

Digital solutions for a shared medication list

A narrative literature review

Unn S. Manskow, Karianne F. Lind and Trine S. Bergmo

Norwegian Centre for E-health Research, University Hospital of North-Norway, Tromsø, Norway
unn.sollid.manskow@ehealthresearch.no

Abstract

Digital solutions for a shared medication list are important in order to provide correct medication information between health care providers and the patient. The objective of this review is to provide an overview of the existing knowledge of effects and experiences with digital solutions for a shared medication list. We conducted a narrative literature review and included nine primary studies. Most studies were qualitative, focusing on experiences of patients and health care providers. This review revealed a gap of knowledge on the effects of patient safety and quality of care related to digital solutions for a shared medication list.

Keywords

Digital medication management, primary health care, health care providers, patients.

1 INTRODUCTION

Correct information on a patient's medicine use makes it possible to cure and prevent many medical conditions [1]. Clinicians and other health care providers do not have immediate access to an up-to-date, complete and accurate list of the patients' prescribed medications which increases the risk of medication errors [2]. Medicine-related problems (MRP) such as side effects, inappropriate use and errors are serious threats to patient safety, as it may reduce quality of life, cause morbidity, death and increase health care costs [3, 4]. Patient safety is the foundation upon which all other aspects of quality of care are built, and are indistinguishable from the delivery of quality health care [5, 6].

The Norwegian Board of Health supervision describes that medication management within the municipalities' health and care services are not sufficient and concludes that health care personnel lack an overview of the patient's actual use of medications. Important information may be lost (observations, test results, documentation) and reduces the quality of services [7]. Further, one of the main challenges is that the digital systems do not provide health care providers or patients an overview of the medications the patient actually uses. Another challenge is the lack of reliable medication safety practices, particularly in patient transition between levels of care, which is recognized as a high-risk area for MPRs [8]. Several studies from Scandinavia [9-11] and internationally [12-14] show problems with correct information about a patient's actual medication list, and the impact on patient safety and quality of care. Polypharmacy patients and/or patients of high age are especially at risk when transitioning between levels of care. Some of the problems arise because different health care units are using different electronic health record

(EHR) systems that are not connected to each other [15]. This may cause poor communication and lack of information between and within services and can lead to potentially harmful medication errors [16].

In Norway, the health authorities are investing in several digital innovations to improve patient safety, the quality of care and the efficiency in the medicine management process. To share updated drug information through the entire patient trajectory across organizations, is one of the prioritized areas in the Norwegian e-health strategy and a nationally shared medication list is the overall goal [17]. The Norwegian Directorate for E-health (NDE) is currently working on the implementation of e-prescribing, the summary care record (SCR) and a nationally shared medication list. The implementation of the summary care record in primary health care (nursing homes and home care) will begin towards the end of 2019, and is an important step towards the implementation of a national shared medication list in Norway. The Norwegian Centre for E-health Research is performing a longitudinal study in the period 2019-2023 on the effects and experiences on health care providers and patients of the summary care record and the nationally shared medication list in primary health care. Based on these ongoing projects, an overview and presentation of the current knowledge on digital solutions for a shared medication list is needed.

The main objective for this narrative literature review is to provide an overview of the existing knowledge on different digital solutions for a shared medication list in primary health care focusing on:

- Effects on patient safety and quality of care
- Experiences from health care providers and patients
- Digital solutions for a shared medication list

2 METHODS

2.1 Search strategy

The research team, consisting of two experienced researchers (TSB, USM) and a research librarian (KFL), identified relevant keywords and developed the search strategy. We systematically searched the databases PubMed, SveMed+, Cinahl, Embase, Cochrane and NORA (Norwegian Open Research Archive) to identify relevant literature. We did not apply a time filter on the search. Search terms used included “Electronic medication record”, “Electronic shared medication list”, “Shared electronic medication record”, “Shared medication record”, “Shared medication list”, “National medication list”, “Computerized National Medication List”, “Digital medication management system”, “Electronic medication management”, “Electronic medication reconciliation (system)”, “Online medication reconciliation”, “Summary care record” and “Summary record”. Depending on the database, we searched ‘title/abstract’ or ‘all fields’.

2.2 Selection of studies and data retrieval

Each member of the research team independently screened the result and identified relevant papers based on title and abstract. Papers that met the following inclusion criteria were included:

- Primary studies on digital solutions within medicine management in primary care (GPs, nursing homes, home care etc.)
- Containing empirical material with a description of methods used for data collection and analysis
- Scandinavian or English language

We resolved any conflicts by discussion until consensus. The team further assessed the full-text articles independently and inclusion of papers meeting the inclusion criteria was determined by consensus. A manual search of the reference lists of included articles was done to identify any papers missed by the systematic search.

We used a predefined data retrieval form to analyze, categorize and systematize information of the included studies. This included information on first author, year of publication, title, digital technology, information sharing, design, population and setting, methods, number of participants (n), objective(s) and results. Further, we performed a thematic analysis of the results of the included papers. Thematic analysis is the most common method within narrative reviews to produce a synthesis of findings [18].

3 RESULTS

The database searches yielded 418 records after removing duplicates. The research team screened all 418 titles and abstracts, and we excluded 384 papers due to irrelevant titles and/or abstracts. Further, we considered 34 records for detailed assessment of full text, and excluded 25 papers not meeting one or several of the inclusion criteria. We

included nine studies in this review, published in the period 2008-2018. The PRISMA flow chart shows the number of records/studies at each stage (Figure 1).

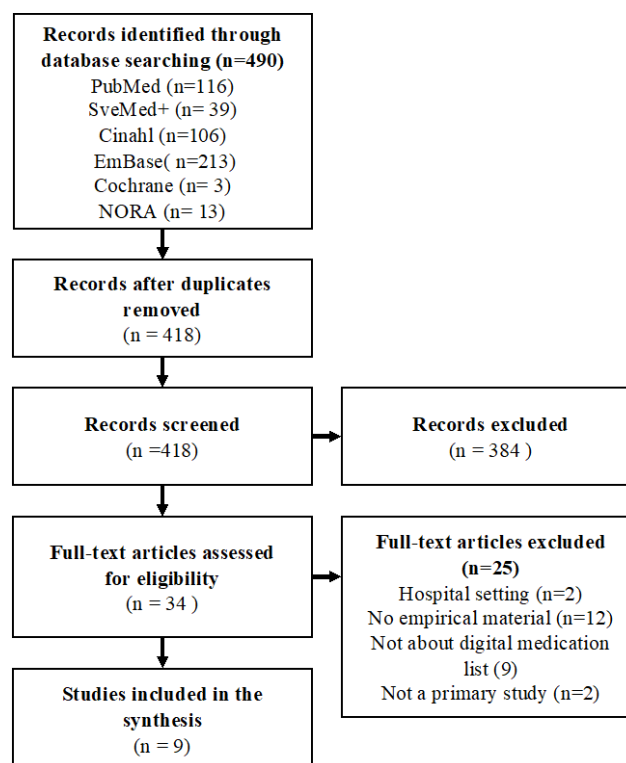


Figure 1 PRISMA flow diagram.

3.1 Characteristics of included studies

Countries represented in the included studies were Germany, Austria, Switzerland, Sweden, the US, Canada, UK and Norway. All settings were in primary health care. Study design varied from longitudinal evaluation studies, qualitative studies, multi-site/-level case studies and evaluation studies of larger e-medication implementations. Two studies used both qualitative and quantitative methods, five used qualitative methods, whereas two studies used quantitative methods.

The populations represented in the studies are mostly health care professionals (doctors, pharmacists, other) and patients. Most outcome measures relate to patient experience and satisfaction, and health care professionals experience with the use of digital technologies for sharing medication information. The digital technologies used for a shared medication list differs between the studies and are as follows: the summary care record (SCR), the eMedikation list, electronic health records (EHR, ELGA) and online personal health record (Shared Care Plan, HealthSpace). In each country represented, there are existing digital solutions for a shared medication list at a local and regional level, and plans for implementation at a national level. See Table 1 for characteristics of the included studies.

First author, year (country)	Digital technology	Setting	Study design and methods	Study participants	Main results
Dyb K, 2018 (Norway)	Summary care record (SCR)	Primary care (ER, GPS, Emergency ward)	Qualitative study. In-depth interviews	25 doctors	The doctors only used the pharmaceutical summary in the SCR for a few subgroups of patients. Reasons for not using the other components of the SCR was the need for manual updating.
Greenhalgh, 2008 (UK)	SCR	4 early adopter sites for the SCR in England	Multi-site, mixed method case study. Interviews, focus groups, ethnographic data	250 staff members, 170 patients/carers	Factors influencing the success of the SCR: Concerns about the workload, experiences from previous IT-implementation, attitude to the new system, the implementation process, the program's functionality and expected benefits.
Greenhalgh, 2008 (UK)	SCR and Health Space	3 primary care trusts	Qualitative study. Individual interviews and focus groups	170 participants	Many participants were not aware of the SCR, were not interested in recording and accessing their own medical data in the SCR and misconceptions of the content was common. Benefits when in need of emergency care, and for people with stigmatizing illnesses. SCR has a potential to support self-management.
Greenhalgh, 2010 (UK)	SCR	3 primary care districts	Mixed-method multi-level case study. Registry data, interviews, consultations, field notes.	Clinicians, patients, managers, policy makers	An increase in patients accessing the SCR was seen. The SCR may support better quality of care and potential to prevent medication errors. Risk for patient safety if the SCR does not contain updated medication information or critical information. Very low access in secondary care.
Gall, 2016 (Germany, Switzerland, Austria)	eMedikation Electronic health record (ELGA)	Germany, Switzerland and Austria	Qualitative study. Focus group interview and literature review	Expert groups from each country	For all three countries, a comprehensive national electronic infrastructure for the exchange of health data is planned but not yet available. Differences in whether it is mandatory or not for health care providers to use.
Hackl, 2014 (Austria).	eMedikation in ELGA eCard network	Austria	Quantitative study. 30-item questionnaire	61 physicians and 68 pharmacists	For physicians, the fear of improper data use, satisfaction with software support most crucial. For pharmacists the expected benefits and the system's functional aspects most crucial.
Hammar, 2014 (Sweden)	Electronic health record system (EHR)	4 counties in primary care	Qualitative study: Semi-structured interviews	7 physicians	Improved availability of information, more complete and accurate medication lists. Many non-current prescriptions, risk for violation of patient privacy. Responsibility for the list unclear. Not possible to share information between counties.
Janzek-Hawlat, 2013 (Austria)	eMedikation in ELGA eCard network	3 regions in Austria.	Quantitative study. Questionnaires, log-file analysis,	97 physicians, 58 pharmacies	Pharmacists and physicians satisfied with the potential impact on patient safety. Inefficient user friendliness and system performance. Recommends better training and support, mandatory nationwide roll-out, develop a patient portal.
Stock, 2008 (US)	Online personal health record (Shared Care Plan)	Ambulatory care clinics	Evaluation study. Mixed methods: focus group, survey, clinical data	486 patients 80 health care professionals	Patients more confident with own medication management, better communication with health care personnel, more active in own health care. Patient safety culture improved and medication list discrepancy decreased.

Table 1 Characteristics of the included studies.

3.2 Patient safety and quality of care

Four of the studies report on the impact on patient safety and the quality of care with a shared medication list: A study from the US evaluated the experiences from health care professionals on a local e-Medication list and the rate of medication list discrepancy before and after the implementation of a community-wide electronic shared medication list [2]. The authors reported an improvement in patient safety culture in 2 out of 3 ambulatory clinics, and a decrease in medication list discrepancy from 80 to 50% post-intervention. Greenhalgh et al evaluated the use, functionality and impact of the SCR and reported that health personnel experienced the SCR to support better quality of care and had the potential to prevent medication errors [19]. Further, the authors reported that incomplete or inaccurate data about medication information or critical information in the SCR was seen as a potential risk for patient safety. A quantitative evaluation study from Austria investigated physicians' and pharmacists' in a pilot study on a national medication list [20]. They reported that a potential positive impact from both professions was revealed for a shared medication list depending on the following factors: a mandatory nationwide roll-out, better user friendliness, system performance and better training and support. Gall et al. performed a structural comparison on the national e-medication approaches in Germany, Switzerland and Austria and reported that all three countries focus on improving medication safety but a national electronic infrastructure for exchange of health data is not yet available [21]. Further, there are differences between the countries as Switzerland has a decentralized approach of information sharing and a high degree of voluntariness for health care providers, whereas Austria and Germany are planning a centralized approach mandatory for health care providers.

3.3 Experiences from health care providers and patients

Four studies from the UK, Sweden, Norway and Austria respectively, are describing factors affecting health care providers' use of the SCR. A mixed-method study by Greenhalgh et al. reported the following factors affecting health care providers' use of the SCR and a future national medication list: concerns about workload, experiences from previous IT-implementation, their attitude to the new system, the implementation process, the programs functionality and expected benefits [22]. A Swedish study explored doctors experiences with the implementation of a regionally shared medication list and reported that doctors experienced a more complete medication list and easier access to information going from a local to a regionally shared medication list [23]. Further, negative experiences included a number of non-current prescriptions, concerns about patient privacy, the lack of possibilities to share information between the regions, and the uncertainty of who is the main person responsible for a shared medication list. In a recent Norwegian study, Dyb et al. explored doctors' use and trust in the summary care record and reported that doctors only used the pharmaceutical summary in the SCR (as 1 of 6 functions in the SCR), and primarily only for a few subgroup of

patients: unconscious patients, elderly with polypharmacy and patients with substance conditions [24]. Hackl et al. performed a quantitative study where physicians and pharmacists completed a 30-item survey identifying factors important for the acceptance of a national e-medication list. Among physicians, satisfaction with the software support and a fear of improper data use was most crucial, whereas the pharmacists pointed out the expected benefits and the system's functional aspect as most crucial [25].

Two studies describes patients' perspective concerning the use of a local e-medication list and the SCR: A study from the US reported that the patients felt more confident with a community-wide electronic shared medication list regarding their own medication management, they experienced better communication with the health care providers and became more active in their own health care [2]. A study from the UK reported a very low use of the SCR, many people were not aware of the SCR, its content or how to get access to it [26]. Further, Greenhalgh et al. found that people with stigmatizing illnesses were most positive about using the SCR. On the contrary, misconceptions of the SCR were common, especially about which type of data the SCR contained and who had access to the data. Greenhalgh et al. also revealed that many participants were not interested in recording their medical data or accessing their SCR through a web-interface, although some saw the potential for the technology to support self-management [26].

4 DISCUSSION

4.1 Principal findings

This narrative review provides an overview of current knowledge of digital solutions of a shared medication list. We found nine primary studies from seven different countries. The countries presented in this review, have different digital solutions and sharing of information at a local, regional or (future) national level. We found no studies investigating the effects on an implemented national shared medication list covering all institutions and levels of care. Digital health interventions are often complex with many different components and often with multiple aims. Therefore, evaluations of such interventions may present methodological challenges [27]. The studies included in this review have a range of different designs and methods used to explore, measure and evaluate digital interventions for a shared medication list. We found no intervention studies investigating the effect on patient outcomes with digital solutions for a shared medication list, and only one study measured and reported the rate of medication list discrepancy before and after the implementation of a single, community based medication list [2]. In addition, more qualitative studies exploring experiences from both health care providers and patients are important to provide an in-depth understanding on how the usability, availability, and efficiency of the digital solutions affects patient safety and quality of care. As new digital solutions for a nationally shared medication list are planned or in progress, there is a need to monitor and learn from their use.

4.2 Patient safety and quality of care

We found both positive and negative experiences affecting patient safety and quality of care [2, 19-21]. Patient safety is defined as the prevention of harm to patients, and emphasis is placed on the system of health care delivery that prevents errors, learns from errors that occurs and is built on a culture of safety involving health care professionals, organizations and patients [5]. Quality of care is seen as conceptual components of quality rather than the measured indicators[6]. Positive aspects of quality care are explained as achievement of appropriate self-care, health-promoting behaviors, health-related quality of life, whereas mortality, morbidity and adverse events are considered as negative outcomes [28, 29]. Qualitative studies on patient safety and quality of care before and after implementing digital tools for a shared medication list are important in order to guide health policy makers to optimize the process of implementation of digital solutions. Only one study used a questionnaire to measure the potential effect of a shared medication list regarding patient safety [20]. More quantitative studies are needed in order to measure the effect on patient outcomes, as well as measure experiences from health care personnel in a larger scale, eg. with validated questionnaires. A recent scoping review of quantitative and qualitative literature aimed to map research on the effectiveness, level of use and perceptions about e-medication administration records (eMAR) in long-term care facilities [30]. Further, the results revealed that the evidence of linking eMAR use and reductions in medication error was weak because of suboptimal study design and reporting inconsistent benefits and challenges as well as low levels of eMAR implementations. This review identified a gap of knowledge on the effects of patient safety and quality of care related to implementation of new digital solutions for a shared medication list.

4.3 Experiences from health care providers and patients

The studies report both positive and negative experiences from health care providers on digital solutions for a shared medication list. Hackl et al. shows that the groups of health care professional can be quite heterogeneous and different factors are important for the use and acceptance of new digital solutions [25]. This may show the importance of differentiating between the subgroups within "health care providers" as their use and requirements of a digital system for sharing medication information might be quite different. None of the studies explored nurses' experiences with the use of digital solutions for a shared medication list. There is a need to study nurses' experience in primary health care as nurses' involvement in the medication managing process includes dispensing and administrating medications, as well as monitoring efficacy of medications [31]. Studies exploring patients' experiences show that there are both positive and negative factors affecting the impact of digital solutions on their own medication management. Stock et al. reported that patients felt more confident with their own medication management, which made them more active in their own health care, is an important finding and shows how patients and people in general may be more involved in their own health [2]. As new digital

interventions aim to involve patients and the general population to assess their own medication list, improve medication adherence, communication with health care personnel and their own health, patient and user experiences are crucial.

4.4 Strengths and limitations

We performed a narrative review in order to provide a synthesis of published literature on digital solutions of a shared medication list and describe the current state-of-art [32]. We used a systematic method in the literature search, assessment of studies and data retrieval, which is a strength of this review. Due to the scope of the project and the short time span, we did not systematically assess and report the quality of the included studies and this may limit the interpretation of our results. However, due to the more evaluative design of several of the studies included, using multiple methods, an assessment of the quality would be difficult to perform. Definitions of the digital solutions as well as the indicators used to measure effects and experiences vary between countries. This may have caused a limitation of the selection of keywords and search terms used in this study and may have restricted our findings.

5 CONCLUSION

This review found nine primary studies of different design and methodology investigating the experiences and effects of a digital shared medication list. The review presents current knowledge on the topic and presents a need for future studies especially with a quantitative design to measure the effects of digital interventions related to patient safety and quality of care. In addition, more studies exploring the experiences and effects on health care personnel's work practice, information sharing and communication before, during and after implemented digital solutions for a shared medication list are needed. This literature review may provide important information to the national health authorities responsible for the implementation of digital solutions for medication management. Furthermore, this review is an important step in planning and conducting the longitudinal study for the introduction of the SCR and the national shared medication list in Norwegian primary health care, especially according to the design and methodology used to investigate and explore the effects and experiences from digital implementations internationally.

6 REFERENCES

- [1] Topinkova, E., et al., 2012, Evidence-based strategies for the optimization of pharmacotherapy in older people, *Drugs Aging*, 29(6): p. 477-94.
- [2] Stock, R.M., E. R.; Gauthier, D.; Center, L.; Minniti, M.; Scott, J.; Pierson, M.; Nichols, L., 2008, *Advances in Patient Safety; Developing a Community-Wide Electronic Shared Medication List*, in *Advances in Patient Safety: New Directions and Alternative Approaches (Vol. 4: Technology and Medication Safety)*, Agency for Healthcare Research and Quality (US): Rockville (MD).

- [3] Makary, M.A. and M. Daniel, 2016, Medical error--the third leading cause of death in the US, *BMJ*, 353: p. i2139.
- [4] Leendertse, A.J., et al., 2011, Preventable hospital admissions related to medication (HARM): cost analysis of the HARM study, *Value Health*, 14(1): p. 34-40.
- [5] Institute of Medicine Committee on Data Standards for Patient, S., 2004, in *Patient Safety: Achieving a New Standard for Care*, National Academies Press (US). Copyright 2004 by the National Academy of Sciences. All rights reserved.: Washington (DC).
- [6] Institute of Medicine Committee on Quality of Health Care in, A., 2001, in *Crossing the Quality Chasm: A New Health System for the 21st Century*, National Academies Press (US). Copyright 2001 by the National Academy of Sciences. All rights reserved.: Washington (DC).
- [7] Helse- og omsorgsdepartementet, 2015, Meld. St. 28 (2014-2015) Legemiddelmeldingen. Riktig bruk – bedre helse, Oslo.
- [8] Laugaland, K., K. Aase, and P. Barach, 2012, Interventions to improve patient safety in transitional care--a review of the evidence, *Work*, 41 Suppl 1: p. 2915-24.
- [9] Devik, S.A., et al., 2018, Variations in drug-related problems detected by multidisciplinary teams in Norwegian nursing homes and home nursing care, *Scand J Prim Health Care*, 36(3): p. 291-299.
- [10] Berland, A. and S.B. Bentsen, 2017, Medication errors in home care: a qualitative focus group study, *J Clin Nurs*, 26(21-22): p. 3734-3741.
- [11] Ekedahl, A., et al., 2011, Discrepancies between the electronic medical record, the prescriptions in the Swedish national prescription repository and the current medication reported by patients, *Pharmacoepidemiol Drug Saf*, 20(11): p. 1177-83.
- [12] Tamblyn, R., et al., 2014, Estimating the information gap between emergency department records of community medication compared to on-line access to the community-based pharmacy records, *J Am Med Inform Assoc*, 21(3): p. 391-8.
- [13] Balon, J. and S.A. Thomas, 2011, Comparison of hospital admission medication lists with primary care physician and outpatient pharmacy lists, *J Nurs Scholarsh*, 43(3): p. 292-300.
- [14] Linsky, A. and S.R. Simon, 2013, Medication discrepancies in integrated electronic health records, *BMJ Qual Saf*, 22(2): p. 103-9.
- [15] Kierkegaard, P., 2013, eHealth in Denmark: a case study, *Journal of medical systems*, 37(6): p. 9991.
- [16] Frydenberg, K. and M. Brekke, 2012, Poor communication on patients' medication across health care levels leads to potentially harmful medication errors, *Scand J Prim Health Care*, 30(4): p. 234-40.
- [17] Direktoratet for e-helse, 2018, Nasjonal e-helsestrategi og mål 2017-2022. , Oslo
- [18] Mays, N., C. Pope, and J. Popay, 2005, Systematically reviewing qualitative and quantitative evidence to inform management and policy-making in the health field, *Journal of health services research & policy*, 10(1_suppl): p. 6-20.
- [19] Greenhalgh, T., et al., 2010, Adoption and non-adoption of a shared electronic summary record in England: a mixed-method case study, *BMJ*, 340: p. c3111.
- [20] Janzek-Hawlat, S., et al., 2013, The Austrian e-Medikation pilot evaluation: lessons learned from a national medication list, *Stud Health Technol Inform*, 192: p. 347-51.
- [21] Gall, W., et al., 2016, The national e-medication approaches in Germany, Switzerland and Austria: A structured comparison, *Int J Med Inform*, 93: p. 14-25.
- [22] Greenhalgh, T., et al., 2008, Introduction of shared electronic records: multi-site case study using diffusion of innovation theory, *BMJ*, 337: p. a1786.
- [23] Hammar, T.E., Anders; Petersson, Göran, 2014, Implementation of a shared medication list: physicians' views on availability, accuracy and confidentiality, *International journal of clinical pharmacy*, 36(5): p. 933-942.
- [24] Dyb, K. and L.L. Warth, 2018, The Norwegian National Summary Care Record: a qualitative analysis of doctors' use of and trust in shared patient information, *BMC Health Serv Res*, 18(1): p. 252-261.
- [25] Hackl, W.O., et al., 2014, Crucial factors for the acceptance of a computerized national medication list: insights into findings from the evaluation of the Austrian e-Medikation pilot, *Appl Clin Inform*, 5(2): p. 527-37.
- [26] Greenhalgh, T., et al., 2008, Patients' attitudes to the summary care record and HealthSpace: qualitative study, *BMJ*, 336(7656): p. 1290-5.
- [27] Murray, E., et al., 2016, Evaluating Digital Health Interventions: Key Questions and Approaches, *Am J Prev Med*, 51(5): p. 843-851.
- [28] Mitchell, P.H., et al., 1997, Outcome measures and care delivery systems. Introduction and purposes of conference, *Med Care*, 35(11 Suppl): p. Ns1-5.
- [29] Mitchell, P.H. and N.M. Lang, 2004, Framing the problem of measuring and improving healthcare quality: has the Quality Health Outcomes Model been useful?, *Med Care*, 42(2 Suppl): p. Ii4-11.
- [30] Fuller, A.E.C., et al., 2018, Electronic Medication Administration Records in Long-Term Care Facilities: A Scoping Review, *J Am Geriatr Soc*, 66(7): p. 1428-1436.
- [31] Holmqvist, M., et al., 2018, Medication Management in Municipality-Based Healthcare: A Time and Motion Study of Nurses, *Home Healthc Now*, 36(4): p. 238-246.
- [32] Ferrari, R., 2015, Writing narrative style literature reviews, *Medical Writing*, 24(4): p. 230-235.