken to find the data point for Level 2 patients.

The above observation sets have the potential to be easier to access through the implementation of a clinical information system. However, any benefits are likely only to be achieved if a view of the data is available, like current paper documentation with the ability to see trends clearly and concisely to the end user. The time spent on documenting this observation set also has the potential to be reduced. However, this is dependent on the method of data collection and the level of automation and validation.

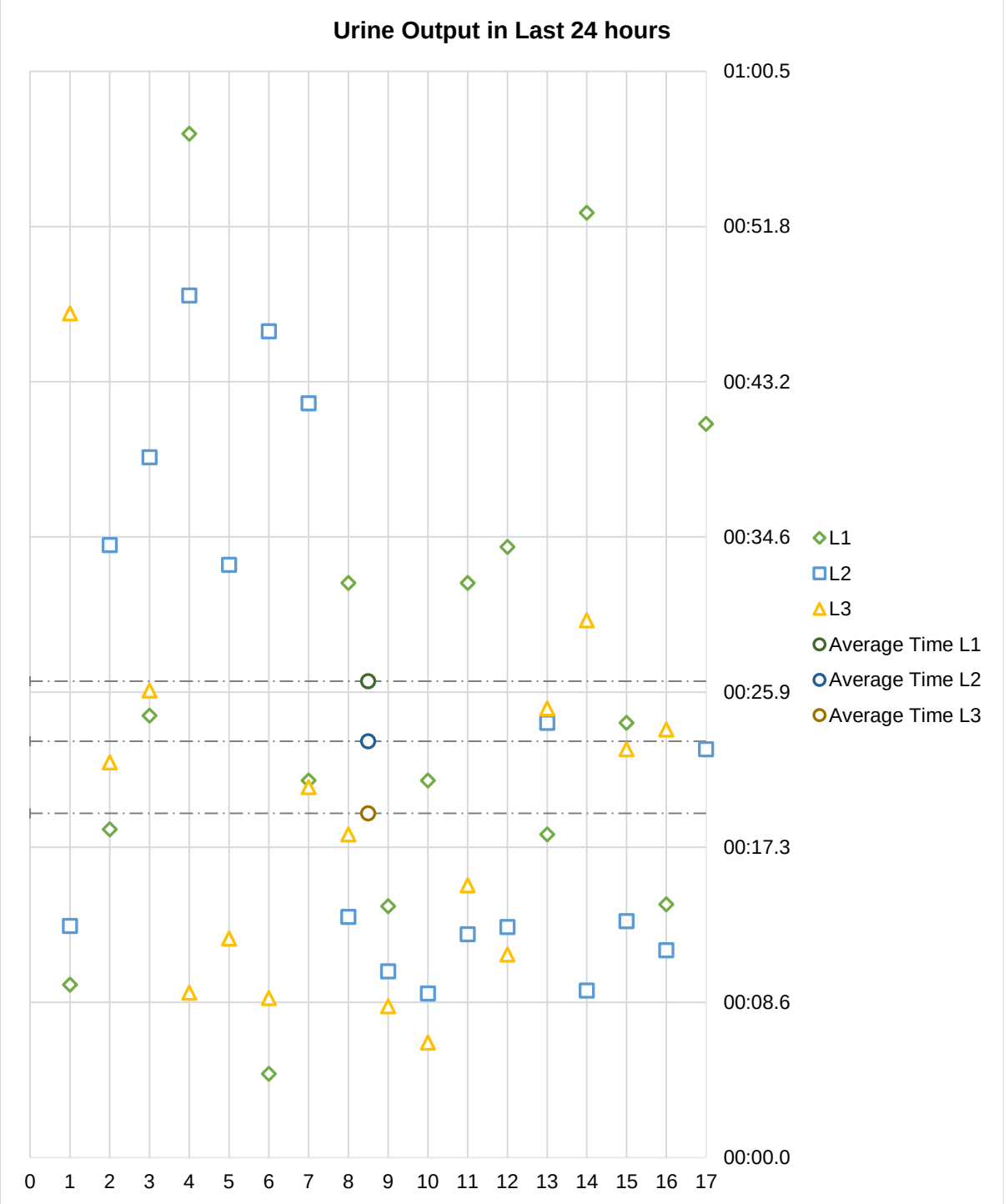



Figure 4.21 - Time Taken to Find the Urine Output for the Last 24 hours where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

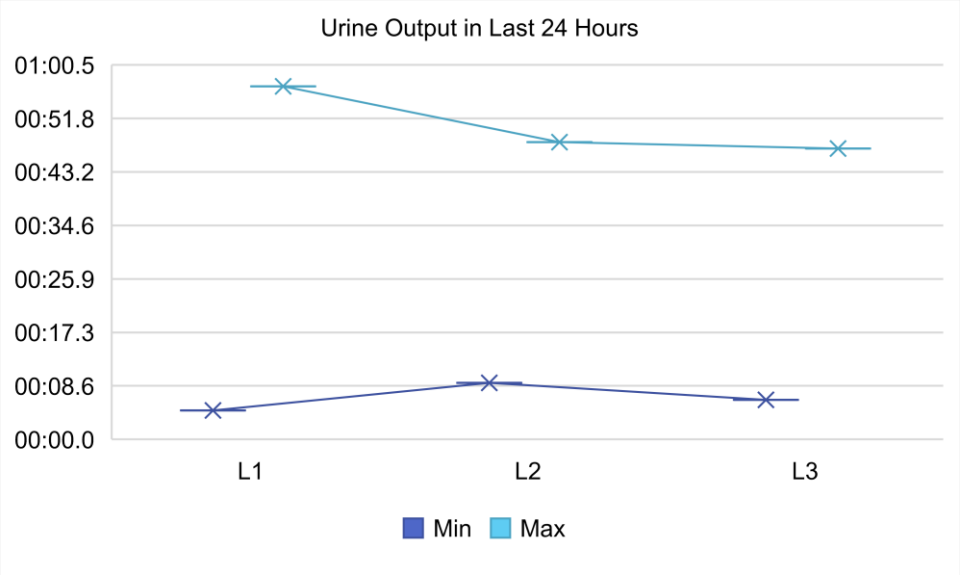



Figure 4.22 - Minimum and maximum time taken to find the urine output in the last 24 hours where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

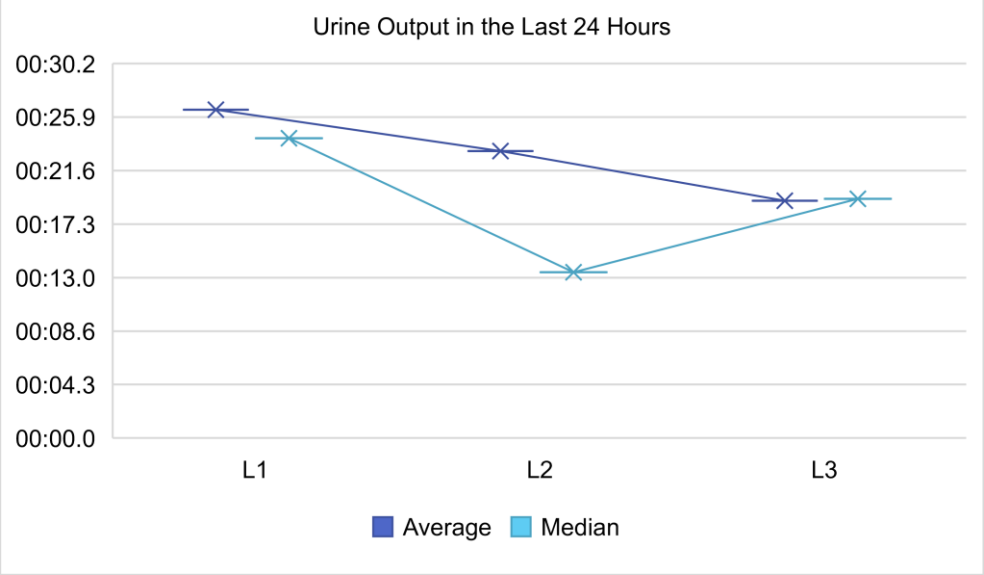



Figure 4.23 - Median and Average time taken to find the urine output in the last 24 hours where L1 refers to Level 1 Patients, L2 refers to Level 2 patients, and L3 refers to Level 3 patients.

## 4.3 Clinician Viewpoint on Nursing Documentation Survey

As previously noted, a survey was sent out to the nursing workforce within adult critical care at the Grange University Hospital, ABUHB. The survey was open from 28th August 2023 through to 28th November 2023, and a total of 17 responses were received. The first seven questions asked the nurses to provide their response as a rating of 1 – Poor, 2 – Below Average, 3 – Average, 4 – Good, and 5 – Very Good. 12 respondents have worked for between 0 to 7 years, with 3 having worked for 20 years or more within critical care in ABUHB. However, there were no respondents who had 16 to 19 years of experience in critical care.

When looking at years of experience in relation to the first question, where users were asked to rate the quality of current documentation, eight respondents rated it as 3 (average). When the responses were grouped in relation to years of experience, Figure 4.24 showed that those with 8 to 11 years' experience rated it as 2 (below average), and those with 20 to 23 years' experience rated it as 4 (good). However, the other 4 years of experience brackets rated it as 3 (average), which is in line with the average rating.

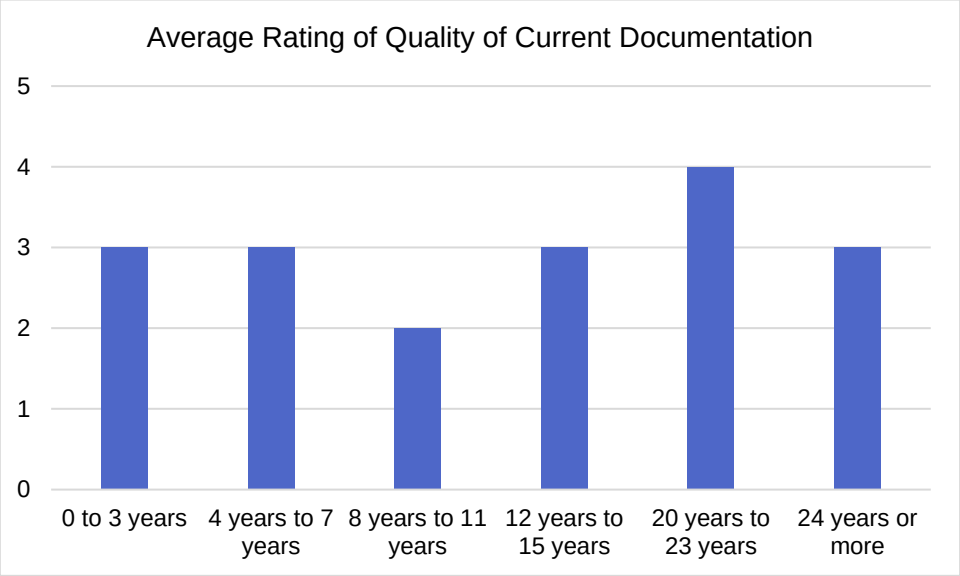



Figure 4.24 - Average Rating by Nurses of Quality of Current Documentation by Years of Experience

The next question asked the respondents to rate the completion of nursing documentation, and 10 respondents rated the current completion of documentation as 3 (average). When the responses and years of experience are grouped together, Figure 4.25 also shows that those with 12 to 15 years' experience rated it as 2 (below average), and those with 20 to 23 years' experience rated it as 4 (good). However, the other 4 years of experience brackets rated it as 3 (average), which is in line with the average rating.

As the average rating of current completion and quality of documentation is classed as average, there is the potential for a clinical information system to improve the quality. However, this will require clinician involvement with design and data entry requirements of the system, so the system does not become more data heavy leading to a reduction in the quality of documentation.

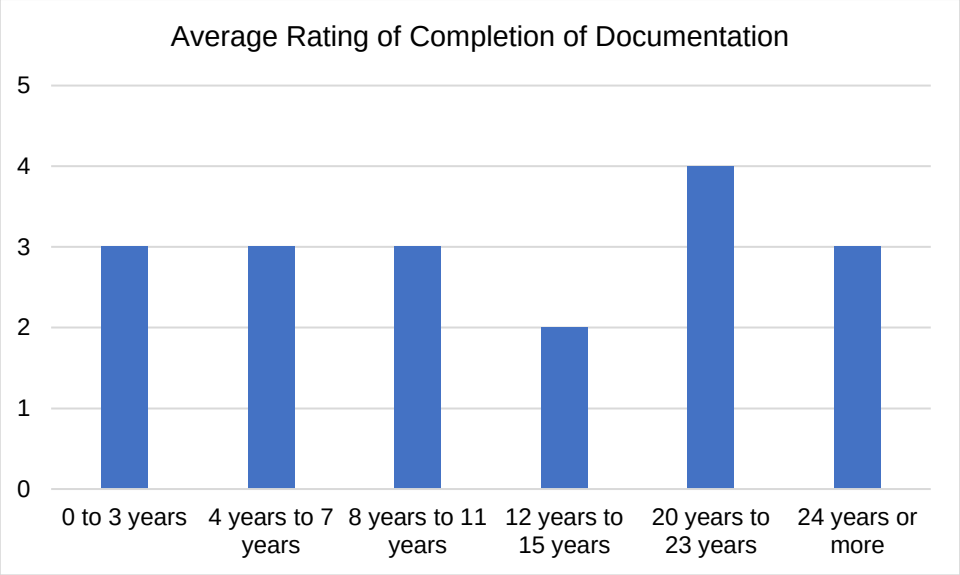


Figure 4.25 - Average Rating by Nurses of Completion of Current Documentation by Years of Experience

The next 5 questions asked the nurses to rate their opinion on how easy it was to access certain information within the patient record with a score of 1 – Poor, 2 – Below Average, 3 – Average, 4 – Good, and 5 – Very Good. Table 4.8 shows that 12 out of 17 respondents rated the ease of access the same for both current height and weight and admission height and weight. It can also be seen that four respondents rate the ease of access to admission height and weight as good or very good. However, six respondents rate the ease of access to admission height and weight as below average or poor. Also, five respondents rated the ease of access to current height and weight as good or very good, but six respondents rated it as below average or poor.

Table 4.8 shows the respondents rated the ease of access to reason for admission, allergy status and past medical history higher than admission and current height and weight. 13 respondents rated the ease of access to reason for admission as good or very good. The remaining four respondents rated the ease of access to the reason for admission as Average. When asked to rate the ease of access for finding the patient's allergy status, Table 4.8 shows six respondents rated it as Good, with seven rating it as Very Good. Two respondents rated it as Average, with one respondent reporting it as Below Average. When looking at Table 4.8, it can also be seen that nine respondents rated the ease of access to past medical history as Good, and three respondents rated it as Very Good. Four respondents rated the ease of access as Average, with one respondent rating it as Below Average.

In Figure 4.26, respondents who identified as having between 12 to 15 years and 20 to 24 years or more experience on average rated as 2 (Below Average) the ease of access to admission and current height and weight. However, the other years of experience brackets, on average, rated it no higher than 3 (Average). As seen in Figure 4.26, admission and current height and weight were the lowest-rated areas across all data items assessed and rated no higher than Average by all experience brackets. However, the Reason for Admission, Allergy Status and Past Medical History all rated no lower than Average across all experience brackets. The highest rate of data point was Allergy Status, which was rated as very good by those with 12 to 15

years' experience. The experience brackets of 0 to 3 years, 4 to 7 years, and 20 to 23 years all rated the ease of access for Allergy Status as Good.

From this, the ease of access to information has the potential to improve ease of access to information. However, this is isolated to admission and current height and weight. This is due to the nurses self-rating the ease of access to reason for admission, allergy status and past medical history as quite high.

Table 4.8 - Nurses' Self-Rating of Ease of Access to Admission Height and Weight, Current Height and Weight Within the Patient Record

| | Ease of Access to | | | | |
|---|---|---|---|---|---|
| | Admission Height and Weight | Current Height and Weight | Reason for Admission | Allergy Status | Past Medical History |
| 24 years or more | 3 | 2 | 4 | 2 | 4 |
| 20 years to 23 years | 4 | 4 | 4 | 4 | 4 |
| 12 years to 15 years | 2 | 2 | 4 | 5 | 3 |
| 4 years to 7 years | 2 | 2 | 3 | 3 | 3 |
| 4 years to 7 years | 3 | 3 | 4 | 4 | 4 |
| 8 years to 11 years | 3 | 3 | 3 | 3 | 3 |
| 0 to 3 years | 2 | 4 | 4 | 5 | 4 |
| 0 to 3 years | 3 | 4 | 5 | 5 | 4 |
| 24 years or more | 2 | 2 | 3 | 4 | 4 |
| 4 years to 7 years | 3 | 3 | 4 | 5 | 5 |
| 0 to 3 years | 3 | 3 | 4 | 4 | 4 |
| 4 years to 7 years | 4 | 4 | 4 | 4 | 4 |
| 0 to 3 years | 4 | 2 | 4 | 4 | 4 |
| 4 years to 7 years | 2 | 2 | 4 | 3 | 2 |
| 0 to 3 years | 3 | 3 | 5 | 5 | 5 |
| 0 to 3 years | 5 | 5 | 5 | 5 | 5 |
| 4 years to 7 years | 1 | 3 | 3 | 5 | 3 |

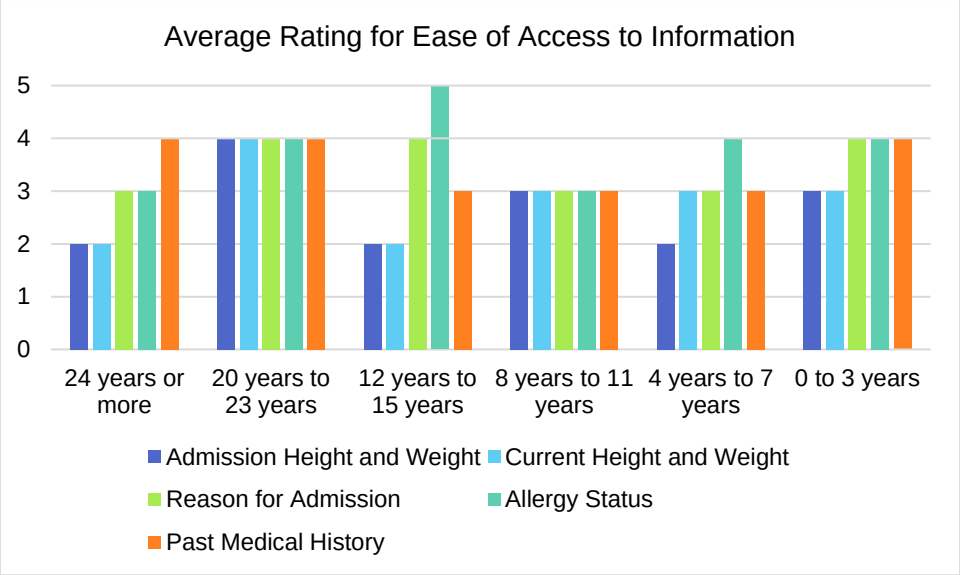



Figure 4.26 - Average Rating of Ease of Access to Current and Admission Height and Weight, Reason for Admission, Allergy Status, and Past Medical History

Word clouds were generated for the two qualitative questions, asking the respondents for their opinions on current nursing documentation and the completion of documentation. Due to the survey looking at 'opinion' of documentation, this was a common word found as part of the word cloud. Therefore, any words or phrases within the word cloud containing documentation will be excluded from the analysis of the word cloud. As seen in Figure 4.27, there were mixed opinions, with some stating that the documentation was great, but then other opinions reported the documentation to be difficult, repetitive, and long-winded. However, it is key to note that some opinions stated that the documentation was necessary despite some negative opinions. The opinions on the completion of nursing documentation, as seen in the word cloud in Figure 4.28, were overly positive. Respondents found that vital information was regularly checked, was of a good standard, and was regularly updated. It was noted that there was a high volume of paperwork, but it was filled in correctly.

Based on the respondents' word clouds it is noted that there is potential for an improvement to the quality of documentation, time spent on documentation, and ease of access to information within the patient record. However, these need to be viewed in sight of the previous questions of the survey to identify clear areas where an improvement can be achieved through the implementation of a clinical information system.


Figure 4.27 - Word Cloud of Respondents Opinion on Current Nursing Documentation


Figure 4.28 - Word Cloud of Respondents Opinion on Completion of Nursing Documentation

The penultimate question on the survey was the respondents, on average, how long in minutes they feel they spend on documentation in a 12-hour shift. As seen in Table 4.9, responses varied from 30 minutes to 360 minutes. This equated to between 4.1% and 50% of a 12-hour shift spent on documentation. The average response time spent on documentation was 149 minutes, which equates to 20%, with the median value being 120 minutes, which equates to 16.6% of a 12-hour shift. When looking at the data in relation to reported years of experience, Figure 4.29 shows that those with 20 to 23 years' experience reported the lowest amount of time spent on documentation with 90 minutes. However, those with 24 years or more of experience reported the highest amount of time spent on documentation, which was 225 minutes. The other years of experience brackets all reported similar average times of between 120 and 180 minutes, which equates to between 16.6% and 25% of a 12-hour shift.

Based on self-reporting, it is evident that a clinical information system has the ability to reduce the amount of time spent on documentation. To make sure that an increase in data input does not result in additional time being spent on documentation, system design is crucial. Additionally, as this would affect the amount of time spent on documentation, we would also need to take the system user's digital literacy into account.

Table 4.9 - Respondents Response on Average Time Spent on Documentation in a 12 Hour Shift

| Years of Experience | Time in Minutes Spent on Documentation in a 12-Hour Shift |
|---|---|
| 24 years or more | 90 |
| 20 years to 23 years | 90 |
| 12 years to 15 years | 120 |
| 4 years to 7 years | 110 |
| 4 years to 7 years | 30 |
| 8 years to 11 years | 180 |
| 0 to 3 years | 360 |
| 0 to 3 years | 120 |
| 24 years or more | 360 |
| 4 years to 7 years | 180 |
| 0 to 3 years | 120 |
| 4 years to 7 years | 150 |
| 0 to 3 years | 120 |
| 4 years to 7 years | 240 |
| 0 to 3 years | 30 |
| 0 to 3 years | 120 |
| 4 years to 7 years | 120 |

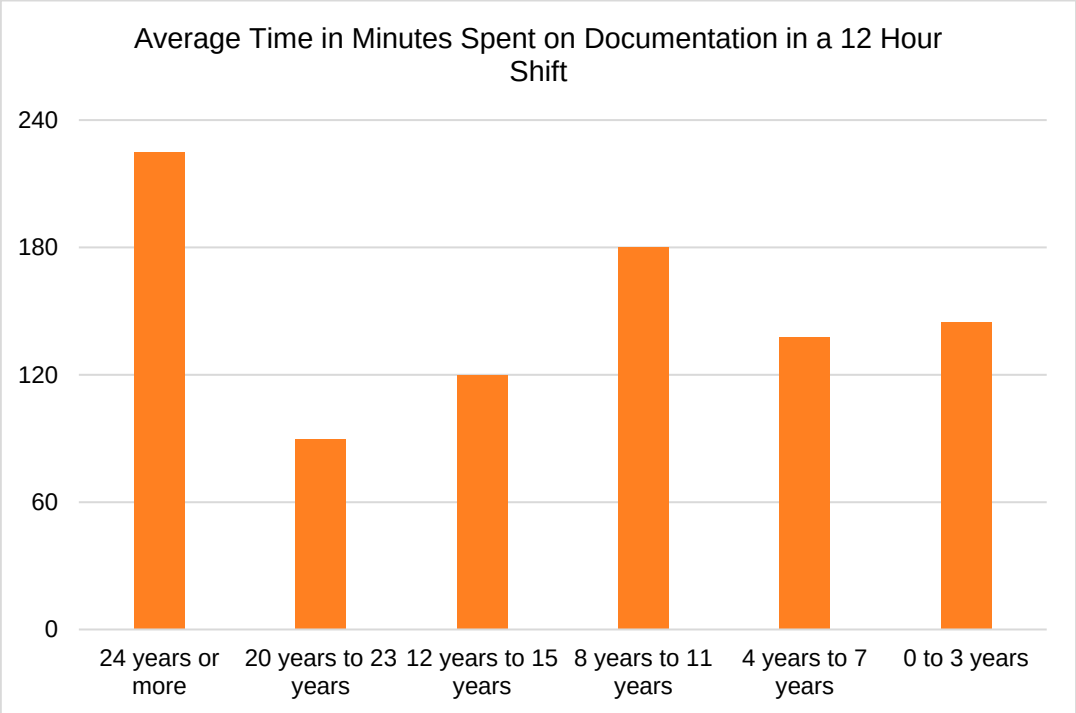



Figure 4.29 - Average Reported Time Spent on Documentation in a 12 Hour Shift by Years of Experience

# Chapter 5. Discussion

The above results and outcomes can now be looked at in further detail and how they relate to the research questions.

## 5.1 Are there areas of nursing documentation within critical care where quality can be improved by implementing a clinical information system?

The answering of this research question was supported by the data collection undertaken during the documentation quality audit form and the survey of the clinician viewpoint on nursing documentation.

The documentation quality audit form provided several key points that support the answering of the research question. The reason that no records were deemed not objective and relevant to the individual patient is likely the Nursing and Midwifery Council Code of Conduct (2018) states that as part of practising effectively, records should be clear and accurate. However, this should also apply to legibility and relevant entries about care planning in relation to the patient's relative / carer as outlined by the latest Nursing and Midwifery Council guidance for record keeping (2009). This identifies two areas of documentation where quality can be improved by implementing a clinical information system (CIS). This is due to a digital patient record being more legible and not reliant on users' handwriting. Also, a CIS could develop a specific section of the nurse care plan to document relevant entries about care planning in relation to the patient's relative / carer.

It was also found that all records had the appropriate clinical risk assessments completed with clear evidence of care planning with measurable, appropriate, and achievable goals. Also, all records had clear documentation of care given and changes in the patient's condition. This is likely due to the Nursing and Midwifery Council standards (2018), which identify assessing needs, planning care, and providing and evaluating care as two of the seven identified platforms.

The variance noted on whether communication with family was documented clearly, as well as the correlation with whether next of kin/carer and contact details were recorded, showed an area where quality could be improved by implementing a CIS. The Nursing and Midwifery Council standards (2018) state that within the platform of evaluating and providing care, nurses could demonstrate communication skills to provide accurate information for the patients' and their families' / carers' needs. Janols *et al.* (2014) identified that clinical information systems can improve communication, but this is only if the system is designed appropriately.

It was found that not all records demonstrated a visible name and signature on nursing records. Also, it was noted that although all entries were accurately dated, not all records had the entry time accurately documented or written in consecutive time order. This is despite the latest Nursing and Midwifery Council guidance for record keeping (2009), which states that as part of these principles, written records should have the

nurse's name and job title printed as well as all records being dated and timed in chronological order. However, this could be a limitation of paper documentation due to available space when documenting, but these could be areas of improvement through the implementation of a CIS.

The latest Nursing and Midwifery Council guidance for record keeping (2009) also outlined that if any records needed altering, the original record was still clear and auditable by scoring through errors with a single line. Also, an alteration should be marked with the nurse's name as well as the date and time of the alteration. However, it was found that not all records containing alterations met the set guidance for record keeping. However, a CIS has the potential to improve this due to the requirement of the author being captured based on the user logged in to the system. Also, it can be defined as part of the system specification of how alterations are managed and displayed in the system.

A common element found in all records was that the patients' details were not fully recorded on each page. This is another area where quality can be improved by implementing a CIS by specifying the display of patient demographics, which are visible whenever the user is within the system. A CIS with role-based access log-in has the potential to improve the quality of access to the system. However, this will follow current practice where all records were stored appropriately and allowing appropriate access to the records.

When looking at the survey responses that support the answering of this research question, it was seen that, on average, the quality of the documentation was deemed average. This is likely due to a lot of documentation, which is also repetitive and duplicated at times, as identified in the word clouds (Figures 4.27 and 4.28). This feedback will be key to identifying specification items for a CIS, such as information being entered once within the system, shared with the other appropriate areas of the system, and shown to the relevant individuals.

The findings are consistent with Wang, Yu, and Hailey (2013), who found that the quality of nursing documentation can be improved through a clinical information system (CIS). This was due to CIS's improving the format, structure, and process of information. Akhu-Zaheya, Al-Maaitah, and Hani (2017) also found in their study that quality was improved as CIS processes enable entries to automatically capture the nurse's name and signature alongside the date and time of each entry. Yu et al. (2013) agreed that paper documentation had many pitfalls, such as illegible writing, unclear alterations of notes, and missing nursing signatures. Nguyen, Bellucci, and Nguyen (2014) also found that there is potential for CISs to improve the quality of documentation, although they identified the limitation that CISs were not widely used at the time of their study.

## 5.2 Are there any areas where ease of access to information within critical care can be improved by implementing a clinical information system?

The second research question was aimed to be answered through the data collected as part of the time and motion data collection and clinician documentation survey.

As seen in the time and motion study, there was a variance in the averages between Level 1, 2, and 3 patients. The admission and current height and weight had the highest average time. When looking at the clinician viewpoint survey, they also rated these data items either average or below average. This is likely due to the fact that there are many different places where this could be documented. However, if a clinical information system (CIS) allows this information to be documented in a single place and shared throughout the system, then this could, in turn, improve the ease of access to information.

When looking at the recording of allergy status, this was an area where there were no issues with ease of access and it was found in a timely manner. The clinician viewpoint survey also identified this and rated it as either average or good. The current process will need to be mapped to maintain ease of access and ensure no decrease in ease of access due to a CIS being implemented.

The time it was taken to find the reason for admission and Past Medical History had similar average times but also the same variance between Level 1, 2, and 3 patients, with it taking longer for Level 2 patients. The clinician's viewpoint, however, rated this as either average or good. This is likely due to this being recorded only at admission and rarely updated throughout the patient stay, thus being part of the older part of the patient record. However, nurses would use this information daily as part of the patient handover process from one shift to another. If the CIS could run reports for each user with a summary at the start of the shift, this could be a way to improve the ease of access to this information.

The admission height and weight took, on average, 1 minute and 8.8 seconds to find. Although this does not sound like a prolonged period, when looked at in the context of a 12-hour shift, this item could be looked for at least 20 times in one shift by various healthcare professionals. This means over 22 minutes in a 12-hour shift would be spent looking for these data items, but if they were readily available in a CIS, the time could be spent instead on direct patient care.

However, the average time taken to find the patients allergy status was 12.9 seconds. In the context of a 12-hour shift, this time taken to find the information has no adverse effect to the clinician. This is especially true as the allergy status is recorded on the same documentation as medicine prescription and administration. This means that the information is readily available in the same place that clinicians will use it.

Maryati Mohd's (2015) evaluation looked at the implementation of a CIS within critical care. The nursing staff reported positive feedback on how the time taken to find information was reduced post-implementation. They also found that nurses reported feeling like they worked more efficiently since the system was implemented. Islam, Poly, and Li (2018) also found in their study that one of the major opportunities for

implementing a CIS was improved access to the patient's records in a timelier manner than paper-based practices. However, they also found that although the ease of access at the front end of the system was good when the data needed to be integrated and audited, this was an area where CISs needed to improve their functionality. Fritz, Tilahun, and Dugas (2015) also identified that CISs could support staff with access to patient data in an easy and systematic manner. Nguyen, Bellucci, and Nguyen (2014) identified that a CIS has the potential to improve ease of access; however, this was dependent on the quality and accuracy of the data.

### 5.3 Does the current time taken for nursing documentation have the potential to be improved through the implementation of a clinical information system?

The third research question was aimed to be answered using the time and motion data collected as well as the clinician viewpoint survey.

When looking at the clinician's viewpoint on the nursing documentation survey, those whose years of experience was 24 years or more stated they spent, on average, 225 minutes within a 12-hour shift on documentation. The next highest average was 180 minutes for those whose years of experience were 8 to 11 years. It is likely that those who identified their years of experience as 24 years or more have seen many changes to documentation and practice over the years, so they have had to adapt to many changes. Also, due to their experience, they are more likely to document in more detail and depth than other nurses with less experience in critical care. However, the average for 20 to 23 years was the lowest at 90 minutes spent on documentation in a 12-hour shift. When looking at those reporting 24 years or more experience, the average was skewed by one respondent reporting 360 minutes and another reporting 90 minutes. Therefore, the averages need to be viewed in the context of individual respondents due to other variables not considered, which may affect time spent on documentation. It may be worth when conducting this again for the respondents to document time spent on average for the 3 different levels of patient to see if there is any correlation between time spent on documentation and the level of care the patient requires.

This research question was also supported by the time and motion data collection study undertaken. The time spent on documentation is likely to be affected by the time taken to find certain data points so it can be referenced to explain trends, changes in the patient's condition, or treatment delivered. The highest average time taken to find data items was for the admission height and weight. The next highest average was also for past medical history and reason for admission. These 4 data items are all key data points that influence the patient’s treatment and ongoing plan of care. However, if a clinical information system (CIS) can display this information and is available at the point of documentation, such as care planning and recording current height and weight, then the time spent on documentation is likely to be decreased.

Bosman et al. (2003), as part of their study, identified that documentation time was reduced post-implementation of a clinical information system, but this time was also reinvested into patient care. Donati et al. (2007) also agreed with Bosman et al. (2003), and when they compared paper vs digital documentation, they found that the time spent on documenting common data items in a CIS was shorter than the time spent on the same data items on paper-based documentation. However, Apkon and Singhaviranon (2000) found that data was more detailed and structured and that although there was a reduction in time spent on documentation, it was not deemed significant. However, the findings of Apkon and Singhaviranon (2000) may not be relevant to current practice as CISs have been further developed due to advances in technology. Despite these technological advancements, Mador and Shaw (2009) found that it remained unclear the impact CISs have on time savings. However, they did find that CISs also led to increased time spent on direct patient care. Saarinen and Aho (2005) found an increase in time spent on documentation post-implementation of a CIS. However, they suggested the system needed further development, which in turn may lead to a reduction in time spent on documentation.

# Chapter 6. Conclusions

## 6.1 Project Aims

This project set out to answer three separate questions looking at nursing documentation in Wales and whether ease of access, quality of documentation, and time spent on documentation could be improved through the implementation of a clinical information system (CIS). As part of the literature review undertaken, it was evident that there have been multiple studies that identified where a CIS could improve nursing documentation, but there were also some studies that found disadvantages to CISs being implemented. As part of the data collection, there was evidence that there were areas of nursing documentation that had the potential for quality and ease of access to be improved. However, there were some data items where it was evident that there is unlikely to be an improvement when a CIS is developed and implemented, but there was also the potential for a CIS to reduce the ease of access and quality of documentation. There were also several areas where a reduction in time spent on documentation could potentially be achieved through the implementation of a CIS, but there were some areas where the reduction in time was minimal. However, it is key to note, as seen in the literature review, that the design and user interface of the developed system will be a key factor to any benefits being achieved. Also identified in the literature review, the development of a CIS cannot replicate current paper processes and needs to ensure the CIS does not create an increase in documentation by being utilised to capture a wider data set of information than current processes.

## 6.2 Limitations, Constraints, and Further Research

The research and data collection were undertaken by a singular person alongside their full-time job. The research conducted has now provided a snapshot and baseline in relation to the research questions. Although the data collected was in a singular unit in Wales, it can be used as a baseline and model to be replicable to other adult critical care units in Wales by other researchers. The sample size was limited to 50 patients, but this was double the amount of funded critical care beds within ABUHB. The data collection took place during October and November prior to the normal cycle of winter pressures within the NHS. All data collected was undertaken on a weekly basis to allow variability in patient records observed.

Based on this, this research can be utilised in the future as part of a wider study looking at the same research questions and data collection methods across other critical care units in Wales. The units used to collect data could be reviewed to give a more representative view of differing population densities as well as a mixture of different rural-urban classification areas. This would then lead to the research being representative of an All-Wales basis and, in turn, identify other trends related to rural-urban classification and population densities. If an All-Wales review is undertaken, it has the potential to identify different data collection windows throughout the year to identify any variables during differing periods of the year, such as winter pressures. Introducing data collection windows throughout the year has the potential to be more reflective of the total adult critical care admissions within Waler per year.

However, one of the main limitations of this study was the lack of funding for a wider research and data collection team. The researcher undertaking it alongside their full-time role introduced time constraints due to the availability of the researcher, who was only available to collect data for a 4-hour period one day a week. The data collected were also limited based on the availability of the patient's notes at the time of the data collection period.

## 6.3 Self-Reflection

The researcher found that the unit and clinicians working during the data collection period were very supportive of the work being undertaken. This provided the opportunity for informal discussions on the research being undertaken and for the researcher to build a good relationship and awareness of the unit after the first visit as part of data collection. However, the researcher found it hard at times to access the patient records to review due to various factors such as infection control restrictions, external clinical reviews of the patient, discussions between clinicians, the patient, and their relatives, or multidisciplinary review of the patient to create an ongoing plan of care. Despite this, the researcher felt that the records reviewed were representative of the unit during the data collection, and discussions with staff led to improved responses to the clinician viewpoint survey.

## References


Akhu-Zaheya, L., Al-Maaitah, R., and Hani, S. 'Quality of Nursing Documentation: Paper-based Health Records versus Electronic-based Health Records', *Journal of Clinical Nursing,* 27(3-4), pp. 578-589. Available at https://doi-org.ezproxy.uwtsd.ac.uk/10.1111/jocn.14097

All Wales Therapeutics and Toxicology Centre. (2022) '*Antibiotic Review Kit (ARK) Hospital Medication Administration Record*'. Available at: https://awttc.nhs.wales/medicines-optimisation-and-safety/medicines-optimisation-guidance-resources-and-data/medication-charts-and-records/antibiotic-review-kit-ark-hospital-medication-administration-record/. (Accessed: 6 January 2024)

Apkon, M., and P. Singhaviranon. (2000) 'Impact of an Electronic Information System on Physician Workflow and Data Collection in the Intensive Care Unit'. *Intensive Care Medicine,* 27, pp. 122–130. Available at: https://doi.org/10.1007/s001340000777.

Bail, K., Merrick, E., Bridge, C., and Redley, B. (2021) 'Documenting Patient Risk and Nursing Interventions: Record Audit'. *Australian Journal of Advanced Nursing* ,38(1), pp. 36–44. Available at: https://doi.org/10.37464/2020.381.167.

Benjamin, A (2008) 'Audit: How to Do It in Practice'. *BMJ*, *336 (May), pp:* 1241–1245. Available at: https://doi.org/10.1136/bmj.39527.628322.AD.

BetterEvaluation (2022) *What is evaluation?* Available at: https://www.betterevaluation.org/getting-started/what-evaluation (Accessed 14 September 2023).

Bidstats (2018) *Critical care clinical information system [CCCIS]*, *Critical Care Clinical Information System [CCCIS] [PIN]*. Available at: https://bidstats.uk/tenders/2018/W19/678559770 (Accessed: 12 September 2023).

Bidstats (2019) *Critical care clinical information system [CCCIS]*, *Critical Care Clinical Information System [CCCIS] [Notice]*. Available at: https://bidstats.uk/tenders/2019/W21/703528986 (Accessed: 12 September 2023).

Bidstats (2021) *Critical care clinical information system [CCCIS]*, *Critical Care Clinical Information System [CCCIS] [Award]*. Available at: https://bidstats.uk/tenders/2021/W44/762118145#:~:text=The%20Critical%20Care%20Clinical%20Information%20System%20%28CCCIS%29%20will,stan

dardise%20care%20thereby%20reducing%20waste%2C%20harm%20and%20variation. (Accessed: 12 September 2023).

Bosman, R., Rood, E., Oudemans-van Straaten, H., Van der Spoel, J., Wester, J., and Zandstra, D. (2003) 'Intensive Care Information System Reduces Documentation Time of the Nurses after Cardiothoracic Surgery'. *Intensive Care Medicine,* 29(1), pp: 83–90. Available at: https://doi.org/10.1007/s00134-002-1542-9.

Brundin-Mather, R., Soo, A., Zuege, D.J., Niven, D.J., Fiest, K., Doig, C.J., Zygun, D., Boyd, J.M., Leigh, J.P., Bagshaw, S.M., and Stelfox, H.T. (2018) 'Secondary EMR Data for Quality Improvement and Research: A Comparison of Manual and Electronic Data Collection from an Integrated Critical Care Electronic Medical Record System'. *Journal of Critical Care;* 47, pp: 295–301. Available at: https://doi.org/10.1016/j.jcrc.2018.07.021.

Courtney, L., and Wilson-Vanmeter, A. (2022) 'Streamlining the Head-to-Toe Assessment on the Adult and Critical Care Summary Flow Sheet in the Electronic Health Record'. *Journal of Informatics Nursing*, 7(4), pp: 29–33. Available at: https://www.proquest.com/docview/2800906919/abstract/F8C473DA4AC64E11PQ/1

Creswell JW, Klassen AC, Plano Clark VL, Smith KC. Best practices for mixed methods research in the health sciences. *Bethesda (Maryland): National Institutes of Health*. 2011; 2013:541-545.

De Georgia, M.A., Kaffashi, F., Jacono, F.J., and Loparo, K.A. (2015) 'Information Technology in Critical Care: Review of Monitoring and Data Acquisition Systems for Patient Care and Research'. *The Scientific World Journal* 2015 (February), Available at: https://doi.org/10.1155/2015/727694.

Digital Health and Care Wales (2020) *£13 Million Technology Investment for NHS Wales' Intensive Care Patients.* Available at: https://dhcw.nhs.wales/news/archived-news/13-million-technology-investment-for-nhs-wales-intensive-care-patients/ (Accessed: 18 September 2023).

Digital Health and Care Wales (2024) *Welsh Intensive Care Information System.* Available at: https://dhcw.nhs.wales/product-directory/our-digital-services/welsh-intensive-care-information-system/ (Accessed: 18 September 2023).

Donati, A., Gabbanelli, V., Pantanetti, S., Carletti, P., Principi, T., Marini, B., Nataloni, S., Sambo, G. and Pelaia, P. (2007) 'The Impact of a Clinical Information System in an Intensive Care Unit'. *Journal of Clinical Monitoring and*

*Computing*, 22(1), pp: 31–36. Available at: https://doi.org/10.1007/s10877-007-9104-x.

The Faculty of Intensive Care Medicine and Intensive Care Society (2022) *Guidelines for the Provision of Intensive Care Services*. Available at https://ics.ac.uk/resource/gpics-v2-1.html (Accessed: 03 October 2023)

Ferdousi, R., Arab-Zozani, M., Tahamtan, I., Rezaei-Hachesu, P., and Dehghani, M. (2020) 'Attitudes of Nurses towards Clinical Information Systems: A Systematic Review and Meta-analysis', *International Nursing Review,* 68 (1), pp: 59–66. Available at: https://doi.org/10.1111/inr.12603.

Fraenkel, D.J., Cowie, M., and Daley, P. (2003) 'Quality Benefits of an Intensive Care Clinical Information System'. *Critical Care Medicine,* 31(1), pp: 120-125. Available at: https://journals.lww.com/ccmjournal/Abstract/2003/01000/Quality_benefits_of_an_intensive_care_clinical.19.aspx

Fritz, F., Tilahun, B., and Dugas, M. (2015) 'Success Criteria for Electronic Medical Record Implementations in Low-Resource Settings: A Systematic Review'. *Journal of the American Medical Informatics Association,* 22(2), pp. 479–488. Available at: https://doi.org/10.1093/jamia/ocu038.

Guyer, A.C., Macy, E., White, A.A., Kuruvilla, M.E., Robison, R.G., Kumar, S., Khan, D.A., Phillips, E.J., Ramsey, A., and Blumenthal, K. (2022) 'Allergy Electronic Health Record Documentation: A 2022 Work Group Report of the AAAAI Adverse Reactions to Drugs, Biologicals, and Latex Committee'. *The Journal of Allergy and Clinical Immunology: In Practice* 10(11), pp: 2854–67. Available at: https://doi.org/10.1016/j.jaip.2022.08.020.

Hammond, J., Milton Johnson, H.M., Varas, R., and Ward, C.G., (1991) 'A Qualitative Comparison of Paper Flowsheets vs A Computer-Based Clinical Information System'. *Chest* 99(1), pp: 155–57. Available at: https://doi.org/10.1378/chest.99.1.155.

Hermon, A., Pain, T., Beckett, P., Jerrett, H., Llewellyn, N., Lawrence, P., and Szakmany. T. (2015) 'Improving Compliance with Central Venous Catheter Care Bundles Using Electronic Records', *Nursing in Critical Care,* 20(4), pp: 196–203. Available at: https://doi.org/10.1111/nicc.12186.

Huang, F.T. (2021) 'Caring for Computers: The Hidden Work of Clinical Nurses during the Introduction of Health Information Systems in a Teaching Hospital in Taiwan'. *Nursing Reports,* 11(1) pp: 105–19. Available at: https://doi.org/10.3390/nursrep11010011.

Intensive Care National Audit and Research Centre (2022) *ICMPDS V4.0 Core Dataset Flow Diagram – NHS.* Available at: https://www.icnarc.org/Our-Audit/Audits/Cmp/Resources. (Accessed: 22 October 2023).

Intensive Care Society (2022), *GPICS V2.1* Available at: https://ics.ac.uk/resource/gpics-v2-1.html (Accessed 24 October 2023).

Islam, M.M., Poly, T.N., and Li, Y. (2018) 'Recent Advancement of Clinical Information Systems: Opportunities and Challenges'., *Yearbook of Medical Informatics* 27(1), pp: 83–90. Available at: https://doi.org/10.1055/s-0038-1667075.

Janols, R., Lind, T., Göransson, B., & Sandblad, B. (2014). 'Evaluation of user adoption during three module deployments of region-wide electronic patient record systems', *International journal of medical informatics*, *83*(6), pp: 438–449. Available at: https://doi.org/10.1016/j.ijmedinf.2014.02.003

Joseph, R., Lee, S., Anderson, S.V., and Morrisette, M.J. (2020) 'Impact of interoperability of smart infusion pumps and an electronic medical record in critical care'. *American Journal of health-system pharmacy,* 77(15), pp. 1231 – 1236. Available at: https://pubmed.ncbi.nlm.nih.gov/32620966/

Klassen, A.C., Creswell, J., Plano Clark, V.L., Smith, K.C., and Meissner, H.I. (2012) 'Best practices in mixed methods for quality of life research', *Quality of Life Research*, 21(3), pp. 377–380. Available at: https://link.springer.com/article/10.1007/s11136-012-0122-x

Lin, Y.L., Trbovich, P., Kolodzey, L., Nickel, C., and Guerguerian, A. (2019) 'Association of Data Integration Technologies With Intensive Care Clinician Performance: A Systematic Review and Meta-Analysis'. *JAMA Network Open,* 2(5), Available at: https://doi.org/10.1001/jamanetworkopen.2019.4392.

Mador, R. L., and Shaw, N.T. (2009) 'The Impact of a Critical Care Information System (CCIS) on Time Spent Charting and in Direct Patient Care by Staff in the ICU: A Review of the Literature'. *International Journal of Medical Informatics,* 78(7), pp: 435–45. Available at: https://doi.org/10.1016/j.ijmedinf.2009.01.002.

Martich, G.D., Waldmann, C.S., and Imhoff, M. (2004) 'Clinical Informatics in Critical Care'. *Journal of Intensive Care Medicine, 19(3),* Available at: https://doi.org/10.1177/0885066604264016.

Maryati Mohd, Y. (2015) 'A Case Study Evaluation of a Critical Care Information System Adoption Using the Socio-Technical and Fit Approach'. *International Journal of Medical Informatics,* 84(7), pp. 486 - 499. Available at: https://doi.org/10.1016/j.ijmedinf.2015.03.001.

National Institute for Clinical Excellence (2002) *Principles for Best Practice in Clinical Audit.* Available at: https://www.nice.org.uk/media/default/About/what-we-do/Into-practice/principles-for-best-practice-in-clinical-audit.pdf (Accessed: 03 October 2023)

Nguyen, L., Bellucci, E., and Nguyen, L.T. (2014) 'Electronic Health Records Implementation: An Evaluation of Information System Impact and Contingency Factors'. *International Journal of Medical Informatics,* 83(11) pp: 779–796. Available at: https://doi.org/10.1016/j.ijmedinf.2014.06.011.

NHS England (2023) *Supporting Clinical Decisions with Health Information Technology*, Available at: https://www.england.nhs.uk/long-read/supporting-clinical-decisions-with-health-information-technology/. (Accessed: 06 October 2023).

Nursing and Midwifery Council (2009) *Record keeping: Guidance for nurses and midwives*. Available at: https://muppet.pbworks.com/f/NMC+guidelines+for+recordkeeping.pdf (Accessed: 02 November 2023)

Nursing and Midwifery Council (2018) *The code - the nursing and midwifery council*, *The Code: Professional standards of practice and behaviour for nurses, midwives and nursing associates*. Available at: https://www.nmc.org.uk/globalassets/sitedocuments/nmc-publications/nmc-code.pdf (Accessed: 21 October 2023).

Nursing and Midwifery Council (2023) *Records Management Policy*. Available at: https://www.nmc.org.uk/globalassets/sitedocuments/data-protection/records-management-policy.pdf (Accessed: 18 Jan 2024)

Ong, A.D. and Weiss, D.J. (2000) 'The Impact of Anonymity on Responses to Sensitive Questions', *Journal of applied social psychology*, 30(8), pp. 1691–1708. Available at: https://doi.org/10.1111/j.1559-1816.2000.tb02462.x.

Pabst, M.K., Scherubel, J.C. and Minnick, A.F. (1996) 'The Impact of Computerized Documentation on Nurses' Use of Time', *Read by QxMD*. Available at: https://read.qxmd.com/read/8605657/the-impact-of-computerized-documentation-on-nurses-use-of-time.

Page, M.J., McKenze, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff, J.M., Akl, E.A., Brennan, S.E., Chou, R., Glanville, J., Grimshaw, J.M., Hróbjartsson, A., Lalu, M.M., Li, T., Loder, E.W., Mayo-Wilson, E., McDonald, S., McGuinness, L.A., Stewart, L.A., Thomas, J., Tricco, A.C., Welch, V.A., Whiting, P., and Moher, D. (2021) 'The Prisma 2020 statement: An updated guideline for reporting systematic reviews', *BMJ* [Preprint]. Available at: https://doi.org/10.1136/bmj.n71

Pierpont, G. L., and Thilgen, D. (1995) 'Effect of Computerized Charting on Nursing Activity in Intensive Care'. *Critical Care Medicine* 23(6), pp: 1067–1073. Available at: https://doi.org/10.1097/00003246-199506000-00012.

Poissant, L., Pereira, J., Tamblyn, R., and Kawasumi, Y. (2005) 'The Impact of Electronic Health Records on Time Efficiency of Physicians and Nurses: A Systematic Review'. *Journal of the American Medical Informatics Association,* 12(5), pp: 505–516. Available at: https://doi.org/10.1197/jamia.M1700.

Reese, T., Segall, N., Nesbitt, P., Del Fiol, G., Waller, R., Macpherson, B.C., Tonna, J.E., and Wright, M.C. (2018) 'Patient Information Organization in the Intensive Care Setting: Expert Knowledge Elicitation with Card Sorting Methods'. *Journal of the American Medical Informatics Association,* 25(8), pp: 1026–1035. Available at: https://doi.org/10.1093/jamia/ocy045.

Saarinen, K., and Aho, M. (2005) 'Does the Implementation of a Clinical Information System Decrease the Time Intensive Care Nurses Spend on Documentation of Care?' *Acta Anaesthesiologica Scandinavica,* 49(1), pp: 62–65. Available at: https://doi.org/10.1111/j.1399-6576.2005.00546.x.

Sado, A.S. (1999) 'Electronic Medical Record in the Intensive Care Unit', *Critical Care Clinics*, 15(3), pp: 499-522, Available at: https://doi.org/10.1016/S0749-0704(05)70068-3.

Schnock, K.O., Kang, M, Rossetti, S.C., Garcia, J., Lowenthal, G., Knaplund, C., Chang, F., Albers, D., Korach, T.Z., Zhou, L., Klann, J.G., Cato, K., Bates, D.W., and Dykes, P.C. (2021) 'Identifying Nursing Documentation Patterns Associated with Patient Deterioration and Recovery from Deterioration in Critical and Acute Care Settings'. *International Journal of Medical Informatics,* 153 (September), Available at: https://doi.org/10.1016/j.ijmedinf.2021.104525.

Schünemann, H., Brożek, J., Guyat, G., and Oxman, A. (2013) *Overview of the GRADE approach*, *GRADE handbook*. Available at: https://gdt.gradepro.org/app/handbook/handbook.html (Accessed: 28 November 2023).

Sharma, H. (2022) 'How Short or Long Should Be a Questionnaire for Any Research? Researchers Dilemma in Deciding the Appropriate Questionnaire Length'. *Saudi Journal of Anaesthesia,* 16(1), pp: 65–68. Available at: https://doi.org/10.4103/sja.sja_163_21.

Stevens, B. (2017) *Improving the Quality of Electronic Documentation in Critical Care Nursing*. MSN Dissertation. Walden University. Available at: https://scholarworks.waldenu.edu/cgi/viewcontent.cgi?article=4739&context=dissertations&httpsredir=1&referer=

Su, W., Dufendach, K. and Wu, D.T.Y. (2019) 'Assessing the Readability of Freely Available ICU Notes'. *AMIA Joint Summits on Translational Science Proceedings,* 2019(May) pp: 696–703. Available at: https://pubmed.ncbi.nlm.nih.gov/31259026/

Tate, A., and Smallwood, C. (2021) 'Comparing the efficiency of paper-based and electronic data capture during face-to-face interviews', *PLOS ONE*, 16(3) e0247570. Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0247570

Varon, J. and Marik, P.E. (2002) 'Clinical Information Systems and the Electronic Medical Record in the Intensive Care Unit'. *Current Opinion in Critical Care,* 8(6), pp: 616–624. Available at: https://doi.org/10.1097/00075198-200212000-00022.

Wang, N., Yu, P., and Hailey, D. (2013) 'Description and Comparison of Documentation of Nursing Assessment between Paper-Based and Electronic Systems in Australian Aged Care Homes'. *International Journal of Medical Informatics,* 82(9), pp: 789–797. Available at: https://doi.org/10.1016/j.ijmedinf.2013.05.002.

Welsh Government (2018) *A Healthier Wales: Long term plan for health and social care*, Available at: https://www.gov.wales/healthier-wales-long-term-plan-health-and-social-care (Accessed: 4 October 2023).

Yang, S., Stansbury, L.G., Rock, P., Scalea, T., and Hu, P.F. (2019) 'Linking Big Data and Prediction Strategies: Tools, Pitfalls, and Lessons Learned'. *Critical Care Medicine*, 47(6), pp: 840-848. Available at: https://doi.org/10.1097/CCM.0000000000003739.

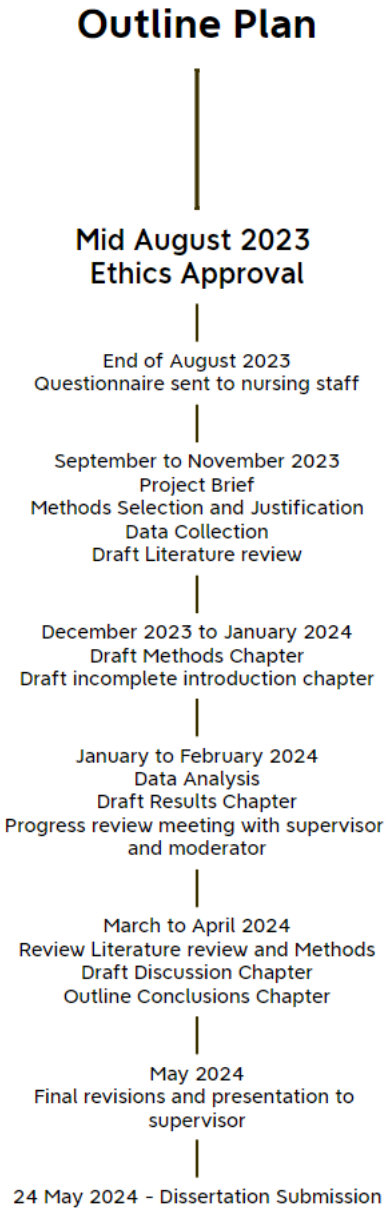
Yu, P., Zhang, P., Gong, P., and Zhang, J. (2013) 'Unintended Adverse Consequences of Introducing Electronic Health Records in Residential Aged Care Homes'. *International Journal of Medical Informatics,* 82(9), pp: 772–88. Available at: https://doi.org/10.1016/j.ijmedinf.2013.05.008.

Yusof, M.M. (2015) 'A case study evaluation of a Critical Care Information System adoption using the socio-technical and fit approach', *International journal of medical informatics*, 84(7), pp. 486–499. Available at: https://doi.org/10.1016/j.ijmedinf.2015.03.001.

Zheng, K., Guo, M.H., and Hanauer, D.A. (2011) 'Using the Time and Motion Method to Study Clinical Work Processes and Workflow: Methodological Inconsistencies and a Call for Standardized Research'. *Journal of the American Medical Informatics Association,* 18(5), pp: 704–710. Available at: https://doi.org/10.1136/amiajnl-2011-000083.

# Appendices

## Appendix 1 – Outline Research Plan



## Appendix 2 – Documentation Quality Audit Data Items Assessed

| **Data Item** |
|---|
| Nursing record written legibly. |
| Nursing records objective |
| Nursing records relevant to individual |
| Nursing records relevant to relative/carer |
| Visible Name and Signature on nursing records |
| Communication with family documented clearly. |
| Entries accurately dated |
| Entries accurately timed |
| Entries written on consecutive time order |
| Alterations scored with single line. |
| User making amendments visible. |
| Amendment date recorded |
| Amendment time recorded |
| Patient details fully recorded on each page. |
| Records stored appropriately |
| Appropriate access to records |
| Appropriate clinical risk assessments completed |
| Next of kin/carer and contact details recorded |
| Clear evidence of care planning |
| Measurable goals |
| Appropriate goals |
| Achievable goals |
| Documentation of care given. |
| Documentation of change in patients' condition |

## Appendix 3 – Time and Motion Data Items Assessed

| **Data Items** |
|---|
| Admission Height |
| Admission Weight |
| Current Height |
| Current Weight |
| Reason for Admission |
| Allergy Status |
| Past Medical History |
| Highest Temperature in Last 24 hours |
| Lowest Mean Arterial Pressure in First 24 Hours since Admission |
| Urine output in last 24 hours |

## Appendix 4 – Questionnaire sent to Nurses.

# Clinician Viewpoint on Nursing Documentation - Pre Implementation

1. How many years of experience do you have working within ITU within ABUHB? *

- ◯ 0 to 3 years
- ◯ 4 years to 7 years
- ◯ 8 years to 11 years
- ◯ 12 years to 15 years
- ◯ 16 years to 19 years
- ◯ 20 years to 23 years
- ◯ 24 years or more

2. How would you rate the quality of nursing documentation?
1 - Poor, 2 - Below Average, 3 - Average, 4 - Good and 5 - Very Good *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

3. How would you rate the completion of nursing documentation?
1 - Poor, 2 - Below Average, 3 - Average, 4 - Good and 5 - Very Good *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

4. Please rate the ease of access when looking in current documentation for Admission Height and Weight
1 - Poor, 2 - Below Average, 3 - Average, 4 - Good and 5 - Very Good *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

5. Please rate the ease of access when looking in current documentation for Current Height and Weight
1 - Poor, 2 - Below Average, 3 - Average, 4 - Good and 5 - Very Good *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

6. Please rate the ease of access when looking in current documentation for Reason for Admission
1 - Poor, 2 - Below Average, 3 - Average, 4 - Good and 5 - Very Good *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

7. Please rate the ease of access when looking in current documentation for Allergy Status
1 - Poor, 2 - Below Average, 3 - Average, 4 - Good and 5 - Very Good *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

8. Please rate the ease of access when looking in current documentation for Past Medical History
1 - Poor, 2 - Below Average, 3 - Average, 4 - Good and 5 - Very Good *

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|

9. What is your opinion on current nursing documentation? *

10. What is your opinion on completion of nursing documentation? *

11. In an average 12 hour shift, how many minutes do you feel you spend on documentation? *

12. Do you have any further comments on Nursing Documentation *