

# A Rapid Review on Application Scenarios for Artificial Intelligence in Nursing Care – Review Protocol

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## **Background**

Even though there has been an increase in funded research and development for the application of digital technologies in nursing practice (digital nursing technologies, or DNT) [1], artificial intelligence (AI) in nursing practice is primarily represented in research and development of robotic systems or monitoring systems. There seem to be unused opportunities for the application of AI in nursing care in other scenarios, such as decision support in complex care situations (see [2]). In addition, AI abilities might hold great potential to support nurses in tasks, that can be considered as remote from direct patient interaction. For example, the German Federal Statistical Office reports an expenditure of 1.7 billion € or 13 % of a nurses' working hours being used up for the documentation of care processes, with some care facilities reporting proportions of 20 % to 30 % of the daily working hours being used for documentation (see [3]). AI-solutions such as speech assistance could contribute to improving nursing care processes and to supporting nurses efficiently throughout their daily work. Furthermore, application scenarios for the direct support of care dependent persons and their relatives are of interest, as experiences with testing of AI-systems in different care settings have been published for some time now [4-6]. Whether these solutions prove to be of practical relevance and are applicable to special requirements in nursing care, e.g. when aiming at care processes involving persons with limited cognitive abilities, has not been researched sufficiently to this day. To our knowledge, an extensive overview on the evidence-base and status quo of research on AI for the application in nursing practice is missing. By identifying promising application scenarios for AI in nursing practice, such an overview contributes to the systematic enhancement of research and development of AI for nursing practice.

## **Aim**

This rapid review aims to identify and systemize scientific publications on described and researched application scenarios for AI in nursing practice considering different care settings, dimensions of AI and aspects of ethical, legal and social implications (ELSI). Overarching goal is the display of typical abilities of AI that aim to support nursing care-specific challenges and requirements. Furthermore, barriers for suitable application scenarios will be identified.

## **Review Question**

- Which application scenarios for AI-Systems in nursing practice considering different care settings are described in the national and international literature?
- What kinds of AI-Systems have been researched on or are being discussed in the national and international literature for which kind of care setting?
- What requirements or barriers for the application in nursing practice are reported?
- Which ELSI-aspects concerning AI and nursing are being discussed in the national and international literature?

## **Search Strategy**

The databases PubMed, CINAHL (including Embase), ACM Digital Library, IEEE Xplore, dblp computer science bibliography, AIS Library will be searched. In addition, we loosely follow the approach given in Hartmann & Henkel [8] and search the digital libraries of leading conferences. After reaching expert consensus within the study team, we include the following conferences: Association for the Advancement of Artificial Intelligence (AAAI) conference (<https://www.aaai.org/>), Association for Computational Linguistics (ACL) conference (<https://acl2020.org/>), conference on Computer Vision and Pattern Recognition (CVPR, <http://cvpr2020.thecvf.com/>), International Conference on Machine Learning (ICML, <https://icml.cc/>), International Joint Conferences on Artificial Intelligence Organization (IJCAI, <https://www.ijcai.org/>), conference of the Association for Computing Machinery's Special

Interes Group on Knowledge Discovery and Data Mining (SIGKDD, <https://www.kdd.org/>) and the conference on Neural Information Processing Systems (NeurIPS, <https://nips.cc/>). Lastly, we screen citations of the top-ten-authors or labs (identified by the number of citations within the sample) that are presented on accessible websites of labs or individual researchers. The search strategy follows the block building approach [9] and combines terms for „nursing“ and “artificial intelligence” and their respective synonyms:

<b>Synonyms for „Care“ – block 1</b>
Pflege
nursing care
elderly care
care for the elderly
home care
care service
geriatric care
gerontolog* care
dementia care
surgical care
orthopedic care
social care
postoperative care
preoperative care
perioperative care
intensive care
critical care
intermediate care
hospital care
emergency care
oncolog* care
palliative care
cardiol* care
psychiatric care
psycholog* care
psychosomatic care
neurolog* care
neurosurg* care
urolog* care
pulmonary care
respiratory care
ophthalmolog* care
dermatolog* care
gynecologic care
obstetric care
otolaryngolog* care
anesthe* care
nephrolog* care
diabet* care
<b>Synonyms for AI – block 2</b>
Künstliche Intelligenz
KI
KI-System
Lernende* System
Intelligente* System

maschinelles Lernen
überwachtes Lernen
verstärkendes Lernen
Deep learning
Big Data
Neuronale Netze
Entscheidungsunterstützung
artificial intelligence
AI
AI-System
learning system
intelligent system
machine learning
supervised learning
reinforcement Learning
Deep Learning
Neuronal networks
Decision-Support
predictive analytics
Bayes learning
Genetic algorithms
Metaheuristics
tabu search
simulated annealing
Support vector machines

The term „robot\*“ is excluded as a search term, as we assume that AI-abilities of a robotic system will be identified by one of the terms given above. If applicable, terms will be searched in titles, abstracts and all fields. In a first step, single terms for each block will be searched for and hits will be recorded. Secondly, all terms of a block will be combined by using the Boolean operator “OR” and will be searched for differentiated by language (German or English) and hits will be recorded. Finally, results from the search in step two will be combined for the two blocks using the Boolean operator “AND” and hits will be recorded.

### **Inclusion Criteria**

We consider publications on AI to quickly become outdated. As there are only a few distinctive points in time that could indicate a possible reasonable limitation of publication dates, such as the increase in research on neuronal networks from 2012 onwards (see [10]), we include quantitative and qualitative original research published in German or English language from 2005 onwards. Included publications need to address the application of AI for

- a) the support of decision or work processes of direct nursing care or
- b) the organization of nursing care processes or
- c) the support of knowledge-transfer and competencies in nurses’ (further) education or
- d) the support of persons in need of care (explicitly referred to as being in need of care) or
- e) persons of all ages in need of support in activities of daily living.

### **Domain of interest**

Application scenarios for AI in ambulatory, stationary long-term care, in acute hospital care and in nursing education.

### **Population**

Nurses (persons with formal national and international qualification in nursing), nursing students, care dependent persons and their informal caregivers (either explicitly referred to as being in need of care or being referred to as being in need of physical or cognitive/mental support; publications using vague terms such as “elderly” without further information will be recorded and assessed for inclusion within the study team).

### **Intervention**

All types of AI-systems.

### **Control**

Likely not applicable. If applicable, usual-care or other comparators can be reported in single studies.

### **Context**

The care settings should be identified distinctly within a publication. Studies, that report findings for more than one setting will be recorded. Studies, that include the population given above in a laboratory setting will be included and recorded.

### **Primary Outcome**

Type of AI-System and respective application scenario in nursing practice.

### **Secondary Outcome**

ELSI-aspects reported. If applicable, reported effects of the AI-system.

### **Dataextraction**

Hits of the third search step described under Search Strategy will be exported in an EndNote-Library, that excludes duplicates. Screening of titles, abstracts and full-texts will be conducted by two independent reviewers using the online resource Rayyan [11]. A third person will be consulted if the initial reviewers still disagree on inclusion or exclusion of a publication after discussion. The number of initial hits as well as the number of titles included and excluded in the screening-process will be documented in a PRISMA-flowchart [12]with reasons for exclusion given.

Study Characteristics to be extracted:

- information on the publication: authors, title, year of publication, study design, aim of study,
- information on the population: country of origin, setting, formal qualification of nurses or nursing students, characteristics of care dependent persons (age, comorbidities, sex, other socio-demographic variables), sample size,
- primary outcome: type/name of AI-system, application scenario (user of the system, support of direct nursing care, support of organization of care, knowledge transfer, support of care dependent persons),
- data used (primary purpose of data, necessity of building a data-base, use of routine data, use of real-time data, use of existing training data, use of “new” data),

- other, explicitly stated requirements for the application of the AI-System,
- secondary outcome: aspects of ELSI, type and direction of assessed effects,
- reported limitations,
- COI statement and funding.

### **Risk of Bias Assessment/Critical Appraisal**

As this rapid review does not aim to assess the effectiveness of AI-Systems in nursing practice, a risk of bias assessment will not be conducted. The design of the included studies can be used to systemize results according to the level of evidence of a single study. In addition, the place of publication (conference or other) as well as the amount of citations of single studies can be used to assess the impact of single studies within the scientific community.

### **Datasynthesis**

Results will be reported narratively, differentiated by types of AI-systems (as defined by the HEG-KI [13]) under consideration of the care setting. We will further differentiate AI-systems, for which results indicate a useful application and benefit for nursing practice and systems, for which such application and benefit yet needs to be reported but that have been discussed for the application in nursing practice. Furthermore, a distinction by categories such as inverse deduction, back propagation, evolutionary algorithms or Bayesian learning will be discussed within the study team when the final sample of studies to be included has been selected. E\*L\*S\*I-aspects will be summarized in general. As an overarching result of the review, a first version of a matrix to categorize AI-systems for nursing care will be presented.

### **Analysis of subgroups**

Not applicable.

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