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Data Precision and Timeliness of Paper versus Software-Assisted Nursing Documentation: A Rapid Review and Meta-Analysis

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Background and Purpose: The nursing industry has progressively transitioned from paper-assisted documentation practices to software-assisted systems. Such a transition raises debates about its implications on the timeliness and precision of documented nursing data. This rapid review and meta-analysis examined existing literature on the effect of paper and software-assisted documentation systems on documentation precision and timeliness.
Methods: Utilizing the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines, this review and meta-analysis examined studies published in the past 50 years (1973 to 2023) and available in PubMed electronic database. The search methodology combined free-text search terms with Boolean operators for a more precise and sensitive search.
Results: The review and meta-analysis selected 15 studies from a pool of 314 articles after applying set inclusion criteria. The synthesis of evidence revealed that Software-assisted nursing documentation systems enhanced by twofold the precision of documented nursing data (Overall random effect Odds Ratio: 2.35, 95% CI: 1.32-4.17; $p = < 0.010$). Software-assisted nursing documentation systems reduced time spent on nursing documentation by nine minutes but was not significant (Overall random effects mean difference = 9.14 minutes; $p = 0.330$).
Conclusions: Software-assisted nursing documentation is valuable for enhancing nursing documentation precision but not timeliness. This study recommends software-assisted nursing documentation systems for improving the precision of nursing documentation.

Keywords: Nursing documentation, Paper records, Precision, Software, Timeliness.

1 Introduction

Nursing care documentation is an essential component of patient care. It archives nursing assessments, interventions, and outcomes [1]. Traditionally, nurses used pen and paper-assisted systems that involved handwritten notes on paper charts [2]. While this method sufficed for years, it posed inherent limitations: illegible handwriting, inconsistencies in nursing diagnosis codes, and extended time spent on documentation [3]. However, with the introduction of Electronic Health Records, software-assisted systems are quickly replacing the paper-assisted documentation system in healthcare facilities [4] [5].

Software-assisted nursing documentation systems have aimed to address the shortcomings of paper-assisted documentation [6]. The systems brought with them improved legibility of records, quick data retrieval and update capabilities [7]. It offers healthcare professionals a more efficient and organized means of recording patient information [8]. Yet, challenges persist regarding the perceived impact on the timeliness and precision of nursing data [9].

Precision is paramount in nursing care quality [10]. The precision of nursing documentation refers to the accuracy and specificity of the information recorded by nurses in patient care documents [11]. It entails capturing details with clarity and completeness, ensuring that the documented information accurately reflects the patient's condition, assessments, interventions, responses, and outcomes [12]. It involves using standardized language consistent with professional guidelines and healthcare standards [13]. Software-

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assisted systems incorporate features such as decision support tools and validation checks to improve data precision [6]. However, proponents of paper documentation argue in favour of its personalized and narrative approach, suggesting a deeper connection between nurse and patient [10].

Timeliness in nursing care documentation is crucial for effective patient care decision-making, care delivery, and inter-professional communication [14]. The timeliness of nursing documentation refers to the promptness with which the nurse records relevant information about patient care activities, assessments, interventions, and outcomes [15]. It indicates how quickly nurses document patient care and the subsequent updates to patient records [13]. Software-assisted systems facilitate instant access to patient information and real-time data recording [16] [17]. Conversely, paper-assisted documentation may delay accessing patient information and updating patient records, thus impacting nursing care decision-making and coordination [5] [10].

Although software-assisted systems offer some benefits, user-friendly challenges may also limit their utility to the nursing industry in terms of data precision and timeliness [12]. This debate raises the question of whether a complete departure from paper-assisted nursing documentation is justified, considering the need for precision and timeliness of documentation.

2 Materials and methods

This rapid review and meta-analysis examined evidence concerning the timeliness and precision of electronic and paper-based nursing care documentation on a global scale. This study utilized the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines [18] [19]. The PubMed electronic database was searched for related studies published between 1973 and 2023 (50 years). The search strategy employed Boolean operators (AND, OR, and NOT) and truncations (*) to combine free-text search terms as follows: (Timeliness OR Time* OR Efficiency OR Precision OR Accuracy) AND (Software OR Electronic) AND (Paper) AND (Nursing OR Nurs*) AND (Documentation OR Document*) NOT (Systematic Review). Hand searches for related studies referenced in retrieved articles were done using the descendant and ancestral approach. The inclusion criteria were as follows to ensure the selection of high-quality studies: (a) primary studies such as randomized controlled trials, quasi-experimental studies, and observational studies, (b) studies involving nurses as participants, (c) compared software to paper-assisted nursing documentation systems, (e) examined quality outcomes related to the timeliness and precision of nursing documentation, (f) published within the past fifty years (1973-2023), (g) available in English, (h) accessible in peer-reviewed academic journals and (i) presented in full-text format. This study excluded systematic reviews, case studies, protocols, and qualitative studies. Two authors (CE and JCS) independently conducted the search and study selection. Discrepancies between search results were discussed with co-authors (CAN and ILO) and resolved through consensus.

The search identified potentially relevant articles. Duplicate entries were removed from the initially retrieved articles. Subsequently, screening of titles and abstracts was done and articles with non-related titles and abstracts were excluded. The full texts of the remaining articles were examined for eligibility. Eligible studies were included in the review and meta-analysis. The quality of evidence in the selected studies was assessed with the help of the Johns Hopkins Evidence-Based Practice Model for Levels of Research Evidence [20]. Relevant data from the included studies were extracted using a data extraction form designed by the research team to extract and tabulate pertinent information covering author details, country, study design, sample characteristics, and study outcomes. Risk of publication bias across the studies was assessed statistically using a Funnel Plot supported by the Egger's test. The data extraction process was carried out independently by two authors (CE and JCS) with the aid of Microsoft Excel 2007 software. Inconsistencies in data extraction were resolved through mutual agreement after deliberations with co-authors (ACN and ILO).

3 Results

Figure 1 depicts the study selection process. The application of data inclusion criteria in this review and meta-analysis resulted in the identification of 15 studies. The literature search yielded 314 articles, with PubMed providing 301 direct hits and 13 hits from manual searches. Screening titles and abstracts led to

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the identification of 40 potentially relevant articles. Upon examination of the full-text articles and application of inclusion criteria, 15 eligible studies were included in the review and meta-analysis. Of the selected 15 studies, four examined timeliness only, four examined both timeliness and precision, while seven examined only precision.

Figure 2 shows the funnel plot for risk of publication bias. The funnel plot indicated no potential risk of bias. The Egger's test did not support the presence of funnel plot asymmetry (Intercept = -1.58, 95% CI:-4.1 - 0.94, t = -1.227, p-value = 0.251).

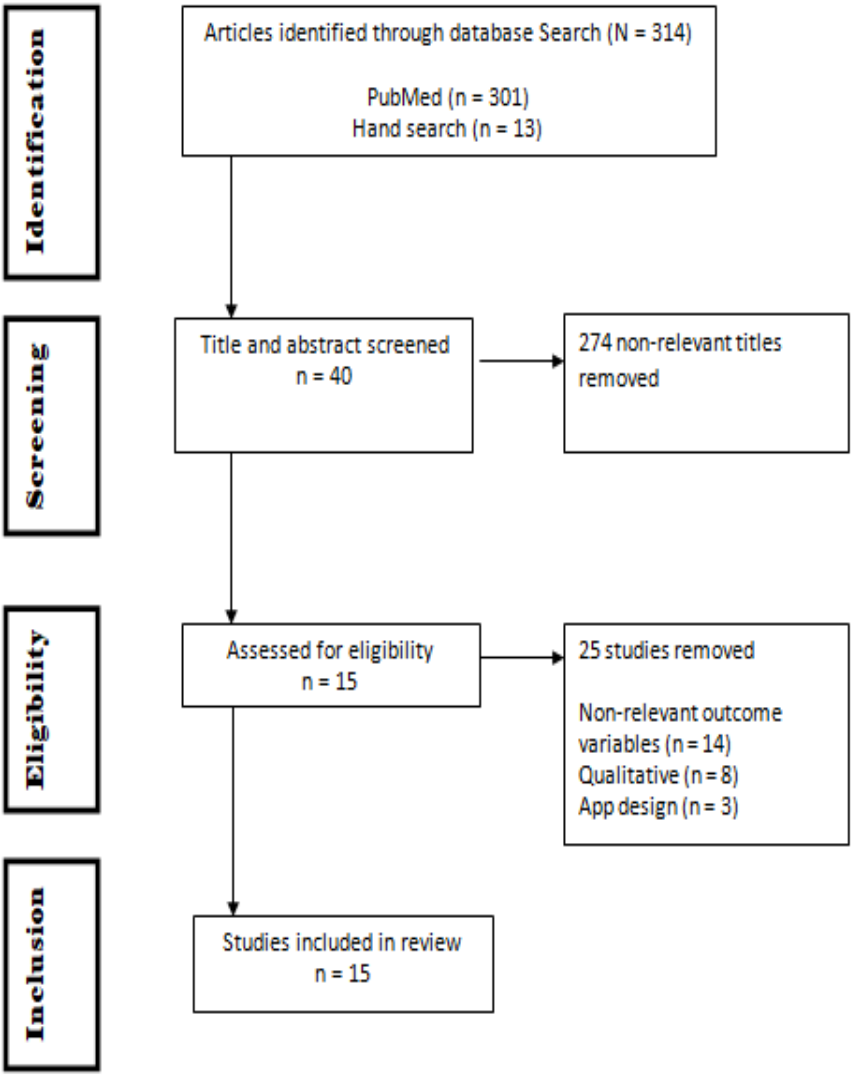

Figure 1: Study selection process (PRISMA flow diagram)

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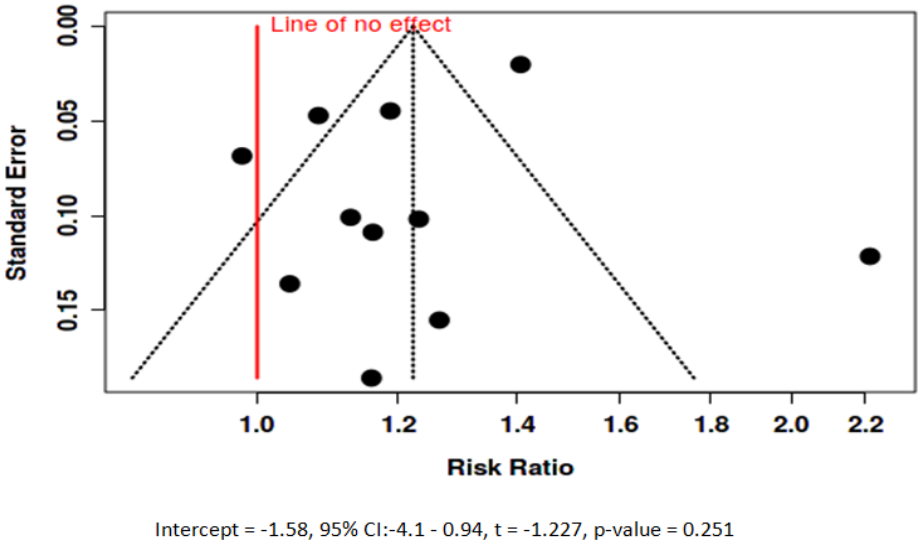

Figure 2: Funnel plot showing risk of publication bias

Table 1 provides an overview of the characteristics of the 11 studies concerning precision. The studies were conducted in Australia (n = 1), Canada (n = 1), Iran (n = 3), Italy (n = 1), Jordan (n = 1), the United Kingdom (n = 1), and the USA (n = 3). Seven of them utilized the single-group quasi-experimental design. The studies contained category II and III levels of research evidence.

Table 1. Precision of nursing documentation

Author	Country	Design	Software assisted records		Paper assisted records		Level of evidence
			n	*Precise*	*n*	*Precise*	
Jamieson *et al.* [8]	Canada	Single group quasi-experimental	21	19	21	15	II
Karp *et al.* [9]	USA	Single group quasi-experimental	904	470	904	434	II
Akhu-zaheya *et al.* [10]	Jordan	Single group quasi-experimental	434	166	434	75	II
Bertocchi *et al.* [11]	Italy	Single group quasi-experimental	198	105	198	93	II
Dean *et al.* [15]	USA	Single group quasi-experimental	998	998	998	709	II
Wilbanks *et al.* [21]	USA	Observational	30	24	30	23	III
Sefton *et al.* [22]	UK	Mixed method prospective	111	109	115	95	III
Wang *et al.* [23]	Australia	prospective	194	144	111	84	III
Tubaishat *et al.* [24]	Iran	Observational	52	43	52	37	III
Samadbeik *et al*. [25]	Iran	Single group quasi-experimental	50	29	50	25	II
Ranjbar *et al.* [26]	Iran	Single group quasi-experimental	40	37	40	30	II

Johns Hopkins Evidence-Based Practice Model for Levels of Research Evidence [20] was used, n = sample size, precise = accurately coding nursing diagnosis, interventions, and evaluations to accurately reflect the conditions of a patient.

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Table 2 provides an overview of the characteristics of the eight studies concerning timeliness. The studies were conducted in Germany (n = 1), Iran (n = 1), the United Kingdom (n = 3), and the USA (n = 3). Five of them utilized the single-group quasi-experimental design. The studies contained category II and III levels of research evidence based on the Nursing Johns Hopkins Evidence-Based Practice Model for Levels of Research Evidence criteria.

Table 2. Timeliness of nursing documentation (in minutes)

Author	Country	Design	Software assisted records			Paper assisted records			Level of evidence
			n	*Mean*	*SD*	*n*	*Mean*	*SD*	
Lucas *et al.* [5]	Germany	Single group quasi-experimental	17675	2.1	0.1	3962	1.4	0.1	II
Karp *et al.*[9]	USA	Single group quasi-experimental	904	2.6	1.7	904	9.3	4.7	II
Dean *et al.* [15]	USA	Single group quasi-experimental	998	20	0.5	1411	55	0.5	II
Sefton *et al.*[22]	UK	Mixed method prospective	111	1.1	0.1	115	1.6	0.1	III
Ranjbar *et al.* [26]	Iran	Single group quasi-experimental	40	5.2	1.1	40	8.2	2.1	II
Wong *et al.* [27]	UK	Single group quasi-experimental	296	2.5	0.5	281	3.6	0.5	II
Read-Brown *et al.* [28]	USA	Observational	188	9.3	2.7	58	7.5	2.8	III
Fieler *et al.* [29]	UK	Prospective	64	5.1	6.6	62	38.5	32.9	III

Johns Hopkins Evidence-Based Practice Model for Levels of Research Evidence [20] was used, n = sample size, timeliness = the amount of time taken in minutes to document a care plan record for one patient. Mean in minutes, SD = standard deviation.

Figure 3 revealed that software assisted systems significantly enhanced precision of nursing documentation by two folds compared to paper (Overall random effect Odds Ratio by 2.35, 95%CI: 1.32-4.17; $p = < 0.010$).

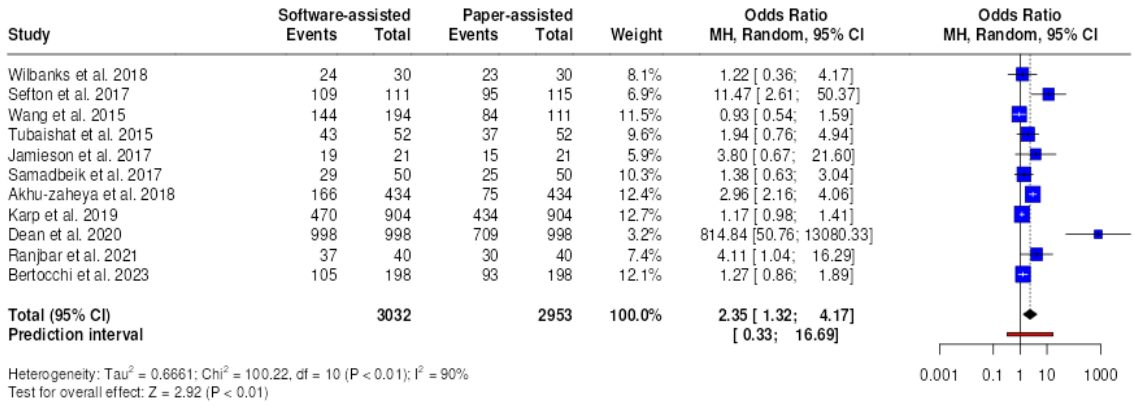

Figure 3. A forest-plot illustrating the synthesis of evidence on precision (Events = number of records with precise nursing documentation, CI = Confidence Interval)

Figure 4 reveals the synthesis of evidence from the reviewed studies on timeliness and demonstrated that although software-assisted systems reduced time spent on documentation by about nine minutes, the decrease was not significant (Overall random effects mean difference = 9.14 minutes; $p = 0.330$).

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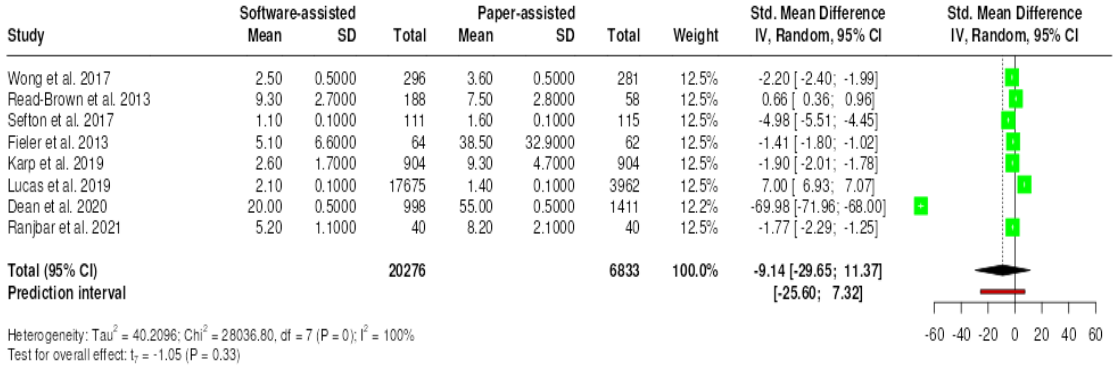

Figure 4. A forest-plot illustrating the synthesis of evidence on timeliness (*Mean in minutes, SD = Standard Deviation, CI = Confidence Interval*)

4 Discussion

This review and meta-analysis found evidence supporting the notion that software-assisted nursing documentation systems enhances documentation precision. The reason behind this observation can be attributed to various factors such as the organization of data within electronic systems, the reduction of human errors through built-in validation checks, real-time updates, and the integration of decision support tools, all contributing to a more precise recording of nursing care information [21]. Additionally, software-assisted systems often provide standardized templates, structured data entry, and automated prompts, minimizing ambiguity and ensuring consistent capture of essential details [6]. Improved legibility of electronic records also play a role in reducing errors associated with illegible handwriting, further enhancing documentation precision [22]. Furthermore, the dynamic nature of software-assisted documentation systems allows for immediate corrections and updates, facilitating ongoing accuracy throughout the care process [21]. The amalgamation of these features within software-assisted nursing documentation systems fosters an environment conducive to improved data precision.

The finding of this review and meta-analysis regarding the precision of software-assisted documentation is consistent with previous research by Akhu-Zaheya and colleagues [10], who found that software-assisted documentation's precision surpassed that of paper-based documentation. This consistency may be attributed to the required minimum nursing data set customization of the software systems [10]. The alignment with prior findings was unexpected, given Akhu-Zaheya's [10] lack of consultation with clinical nurses for desired system features before clinical deployment and evaluation. Utilizing the Pressman Five-Stage System Software Development Life Cycle (Waterfall Model), which requires qualitative information on desired software features from clinical nurses and literature before development and deployment, could enhance future research on this subject matter [30].

This review and meta-analysis uncovered evidence supporting the notion that software-assisted nursing documentation systems hold potentials to improve documentation timeliness by reducing the time from service to completion of nursing documentation, even though not significantly. The reason for this finding could be because nursing documentation software is equipped with features that support real-time data entry and updates, automated reminders and alerts [6] [15]. Moreover, electronic systems often feature timestamp functionalities, providing a clear chronological order of events [22]. The elimination of physical barriers associated with paper-based records further accelerates the documentation workflow [15]. Additionally, electronic systems facilitate simultaneous access by multiple healthcare providers, promoting collaborative and concurrent documentation efforts [21].

This finding contrasts with Lucas and colleagues [5], who reported better timeliness with paper-aided documentation compared to the electronic approach. The discrepancy may be attributed to specific limitations in the features of the software system examined by Lucas and colleagues [5], such as the inability to suggest nursing diagnoses. Conversely, Ranjbar and colleagues [26] reported reduced nursing documentation time with advanced electronic systems capable of suggesting NANDA nursing diagnoses. This finding aligns with previous research by Dean and colleagues [15], who demonstrated that software

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documentation systems are timelier compared to paper-aided documentation if nursing diagnoses and outcomes were programmed into the electronic design algorithm.

5 Limitations

This rapid review and meta-analysis is not without some limitations. The protocol for this review and meta-analysis was not registered in PROSPERO (An international database of prospectively registered systematic reviews in health science). Only one database (PubMed) was searched for this review and meta-analysis. While the searched database may contain a substantial amount of peer-reviewed literature, it may not have captured all relevant studies, particularly those published in non-indexed or non-traditional sources. Grey literature, which includes unpublished studies, conference abstracts, government reports, and dissertations, often provides valuable insights and data that may not be accessible through traditional research databases.

6 Conclusion

The software-assisted nursing documentation systems enhances precision by offering structured templates for data entry, validation checks, and real-time updates to ensure reliable recording of essential nursing care information. Nonetheless, software-assisted nursing documentation systems did not significantly improve timeliness of nursing care documentation. This use of software-assisted nursing documentation systems for improving the precision of nursing documentation is therefore recommended.

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Statement on conflicts of interest

The authors declare that there are no conflicts of interest.

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Ethical Consideration

The ethical review and approval for this study were waived by the University of Nigeria IRB since it involved secondary data.

Informed Consent

Not applicable.

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