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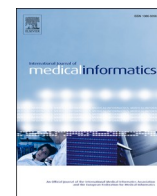
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Review article

Use of standardized terminologies in clinical practice: A scoping review

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ABSTRACT

Aim: To explore the use and impact of standardized terminologies (STs) within nursing and midwifery practice.**Introduction:** The standardization of clinical documentation creates a potential to optimize patient care and safety. Nurses and midwives, who represent the largest proportion of the healthcare workforce worldwide, have been using nursing-specific and multidisciplinary STs within electronic health records (EHRs) for decades. However, little is known regarding ST use and impact within clinical practice.**Methods:** A scoping review of the literature was conducted (2019) across PubMed, CINAHL, Embase and CENTRAL in collaboration with the Five Country Nursing and Midwifery Digital Leadership Group (DLG). Identified studies (n = 3547) were reviewed against a number of agreed criterion, and data were extracted from included studies. Studies were categorized and findings were reviewed by the DLG.**Results:** One hundred and eighty three studies met the inclusion criteria. These were conducted across 25 different countries and in various healthcare settings, utilising mainly nursing-specific (most commonly NANDA-I, NIC, NOC and the Omaha System) and less frequently local, multidisciplinary or medical STs (e.g., ICD). Within the studies, STs were evaluated in terms of Measurement properties, Usability, Documentation quality, Patient care, Knowledge generation, and Education (pre and post registration). As well as the ST content, the impact of the ST on practice depended on the healthcare setting, patient cohort, nursing experience, provision of education and support in using the ST, and usability of EHRs.**Conclusion:** Employment of STs in clinical practice has the capability to improve communication, quality of care and interoperability, as well as facilitate value-based healthcare and knowledge generation. However, employment of several different STs and study heterogeneity renders it difficult to aggregate and generalize findings.

1. Introduction

Nurses and midwives represent the largest proportion of the healthcare workforce globally [1,2] and they routinely capture a large volume of patient data across the entire life span [3,4]. The evolution of Electronic Health Records (EHRs) has further enhanced the potential of nursing clinical documentation to generate valuable knowledge [5,6]. However, despite nurses spending an estimated 13–28 % of total shift time recording clinical care [7], nursing documentation has remained largely untapped and undervalued [8]. This is perhaps amplified by reportedly low quality nursing documentation [9,10] containing few formulated nursing diagnoses [11] and patient needs [12]. Quality

information is critical to patient safety, high quality care [8,9,13–15], in quality assurance and to demonstrate the nursing and midwifery contribution to patient care [3]. These requirements and issues are not unique to nurses and midwives, and exist across the healthcare disciplines [16].

As part of a concerted effort to promote consistency in professional vocabularies and high quality documentation, Standardized Terminologies (STs) have been developed and employed [17]. According to the World Health Organization (WHO), a ST is a “compilation of terms used in the clinical assessment, management and care of patients, which includes agreed definitions that adequately represent the knowledge behind these terms and link with a standardized coding and

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classification system” [18]. STs usually represent defined aspects of clinical practice [19–21] and facilitate semantic interoperability across geographical boundaries, irrespective of language [16,20,22,23]. Standardized nursing terminologies, which are often used interchangeably with standardized nursing languages, systematically group, define and encode nursing care as nursing diagnoses, interventions and/or outcomes [24–27], and link nursing diagnoses with evidenced-based interventions and outcomes [7]. No universal ST has been determined and several nursing-specific and multidisciplinary STs have been approved for clinical use by the American Nurses’ Association [28,29]. Additionally, Nursing Minimum Data Sets (NMDS) and other terminologies are being locally-developed to meet specific requirements.

Nursing has a long history of ST use. One of the first nursing STs, the North American Nursing Diagnosis Association (NANDA) was pioneered in the 1970s [17]. To date, literature reviews have evaluated single [6,30] or several nursing-specific STs [31–35] and have largely focused on the secondary use of STs in nursing and midwifery practice [32,33,35]. Few of the studies identified by these reviews had evaluated the use of STs within clinical practice [6,34]. Additionally, the importance of interoperability and data continuity across disciplines and settings, is now widely recognised, necessitating consideration of multidisciplinary STs such as the Systemized Nomenclature of Medicine – Clinical Terms (SNOMED-CT). The potential use of STs in nursing and midwifery practice within EHRs has become a priority for the Five Country Nursing and Midwifery Digital Leadership Group (DLG) with representatives from England, Wales, Scotland, Northern Ireland and the Republic of Ireland. The DLG commissioned a literature review with the aim of exploring the use of STs in nursing and midwifery practice. The objectives of this scoping review are to:

- (i) Identify the STs being used in nursing and midwifery practice across different healthcare contexts.
- (ii) Review the impact of STs on nursing and midwifery practice.

2. Methods

2.1. Study design

A rapid scoping review was conducted to provide a broad overview of the available evidence and identify and analyze the knowledge gaps, and was guided by the WHO Rapid Reviews to Strengthen Health Policy and Systems guidelines [36] with reporting informed by the PRISMA-SCR guidelines [37]. The Population, Concept, Context Framework was employed to determine the research question and study eligibility (Table 1). Active collaboration throughout the project with members of the DLG, enhanced the review process [38]. To facilitate uptake and use of these findings by planners, decision-makers and healthcare professionals, the synthesized findings have also been presented in a report format [39]. Ethical approval was not required for this study.

2.2. Search strategy

The search strategy, based on prior systematic reviews [6,12,31,40], other literature [29] and via consultation with the DLG, included key words to identify both internationally-recognised and locally-developed terminologies (Appendix A). The initial search was employed using Boolean Operators across the Cumulative Index of Nursing and Allied

Health Literature (CINAHL), PubMed, Embase and the Cochrane Controlled Register of Trials (CENTRAL). Following the preliminary search, CENTRAL was excluded as no additional relevant studies were identified.

2.3. Screening and selection

Search results were aggregated into Endnote Software version X9 and duplicates were removed. Titles and abstracts of the remaining articles were screened by the researcher [OF] using the eligibility criteria (Table 2). Full text articles were then assessed and articles not meeting the inclusion criteria were removed to produce the cleaned up list of included articles.

2.4. Data abstraction and analysis

A standardized data abstraction form was developed and included the following: title, authors, year, country, study design, terminologies employed, professions, study outcome(s) and relevant findings. The findings from the studies under each section were then synthesized. Study outcomes were reviewed, validated and categorized with the involvement and engagement of the DLG [41,42].

3. Results

3.1. Study characteristics

Of the 3547 titles retrieved, 183 articles were identified as evaluating the use of a ST in clinical practice by nurses alone or nurses alongside other healthcare professionals (Fig. 1). More than one third of these studies were conducted in the USA ($n = 67$), followed by Brazil ($n = 33$), Turkey ($n = 14$), Spain ($n = 12$), Korea ($n = 10$), Finland ($n = 7$), Nigeria ($n = 6$), China ($n = 5$), Iceland ($n = 4$), Switzerland ($n = 4$), three each in the Netherlands, Portugal, Indonesia, Australia and Italy, two in Norway and the UK, and one study from Poland, Mexico, New Zealand, Canada, Jordan, Ireland, Cyprus and Belgium (Appendix B). Some studies were conducted across several countries and/or healthcare settings including hospitals, community settings, homecare, universities, schools and long-term care (LTC) settings.

The included studies most commonly evaluated nursing use of NANDA-I alone ($n = 43$ studies), the Omaha System ($n = 42$) and NANDA-I in combination with the Nursing Interventions Classifications (NIC) and Nursing Outcomes Classification (NOC) (NNN) ($n = 33$). Others evaluated nursing-specific STs or versions of these including NANDA-I with NIC, NIC alone, NOC alone, the International Classification for Nursing Practice (ICNP), Clinical Care Classification (CCC) and the Perioperative Nursing Data Set (PNDS) (Appendix C). Additionally, NMDS from Ireland [43], Belgium [44], the Netherlands [45,46] and the USA [47–49] were evaluated as well as the locally-developed Spanish Interface Information Nursing (Infermeria) and Knowledge (Coneixement) (ATIC) [50,51]. Reference terminologies including the Logical Observation Identifiers Names and Codes (LOINC) and SNOMED-CT as well as statistical classifications often primarily

Table 1
Population, Concept, Context (PCC) Framework.

Criteria	Determinant
P	Nurses and/or midwives.
C	Use of STs in clinical practice.
C	Healthcare or related setting.

Table 2
Criteria for study inclusion or exclusion.

Inclusion Criteria	Exclusion Criteria
Local or internationally-recognised terminology evaluated.	Application of ST to the clinical documentation post hoc by researchers or computers.
Included nurses and/or midwives.	Development, improvement or maintenance of the ST evaluated only.
ST applied within a clinical scenario (including education).	Description of study inclusion criteria or evaluation measure using ST only.
Any study design.	
Primary empirical research.	

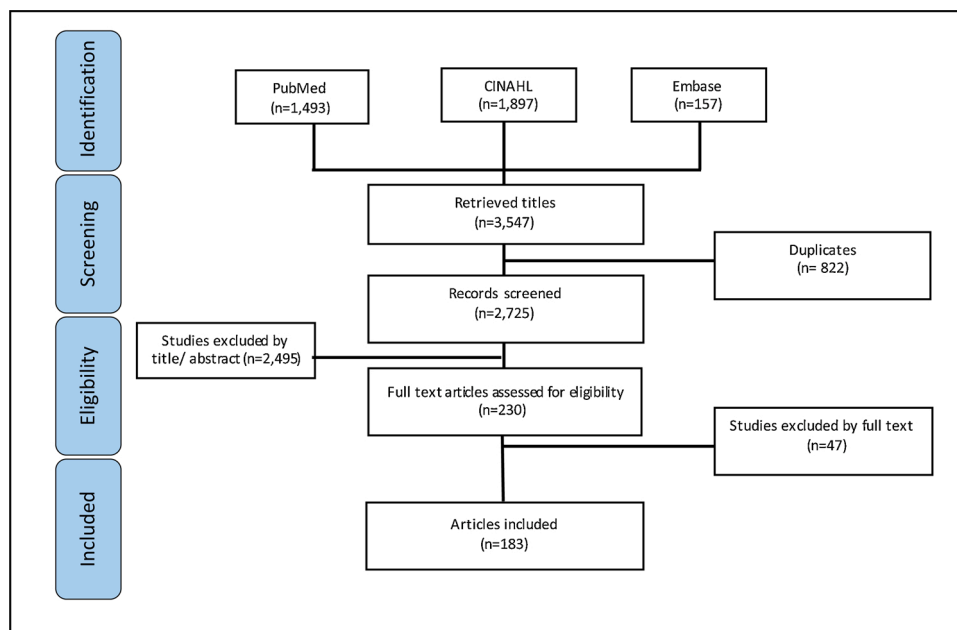


Fig. 1. PRISMA Flow Diagram.

used for reimbursement and/or quality assurance purposes were also identified including the International Classification of Disease (ICD), the Medical Entities Dictionary (MED), ABC, Read Codes, Outcomes Assessment Information System (OASIS) and the Diagnostic and Statistical Manual of Mental Disorders (DSM). Finally, the Australian Standardized Terminology and Definitions for Texture Modified Foods and Fluids was used in one of the identified studies by Speech-language pathologists, Dietitians and Nurses [52]. Overall the STs were evaluated in terms of *Measurement properties*, *Usability*, *Documentation quality*, *Patient care*, *Knowledge generation*, and *Education (pre and post registration)*.

3.2. Measurement properties

Thirty-six articles evaluated the validity, reliability and responsiveness of STs including the NOC, NANDA-I, Omaha System, OASIS, NMDS (Ireland) and ICNP [43,49,53–86].

3.2.1. Validity

Most studies assessing validity evaluated an individual term from the ST (e.g., “sedentary lifestyle”) within a specific patient cohort [49], such as pediatric patients with respiratory infections [66,70] or adolescents [53]. The term was usually compared with a validated outcome measure but these were not always available [59]. This led to other studies comparing the findings of nurses for the same patient [84] or for different cohorts of patients [75], and exploring the perspective of student nurses [55]. Only one study compared the diagnostic accuracy of two STs (NANDA-I and ICNP) when applied to a case study [79]. While positive findings were reported, results depended on the patient presentation [56,59,60,64] and diagnostic ability of the nurses [79].

3.2.2. Reliability

The majority of papers in this section evaluated the inter-rater reliability of NOC outcomes in different settings such as cardiology [81], oncology [62] and orthopedics [76], four of which were based on the same data collection [56,57,59,60]. Other studies evaluated NANDA-I for patients with cardiac issues [65], the Omaha System in community care [55], and the internal reliability of the NMDS (Ireland) [43]. Good to excellent reliability was reported for most of the evaluated terms with the exception of more subjective or changeable NOC measures such as

pain levels [60,62].

3.2.3. Responsiveness

The responsiveness of NOC measures was evaluated across hospitals, community settings, LTC and home care agencies [56,57,59,60,68,73,80], in all but one study in this category which evaluated the Omaha System and OASIS [61]. The measures usually detected differences in the status of a single patient across time points or between patients [61,70]. However, no difference in patient status was identified in some studies conducted in LTC [73], homecare [68], oncology and maternity [80], perhaps as the nurses did not aim to instigate change in patient status in these settings.

Overall the measurement properties of STs were dependent on the specific term evaluated, patient presentation and condition, clinical setting, nurses’ experience and ability, and the comparators used.

3.3. Usability

Thirty-six articles evaluated the usability of STs with regards to time efficiency, user perceptions, applicability and interoperability [4,50–52,55,75,79,87–115]; five of which referred to the same data collection [104–108].

3.3.1. Time efficiency

One study by Hariyati et al., (2016) [95] compared pre and post implementation of NNN and a computerized system, and demonstrated a statistically significant reduction in time taken for clinical documentation. Two further studies found that end-user efficiency using the MED [87] and ICNP [89] improved as nursing experience increased. However, the system response time, interface usability and the number of retrieved terms influenced the time taken.

3.3.2. User perceptions

Studies employed surveys and qualitative methodologies to evaluate the perceptions and experiences of healthcare professionals using STs [4,52,55,90,92,93,97,100,104,108,114,115]. Estrada and Dunn (2012) [93] reported that NANDA-I improved the nurses’ abilities to find diagnoses and interventions, and STs were found to improve accuracy of documentation [93,100] and facilitate communication between nurses [107] and other disciplines [52,100]. However, Olatubi et al., (2019)

[4] found that more than half the surveyed nurses agreed that NANDA-I was cumbersome to use. Other studies reported that the NNN [90], Read Codes [114] and ICNP [111] lacked descriptiveness and could foster inaccuracies, requiring further qualification with free text. However, ease-of-use was largely influenced by education [97,100], availability and access to indexes and computers with usable interfaces [111,114,115] and applicability to the specific patients [52,101].

3.3.3. Applicability to the clinical setting

Studies determined applicability of the ST based on the proportion of terms employed by the healthcare professionals and/or their ability to find an appropriate term within the ST. Three studies found that 70–100 % of the Omaha System domains were used in community centres and homecare agencies [55,99,112], but no term was available to cover “family planning methods” in Turkey [55]. Free text was also required by nurses documenting the prescription of medication in a Finnish study using a version of the CCC [103]. Aslan and Emiroglu (2013) [91] also evaluated the CCC but in LTC and found that only 43/182 diagnostic and 38/198 intervention terms were utilized. Of the 90 diagnostic terms available in the PNDS, 12 and 25 respectively never appeared in intra-operative and post-operative documentation in another Finnish study [96]. Two studies evaluating the ATIC in Spain found that 92.3 % of diagnoses [50] and 98.4 % of psychosocial nursing interventions were utilized [51]. Another two studies identified that there was overlap in meaning of some terms within NANDA-I [79] and the Omaha System [75]. Cimino et al., (2001) [87] monitored the selection of terms from MED and reported that an appropriate term was found by the healthcare professional in 82 % of cases but many failed or suboptimal terms were due to the ST missing the concept or a computer interface or searching issue.

3.3.4. Interoperability

Only one study evaluating interoperability was identified. Westra et al., (2010) [110] evaluated the use of the Omaha System and OASIS across 15 homecare agencies and although STs enabled aggregation of findings across sites, they found that interoperability challenges remained due to inconsistent data and file formats.

In addition to the content of the ST, many environmental factors influenced the usability of the STs including the EHR design, nursing education and healthcare settings.

3.4. Documentation quality

Studies ($n = 15$) used several different methods to evaluate documentation quality including the 29-item Quality of Diagnoses, Interventions and Outcomes [11,117,121,125–127] and other self-developed and/or validated instruments or content analysis [95,116,118–120,122–124,128]. Müller-Staub et al., (2007, 2008, 2009) evaluated the education and implementation of NANDA-I and NNN in three studies and reported significant improvements in the completeness and comprehensiveness of nursing documentation [10,126], with improvements more notable when ST education included guided clinical reasoning compared with case discussions [125]. Von Krogh et al., (2012) [119] demonstrated similar improvements in documentation quality with the introduction of a ST but this coincided with a reduction in the collection of patient safety information. Only one study compared different STs, but the better performing NANDA-I and NIC had been introduced within an EHR compared to the paper-based ICNP [117]. As well as the impact of co-introducing the ST with an EHR and education [116,120,123], the baseline documentation, healthcare setting [121,128], nursing level of experience [121] and comprehensiveness of the ST (i.e., diagnoses, interventions and outcomes) also impacted on the improvements noted in documentation quality [118,122].

3.5. Patient care

Fourteen studies evaluated the impact of STs on patient care [28,129–141]; three of which did not include a control group [129,136,137]. Wei et al., (2019) [140] and Zhang et al., (2017, 2018) [131,132] compared usual care with the use of the Omaha System respectively alongside clinical guidelines or Pender's Health Promotion Model. Therefore, the statistically significant benefits cannot be attributed to the ST alone. Discrepancies in baseline presentation of patients in studies evaluating NANDA-I and NIC, and NNN, would have also influenced the benefits [28,134,135]. It was also reported that the skills, experience, clinical reasoning and age of the nurses choosing to use STs may influence results in retrospective analyses [28,133,139]. However, randomized controlled trials also reported significant improvements when the Omaha System was used to inform discharge guidance for patients with angina [130] or a transitional care programme post stroke [141]. To distinguish the contribution of the EHR with that of the ST, Lunney et al., (2004) [138] compared the use and non-use of NNN by school nurses within EHRs and found no significant benefit or evidence of harm for students. Overall, STs appeared to contribute to patient care but often by facilitating the use of clinical guidelines.

3.6. Knowledge generation

Seventy-nine studies generated information from nursing-specific STs, as well as from ICD and SNOMED-CT which were used by medical doctors, both within and across sites [43–48,51,99,112,142–211]. STs were commonly used to characterize nursing care including the prevalence of patient diagnoses and signs and symptoms, frequency and types of interventions provided, and changes in patients' status. Additionally, STs facilitated the classification of these data into domains [156] and the linking of health data with patient socio-demographics [146,155,162,174,182,188,195], time periods [48,145,146,158,170,174,194,210], type of admission [159] and outcome measures [157,162,178,206,209]. Where a NMDS was used, knowledge could also be generated from the STs and the other codes or information (e.g., length of stay, patient demographics) which were captured and linked by the NMDS [44,44,45,46,47,48]. Some studies also utilized these data for predictive modelling such as estimating patient-facing time [196], nursing hours required [176], and likely discharge (when used in conjunction with medical and pharmacy codes) [201] and hospitalization (based on the number of homecare interventions provided) [179].

However, several challenges were identified when retrieving and mining data using terms from STs. Firstly, an EHR capable of searching for and aggregating information allowed retrieval of data related to larger populations [144,146] compared with manual review alone [150,191,200,203]. When the relevant term from the ST was searched for, this yielded both those with the condition or receiving the specific intervention, as well as those at risk of and with a family history of the condition [145] and those who were ineligible for the intervention [144]. Kim et al., (2012) [207] found that searching using a term from a ST resulted in high specificity (99.6 %) but lower sensitivity (66.7 %) often necessitating some manual review. While the benefits of STs to generate knowledge were extensive, efficient knowledge generation requires the capabilities to exist within the EHR and support to manually review the retrieved results, as well as consistent and correct use of the ST by the healthcare professional [146,175,185].

3.7. Education (pre and post registration)

Thirteen of the identified studies evaluated the education of pre and post registration nursing students using STs [55,111,212–222]. Ateş and Ulus (2019) [216] evaluated the ability of nursing students to identify diagnoses using the Omaha System compared with the educator and found that 73 % of the students adequately determined nursing diagnoses. Other studies used the STs to identify gaps in the students'

knowledge or clinical experience and to evaluate the effectiveness of their interventions for patients [212,214,215,217,219,220]. NNN was used as part of the *Outcome-Present-State-Test (OPT) Model of Reflective Clinical Reasoning* by two studies (USA and Indonesia) to evaluate students' clinical reasoning and ability to make decisions over time [221] and facilitate the supervision process [213]. Those using NNN more frequently scored higher in the clinical placement [221], while Wuryanto et al., (2017) [213] found, using qualitative methods, that NNN improved students' clinical logic ability, fostered self-directed learning, encouraged collaborative learning, and supported documentation. Zarzycka and Górajek-Jóźwik (2004) [111] also reported that the ICNP contributed to shorter and simpler ways of formulating diagnoses, thus, facilitating the nursing students to observe more nursing phenomena and stimulate critical thinking. Additionally, educating nursing students to use the Omaha System via online and classroom-based case studies resulted in nursing students being more accurate with defining the diagnoses and interventions but not outcomes, which was reportedly similar to what is seen with registered nurses [218]. However, STs were also difficult to use according to students [215]. Overall, most of the identified studies did not include a control group but they demonstrated that STs have been used to assess student knowledge, facilitate clinical decision making, and prepare nurses for ST use in clinical practice [55, 222].

4. Discussion

This scoping review identified that several different nursing-specific and multidisciplinary STs have been employed and evaluated in nursing and midwifery practice across six key areas; *Measurement properties, Usability, Documentation quality, Patient care, Knowledge generation, and Education (pre and post registration)*. While the ability of the ST to characterize nursing care and its impact on patient outcomes was identified in previous reviews [6,30,32–34], this review found additional areas of evaluation including measurement properties, usability, documentation and education. Similar to previous reviews, NANDA-I, NIC, NOC and the Omaha System were the most frequently evaluated STs, however, other STs such as the ICNP, CCC and PNDS appear to now be more widely utilized in clinical practice [31–33]. Additionally, some STs were more commonly employed in a specific setting such as the Omaha System in the community, the ICNP in hospitals and PNDS in surgical wards. However, use of several different STs within nursing and midwifery practices even across comparable healthcare settings, creates further heterogeneity and challenges for evidence synthesis and generalizability of the findings.

Reaching consensus on the use of a single ST or language at a national or Five Country level (i.e., Republic of Ireland, Northern Ireland, Wales, Scotland and England) would alleviate these issues, as has occurred in the National Health Service (NHS) in Wales [223]. Although a universal ST across disciplines could help promote a continuum of care and interdisciplinary communication [52], the identified multidisciplinary STs often lacked clinical granularity for nursing and midwifery care [43,52,55]. However, nursing problem subsets have been added to reference and aggregation STs such as SNOMED-CT [224,225], which has been implemented in EHRs across several countries, including Ireland and the UK [226,227]. Additionally, nursing-specific STs are being mapped to SNOMED-CT and other multidisciplinary STs [24,228, 229].

Different versions of STs also exist to accommodate changes in healthcare and professional practices such as a new disease e.g., COVID-19 [230], various languages e.g., FinCC [100], Korean ICNP [89] and discrepancies in professional scope of practice between countries [55, 231]. As the STs are updated and adapted, this also renders generalizability of findings from these studies as difficult and necessitates maintenance of mapping between nursing-specific and reference terminologies. This can be a challenging process as not all nursing terms will instinctively map to the reference terminology and while loss of

meaning should be avoided, this needs to be balanced with the risk of content duplication within the nursing ST [75,79].

The reliable and valid use of STs as well as their usability, impact on documentation quality, and capability to generate knowledge, were all largely influenced by the implementation and adoption processes. This included effective education and support [10,55,97,100,116,120,125, 126,222] and early introduction of the ST to nursing students [55,222]. These affirm the known facilitators for successful EHR and/or ST implementations which also include leadership, phased implementations with small wins, knowledge sharing between sites, champions, support, and sharing of the benefits [232,233]. Additionally, the EHR interface needs to be usable and support and facilitate the use of the ST [87,89,95,111,114,115,117]. This can be achieved by allowing free text entry to qualify the structured code [55,103], 'favorites' or personalized templates of commonly used terms [234] and a ST search engine with a fast response time which retrieves few appropriate terms and recognizes commonly used acronyms and synonyms [95]. Natural language processing also has the potential to alleviate the burden on healthcare professionals of entering coded data [235]. However, semantic interoperability and unambiguous data sharing also requires standardization of the structure of both the data [110] and the system [236], as well as employment of data exchange standards (e.g., HL7 or ISO 13606). Overall, the implementation process has many implications for the benefits obtained from the ST, and should therefore be clearly described in future studies, and further research should focus on effective implementation processes.

4.1. Strengths and limitations

By including studies evaluating STs within nursing and midwifery practice, as opposed to a controlled research environment, the impact of different nurses, clinical contexts and patient cohorts was captured. Additionally, expanding the search to multidisciplinary and medical STs enabled exploration of cross-disciplinary use of STs. However, there may be other multidisciplinary STs such as the International Classification of Functioning, Disability and Health which are also been used by nurses within clinical practice [237]. Consistent with scoping review guidelines [37], the quality of the included studies was not evaluated but it was clear that the study designs and heterogeneity would limit the ability to grade and generalize the evidence for policy and practice. Additionally, while this review aimed to explore the impact on both nursing and midwifery practice, there was minimal research which included midwives. Overall, this review highlighted the persisting gaps in the literature [238], as well as the areas of practice in which STs are being evaluated, and it discussed the implications for research and clinical practice.

5. Conclusion

Several different STs have been used by nurses and midwives both within and across countries and healthcare settings. The heterogeneity of these STs as well as the nurses, patient cohorts and healthcare contexts renders it challenging to aggregate or generalize the findings from the current and previous studies. However, the foci and challenges met by research studies and identified in this review will help guide and promote further research in this area. STs appear to facilitate the nursing process, comprehensive documentation and use of evidence-based clinical guidelines, which all have huge potential to optimize patient care and subsequently provide information to generate important knowledge. In addition to the contribution of STs themselves, other factors, such as the implementation process and usable EHR interfaces, also help to reveal benefits in their use.

Authors contribution

Dr. Orna Fennelly: Methodological design, Screening, Data

Summary points

What was already known on the topic:

- Many different nursing and multidisciplinary STs exist.
- No universal ST has been chosen.
- STs promote consistency in use of vocabulary to facilitate semantic interoperability.
- Literature reviews have largely focused on secondary use of STs and a single nursing-specific ST.

What this study added to our knowledge:

- Increase in the number of different STs used by nurses and midwives internationally.
- STs have potential to optimize patient care by facilitating improved documentation, use of clinical guidelines, interoperability and knowledge generation.
- Multidisciplinary STs facilitated communication but often lacked granularity for nursing and midwifery practice.
- Heterogeneity in ST use creates challenges within clinical practice and for evidence synthesis.
- ST alone does not drive benefits and success required education, support and usable EHR interfaces.

abstraction and analysis.

Loretto Grogan: Methodological design, Data analysis, Digital Leadership Group

Angela Reed: Methodological design, Data analysis, Digital Leadership Group

Prof. Nicholas R Hardiker: Methodological design, Data analysis, Digital Leadership Group

Declaration of Competing Interest

The authors report no declarations of interest.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.ijmedinf.2021.104431>.

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