

**Title:** Development of an Automated Mapping Tool to Transform Nursing Narrative Information into Quantifiable Nursing Data

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**Background:** Inspecting the effectiveness of health care has been a central focus of health care professionals challenged by a system with aggressive cost constraints and increasing demands for quality of care. This focus has highlighted the importance of having health care data and facilitated the use of large data sets. It is crucial that nurses clearly verify the economic and clinical values of nursing interventions for the improvement of patient outcomes. However, rarely has effectiveness of nursing care in hospitals been demonstrated due to nurse scientists' inability to electronically obtain valid and comparable nursing data. The importance of "computable" nursing data and databases have been long recognized and led to the development of standardized nursing terminologies (SNTs) to represent nursing interventions and outcomes. Yet, a majority of nursing information systems in hospitals is still using nurses' free-text records to document care processes and patient outcomes. Free-text records, which may produce rich information on nursing phenomena yet incomputable, have been of limited use for generating nursing information and knowledge. Therefore, the study aimed at the development of an automated mapping tool to extract and transform the narrative nursing notes to quantifiable data in SNTs.

**Method:** The nursing narrative notes were collected from a retrospective nursing record review of patients who were admitted to a community hospital with the diagnosis of Septicemia. The Nursing Interventions Classification and the Nursing Outcome Classification were the SNTs used for mapping. The automated mapping tool was developed using natural language processing; the Graphic User Interface was designed using NetBeans IDE and Perl programming language. Tokenizing each sentence to identify single word term candidates, stemming them, lexical collocations to coordinate the words into meaningful information (phrases/sentences), and mapping them into labels and indicators of SNTs were accomplished by using Regular Expressions. The validation of the tool was completed by comparing the result from the use of the tool with the result from the manual mapping by 2 nursing experts, which was considered as the gold standard.

**Results:** The interface features of the automated mapping tool included data entry options (i.e., browse/upload files or type-in each nursing narrative sentence), mapping sources to select NIC and NOC dictionaries, their domains and classes by their hierarchical classification structure, and output options (i.e., nursing representation with the mapped terms, Frequency of the mapped terms). A total of 25588 words from nursing narrative records of 14 patients were used. On average 52 parsed phrases or sentences per nursing record were mapped. In total, 768 labels of NIC and 4733 indicators of NOC, including the duplicates. Compared with the manually mapped terms (the gold standard), the automated mapping tool showed the accuracy rates ((True positive + True negative)/The Overall mapped), 80.6% with NIC and 74.8% with NOC. The most frequently mapped descriptors of NIC were 'Report changes in patient status' under the label of 'Physician Support (7710).' The most commonly mapped indicators of NOC were 'Coughing (041019)' under the label of 'Respiratory Status: Airway Patency.' Nurses were likely to document their observations of patient status than what nursing interventions were provided.

**Conclusion/Implications:** The new automated mapping tool showed high performance at the initial stage. The validation of the tool will be continuously tested with more nursing narratives data. It is expected that the tool will be useful for transforming nursing information with SNTs into quantifiable and comparable data, which consequently can be used for nursing effectiveness research. It can be used for outcomes analyses, regulatory quality report generation, and text analysis for finding appropriate nursing literature and capturing nursing concepts in qualitative research. The study findings can also contribute to the development and refinement of SNTs to more accurately represent nursing practice.