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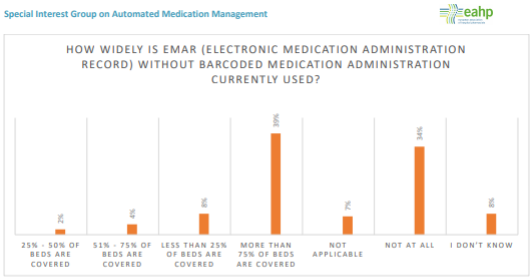
Forskerperspektivet: Hvorfor er det vanskelig å måle effektene av teknologi (på pasientsikkerheten)?

Alma Mulac
Postdoktor, PhD, farmasøyt
Farmasøytisk institutt, UiO

1

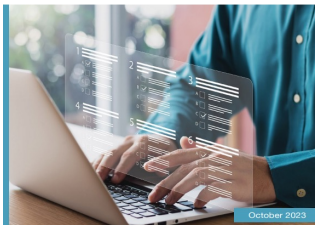
- European Association of Hospital Pharmacists (EAHP) rapport, oktober 2023
- Spørreundersøkelse blant europeiske land om bruk av elektroniske kurveløsninger, strukturert elektronisk forordning, legemiddelkabinetter og strekkodeskanning i legemiddeladministrering

Norge i Europatoppen i bruk av teknologi i legemiddelhåndtering!



Figur: Andel av svar på spørsmål " I hvor stor grad brukes elektronisk kurve uten strekkodeskanning?"

- **39%** svarer elektronisk kurve er brukt i store deler av sykehuset (over 75% av senger)
- **34%** svarer at elektronisk kurve ikke er i bruk for tiden (27% av disse er det ikke planer om å bruke det i de neste 3 årene)



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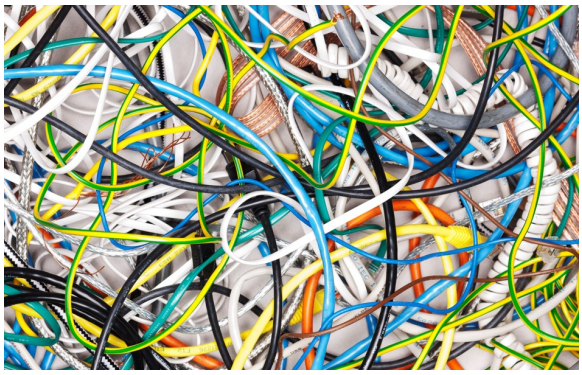
Special Interest Group on Automated Medication Management. European Association of Hospital Pharmacists. Survey Report. October 2023. https://www.eahp.eu/sites/default/files/sig_automated_medication_management_survey_report_0.pdf

2

Hvorfor er det vanskelig å måle effektene av teknologi?

- Komplekst å evaluerere hvordan teknologi og digitalisering påvirker pasientsikkerhet
- Isolerte deler av systemet er enkelt å evaluere:
  mekaniske feil
  produksjonsfeil
  bugs i systemet
  feil ved systemoppdatering

- Hva gjør vi når årsakene ligger i samspillet mellom teknologi, mennesker og organisajoner?
- …og når det er flere teknologier som bør vurderes samlet?



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Research in Social and Administrative Pharmacy 17 (2021) 832–841

Contents lists available at ScienceDirect

Research in Social and Administrative Pharmacy

journal homepage: www.elsevier.com/locate/rsap

The impact of introducing automated dispensing cabinets, barcode medication administration, and closed-loop electronic medication management systems on work processes and safety of controlled medications in hospitals: A systematic review

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[a] The University of Sydney, Faculty of Medicine and Health, Sydney School of Health Sciences, Charles Perkins Centre, Sydney, New South Wales, Australia
[b] Centre for Health Systems and Safety Research, Australian Institute of Health Innovation, Macquarie University, Sydney, New South Wales, Australia
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ARTICLE INFO

Keywords:
Controlled medications
Drug diversion
ADCs
BCMA
Closed-loop EMMS

ABSTRACT

Background: Technology in the form of Automated Dispensing Cabinets (ADCs), Barcode Medication Administration (BCMA), and closed-loop Electronic Medication Management Systems (EMMS) are implemented in hospitals to assist with the supply, use and monitoring of medications. Although there is evidence to suggest that these technologies can reduce errors and improve monitoring of medications in general, little is known about their impact on controlled medications such as opioids.

Objectives: This review aimed to fill this knowledge gap by synthesising literature to determine the impact of ADCs, BCMA and closed-loop EMMS on clinical work processes, medication safety, and drug diversion associated with controlled medications in the inpatient setting.

Methods: Eight databases (Medline, Pubmed, Embase, Scopus, Web of Science, PsycINFO, CINAHL, and ScienceDirect) were searched for relevant papers published between January 2000 and May 2019. Qualitative, quantitative, and mixed-methods empirical studies published in English that reported findings on the impact of ADCs, BCMA and/or closed-loop EMMS on controlled medications in the inpatient setting were included.

Results: In total, 16 papers met the inclusion criteria. Eleven studies reported on ADCs, four on BCMA, and only one on closed-loop EMMS. Only four studies focused on controlled medications, with the remainder reporting only incidental findings. Studies reported the elimination of manual end-of-shift counts of controlled medications after ADC implementation but cases of drug diversion were reported despite introducing ADCs. Three quantitative studies reported reductions in medication errors after implementing BCMA, but medications labelled with wrong barcodes and unreadable barcodes led to confusion and administration errors.

Conclusions: More quality, targeted research is needed to provide evidence on the benefits and also risks of implementing technology to safeguard against inappropriate use of controlled medications in the inpatient setting. Processes need to be in place to supplement technological capabilities, and resources should be made available for post-implementation evaluations and interventions.

Introduction

Controlled medications, such as opioids, are frequently used in healthcare to provide patient pain relief and treatment, but their use is associated with errors,[1,2] possible addiction, and patient harm, as exemplified by the opioid epidemic in the US.[3] These medications are usually known as 'schedule 4' and 'schedule 8' ('s4' or 's8') drugs in Australia, 'controlled drugs' in the UK, and 'scheduled drugs', 'controlled substances' or 'narcotics' in North America. In most countries, supply and use of controlled medications are regulated by laws or policies.[4–7] For example, in the US and Australia, clinicians are required to store controlled medications in secure locations, keep accurate records of all transactions and available stock, and monitor and report incidents.[5,7] Thus, considerably more work goes into safeguarding

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1551-7411/© 2020 The Authors. Published by Elsevier Inc.

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4

INNOVATIONS IN PHARMACY PRACTICE: SOCIAL AND ADMINISTRATIVE PHARMACY

Bar Code Medication Administration Technology: A Systematic Review of Impact on Patient Safety When Used with Computerized Prescriber Order Entry and Automated Dispensing Devices

Kieran Shah, Clifford Lo, Michele Babich, Nicole W Tsao, and Nick J Barisback

INTRODUCTION

Medication errors (any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer) that lead to adverse drug events (any undesirable experience associated with a patient's use of a drug) are known to represent a major threat to patient safety, despite widespread preventive programs and extensive education of hospital personnel.[1–4] It has been estimated that when adverse drug events occur in the hospital setting, they increase the patient's length of stay by an average of 4.6 days, and the cost to the Canadian health care system is $4685 per event* ($6655 in 2016 Canadian dollars, adjusted for inflation). Fortunately, many medication errors are preventable, and the implementation of health information technologies, such as bar code medication administration (BCMA) systems, is increasingly being considered as one solution.[4–6] In fact, the American Society of Health-System Pharmacists and the Healthcare Information and Management Systems Society both recommend the use of BCMA.[7,8]

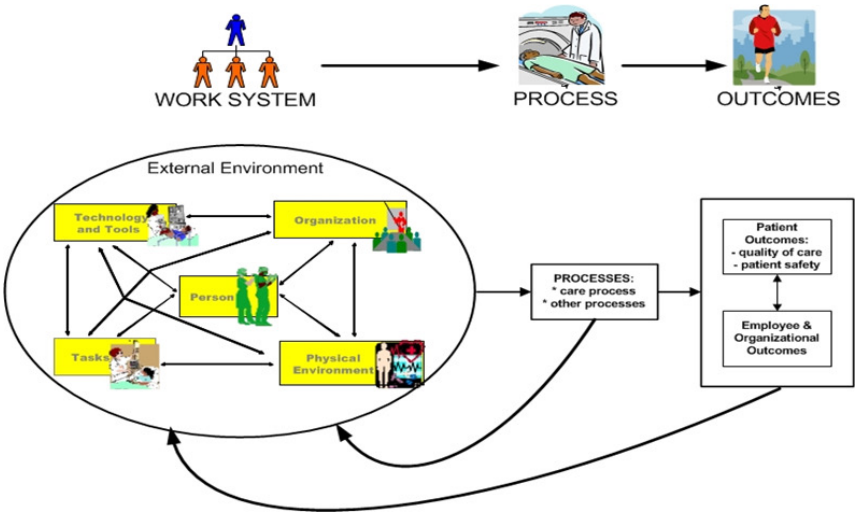
BCMA systems reduce medication errors by electronically verifying the "5 rights" of medication administration—right patient, right dose, right drug, right time, right route—at the patient's bedside.[7] For example, when a nurse scans a bar code on his or her identification badge, on the patient's wristband, and on the medication to be administered, the data are delivered to a computer software system where algorithms check various databases and generate real-time warnings or approvals.[7] Most systems then automatically document, in real time, the administration of the medication in an electronic medication administration record (eMAR).

Other than cost, one of the barriers to widespread adoption of BCMA technology is the lack of definitive evidence that BCMA actually reduces preventable medication errors, especially in hospitals that are already using other safety systems, such as computerized prescriber order entry (CPOE) and automated dispensing devices (ADDs).[7,9] The objective of this systematic review was to determine the impact of BCMA on medication errors when used as part of a closed-loop medication administration system (i.e., BCMA with CPOE and ADD).

METHODS

A comprehensive search, covering the years 1992 to 2015, was conducted within the MEDLINE, PubMed, and Embase databases, for English-language articles reporting on medication errors with the use of BCMA systems combined with CPOE and ADDs in hospital wards. The keywords "bar code", "bar codes", "bar coding", and "barcoding" generated the Medical Subject Heading (MeSH) terms "automatic data processing", "medication errors", and "medication systems, hospital". The MeSH terms "systems analysis" and "medication systems," adapted from Young and others,[9] were used to broaden the search. Related articles identified by using the function "similar articles" or "related articles" in each database, pertaining to systematic reviews or other studies found to be relevant to this literature review, were also reviewed. This additional step helped to incorporate any other studies not found using the specific

Kompleksitet i arbeidssystemer



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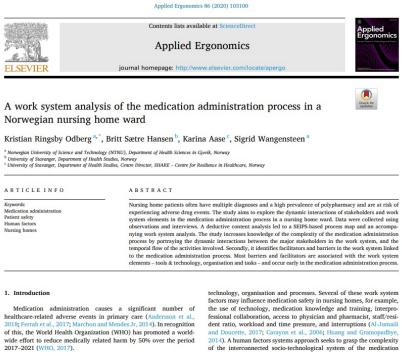
Human Factors tilnærming (SEIPS modell) - samspill mellom arbeidssystem, prosesser og utfall

Carayon, P et al. "Work system design for patient safety: the SEIPS model." *Quality & safety in health care* vol. 15 Suppl 1,Suppl 1 (2006): i50-8

5

Bruk av SEIPS modell for å forstå kompleksiteten i legemiddelhåndtering



Applied Ergonomics 86 (2020) 103100

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journal homepage: http://www.elsevier.com/locate/apergo

A work system analysis of the medication administration process in a Norwegian nursing home ward

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[c] University of Stavanger, Department of Health Studies, Centre Director, SHARE – Centre for Resilience in Healthcare, Norway

ARTICLE INFO

Keywords:
Medication administration
Patient safety
Human factors
Nursing homes

ABSTRACT

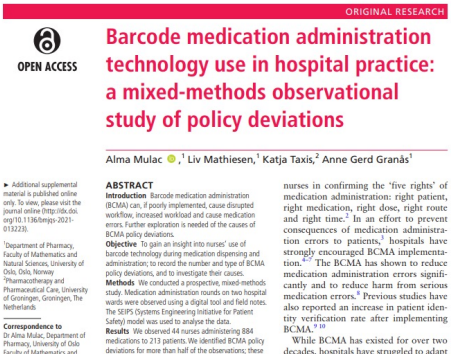
Nursing home patients often have multiple diagnoses and a high prevalence of polypharmacy and are at risk of experiencing adverse drug events. The study aims to explore the dynamic interactions of stakeholders and work system elements in the medication administration process in a nursing home ward. Data were collected using observations and interviews. A deductive content analysis led to a SEIPS-based process map and an accompanying work system analysis. The study increases knowledge of the complexity of the medication administration process by portraying the dynamic interactions between the major stakeholders in the work system, and the temporal flow of the activities involved. Secondly, it identifies facilitators and barriers in the work system linked to the medication administration process. Most barriers and facilitators are associated with the work system elements – tools & technology, organization and tasks – and occur early in the medication administration process.

1. Introduction

Medication administration causes a significant number of healthcare-related adverse events in primary care (Andersson et al., 2018; Ferrah et al., 2017; Marchon and Mendes Jr, 2014). In recognition of this, the World Health Organization (WHO) has promoted a worldwide effort to reduce medically related harm by 50% over the period 2017–2021 (WHO, 2017).

technology, organisation and processes. Several of these work system factors may influence medication safety in nursing homes, for example, the use of technology, medication knowledge and training, interprofessional collaboration, access to physician and pharmacist, staff/resident ratio, workload and time pressure, and interruptions (Al-Jumaili and Doucette, 2017; Carayon et al., 2006; Huang and Gramopadhye, 2014). A human factors systems approach seeks to grasp the complexity of the interconnected socio-technological system of the medication

Analyse av legemiddelhåndteringsprosseses på sykehjem



ORIGINAL RESEARCH

OPEN ACCESS

Barcode medication administration technology use in hospital practice: a mixed-methods observational study of policy deviations

Alma Mulac ,[1] Liv Mathiesen,[1] Katja Taxis,[2] Anne Gerd Granås[1]

► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/bmjqs-2021-013223).

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[2]Pharmacotherapy and Pharmaceutical Care, University of Groningen, Groningen, The Netherlands

Correspondence to
Dr Alma Mulac, Department of Pharmacy, University of Oslo

ABSTRACT

Introduction Barcode medication administration (BCMA) can, if poorly implemented, cause disrupted workflow, increased workload and cause medication errors. Further exploration is needed of the causes of BCMA policy deviations.

Objective To gain an insight into nurses' use of barcode technology during medication dispensing and administration; to record the number and type of BCMA policy deviations, and to investigate their causes.

Methods We conducted a prospective, mixed-methods study. Medication administration rounds on two hospital wards were observed using a digital tool and field notes. The SEIPS (Systems Engineering Initiative for Patient Safety) model was used to analyse the data.

Results We observed 44 nurses administering 884 medications to 213 patients. We identified BCMA policy deviations for more than half of the observations; these

nurses in confirming the 'five rights' of medication administration: right patient, right medication, right dose, right route and right time.[2] In an effort to prevent consequences of medication administration errors to patients,[2] hospitals have strongly encouraged BCMA implementation.[2–7] The BCMA has shown to reduce medication administration errors significantly and to reduce harm from serious medication errors.[8] Previous studies have also reported an increase in patient identity verification rate after implementing BCMA.[9 10]

While BCMA has existed for over two decades, hospitals have struggled to adapt

Analyse av legemiddelhåndteringsprosses på sykehus

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6

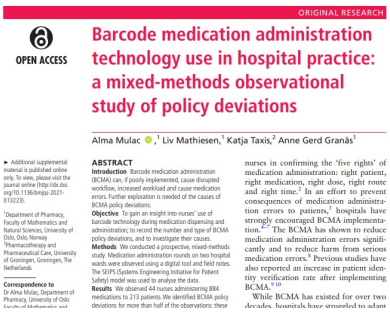
Forskning på lukket legemiddelsløyfe:

Observasjonsstudie på strekkodeskanning i tilberedning og utdeling av legemidler på Sykehuset Østfold Kalnes

- To observatører
- 44 sykepleiere
- 213 pasienter
- Data registrert på digital observasjonsverktøy
- Analysert ved Human Factors tilnærming (SEIPS modell)

80% av pasientarmbånd skannet
78% av legemidler strekkodemerket
71% av legemidler skannet

- **Forebygget potensiell feilmedisinering hos 11 av 213 pasienter (5%)**
- Teknologi kan føre til nye feil når den ikke er brukt riktig



ORIGINAL RESEARCH

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Barcode medication administration technology use in hospital practice: a mixed-methods observational study of policy deviations

Alma Mulac ,[1] Liv Mathiesen,[1] Katja Taxis,[2] Anne Gerd Granås[1]

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While BCMA has existed for over two decades, hospitals have struggled to adapt

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Mulac, A, et al. "Barcode medication administration technology use in hospital practice: a mixed-methods observational study of policy deviations." *BMJ quality & safety* vol. 30,12 (2021): 1021-1030.

7

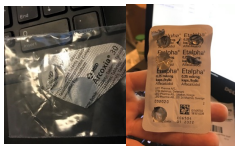
Eksempler fra forskning på Lukket legemiddelsløyfe

Nye risiko oppstår når teknologien ikke blir brukt som tiltenkt

Størrelse på trallene, skanner koblet til laptop

- Vanskelig å manøvrere, liten fleksibilitet

Snarvei: Skanner legemiddel utenfor pasientrommet



Oppgaver i dispensering ikke tilpasset arbeidsflyten og tidsbruk

- Komplisert prosess med mange manuelle oppgaver

Snarvei: Legger hele blister/ flere doser av gangen

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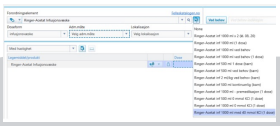
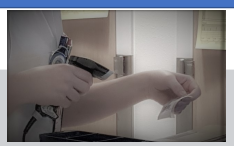
Mulac, A, et al. "Barcode medication administration technology use in hospital practice: a mixed-methods observational study of policy deviations." *BMJ quality & safety* vol. 30,12 (2021): 1021-1030.

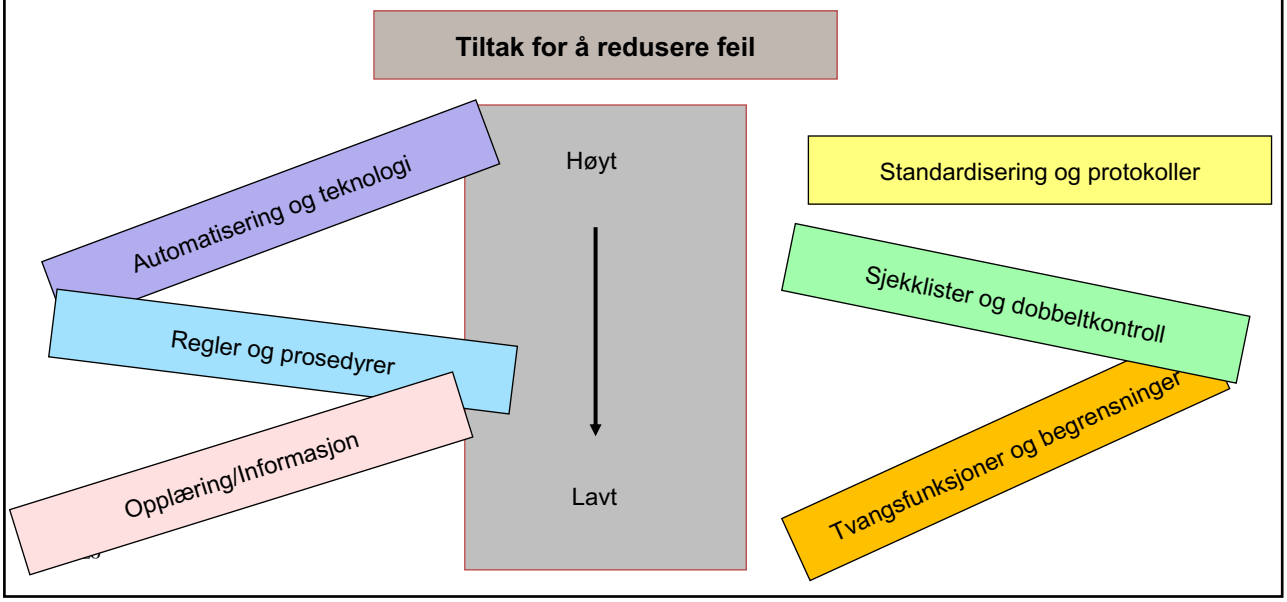
8

	FORSKRIVNING	DISPENSERING	ADMINISTRERING
			
	Forordning i elektronisk kurve	**Legemiddelkabinett**	**Strekkodeskanning i legemiddeladministrering**
FORDEL	Utryddet transkriberingsfeil, mistolkning av utydelig tekst og tall, og farlige forkortelser	Redusert feilmedisinering på akuttmottak, mindre tidsbruk for sykepleiere - forebygger forvekslingsfeil	Feilmedisinering redusert med opptil 40% Forebygger: feil pasient, feil legemiddel, feil dose
RISIKO	Feil ved valg fra nedtrekksmenyen, tastefeil, dobbel forordning	Falsk sikkerhet, uheldig oppbevaring fører til feil (prinsipper rundt navnlikhet, likt utseende)	Snarveier "workarounds", kompliserte løsninger for hardware og software medvirker til feil
SUKSESS FAKTOR	Klinisk forskrivningsstøtte (interaksjoner, allergier, dose varsling), brukergrensesnitt	Farmasøyt involvert i planlegging av kabinett design, integrering av software med elektronisk kurve	Funksjonell teknologi tilrettelagt miljøet man jobber, overvåkning av skannegrad på avdelingsnivå

Strudwick G, Reisdorfer E, Warnock C, et al. Factors associated with barcode medication administration technology that contribute to patient safety: an integrative review. J Nurs Care Qual. 2018;33:79–85
8. Berdot S, Korb-Savoldelli V, Jaccoulet E, et al. A centralized automated-dispensing system in a French teaching hospital: return on investment and quality improvement. Int J Qual Health Care. 2018;11
Burton, Samantha J. "Automated Dispensing Cabinets Can Help or Hinder Patient Safety Based On the Implementation of Safeguard Strategies." *Journal of emergency nursing* vol. 45,4 (2019): 444-449.

9

Effektivitet av ulike tiltak for trygg legemiddelhåndtering



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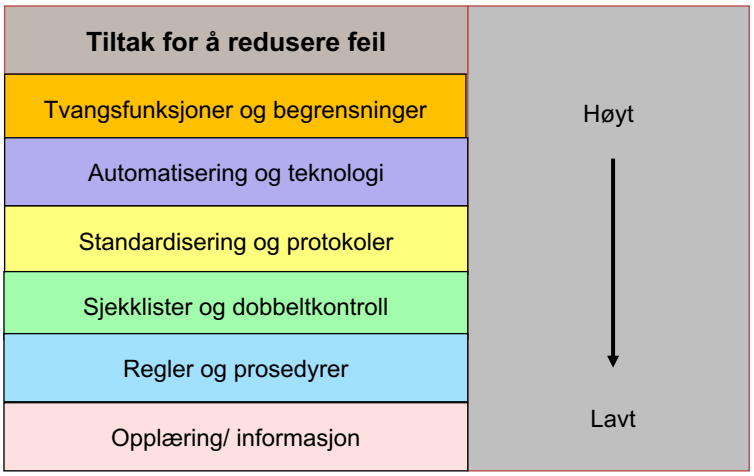
Effektivitet av ulike tiltak for trygg legemiddelhåndtering



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Agency for Healthcare Research and Quality, Sustainability, Learning from defects: https://www.ahrq.gov/hai/tools/surgery/modules/sustainability/learn-from-defects-slides.html

11

Hvordan evaluere effektene av teknologi?
Metoder

Observasjon

Gullstandard, detaljinnsikt, ressurskrevende

Intervjuer

Innsikt i erfaringer og holdninger

Teknologigenerert data

Rapporter om bruken av teknologi, varsler

Avviksmeldinger, uønskede hendelser

Verdifulle data, teknologi-relaterte hendelser


CHAPTER 7

Detecting Medication Errors and Adverse Drug Events: A Review of Current Methodologies

Alma Mulac[1] *& Anne Gerd Granås*[1,2]

[1]Department of Pharmacy, The Faculty of Mathematics and Natural Sciences, University of Oslo, Norway

[2]Norwegian Centre for eHealth Research, University Hospital of North Norway, Tromsø, Norway

Abstract: To establish the scope of harm related to medications, and thus design harm-reduction measures, healthcare organizations are required to measure medication safety events. This chapter will investigate methodologies for detecting adverse drug events and medication errors, analyse what type of events they detect, and discuss their advantages and limitations. We conducted a scoping review, and identified studies that compared at least two detection methods directly. The review resulted in 13 studies, of which ten were conducted in hospitals, and three were from the outpatient setting. Methods used to detect medication safety events were: incident reporting, record review, computerized surveillance, direct observation, and interviews. The detection rate of adverse drug events and medication errors varied substantially depending on the method. Incident reporting detected small numbers of events, but detected events that were not identified by other methods. Record review detected more adverse drug events than incident reporting, but missed whole classes of events, such as medication administration errors and omissions. Direct observation detected most medication errors. Computerized surveillance has promising detection abilities and can be less resource and time-intensive compared with record review, after the initial implementation. Small numbers of events were detected using any one method alone, that is, none of the methods can serve as a gold standard, and each method described has its place in monitoring medication safety. The literature supports a combination of methods to be used to detect adverse drug events and medication errors. The 10 studies in this scoping review that are from hospitals, are also described and discussed in the PhD thesis of the first author(Mulac, 2022). The scoping review, however, resulted in a low number of studies (n = 3) from the outpatient setting, which highlights the research and

Citation: Mulac, A., & Granås, A. G. (2022). Detecting Medication Errors and Adverse Drug Events: A Review of Current Methodologies. In R. M. Olsen & H. Sletvold (Eds.), *Medication Safety in Municipal Health and Care Services* (Chap. 7, pp. 135–160). Cappelen Damm Akademisk. https://doi.org/10.23865/noasp.172.ch7
License: CC-BY 4.0

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Alotaibi, Yasser K, and Frank Federico. "The impact of health information technology on patient safety." *Saudi medical journal* vol. 38,12 (2017): 1173-1180.

Mulac, A. & Granås, A. G. (2022). Detecting Medication Errors and Adverse Drug Events: A Review of Current Methodologies. In R. M. Olsen & H. Sletvold (Eds.), Medication Safety in Municipal Health and Care Services (Chap. 7, pp. 135–160). Cappelen Damm Akademisk. https://doi.org/10.23865/noasp.172.ch7

12

Tryggere forordning i elektronisk kurve på OUS?

- Elektronisk kurve i bruk over flere år
- Lite forskning i Norge
- Masteroppgaveprosjekt 2023/2024
  - ❖ Uønskede hendelser relatert til forordning i elektronisk kurve på Oslo Universitetssykehus
  - ❖ Analyse av uønskede hendelser fra ulike tidspunkt
  - ❖ Metodologi for å identifisere teknologi-relaterte hendelser

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13

Hovedprinsipper: Implementering og evaluering av teknologi i legemiddelhåndtering

1. **Evaluere samspill mellom alle elementer i arbeidssystemet**
   - Samspill mellom mennesker, oppgaver, prosedyrer, miljø og teknologi
2. **Skal man implementere bør man evaluere!**
3. **Overvåke bruk av teknologi over tid**
   - teknologi forandres over tid (funksjonalitet, brukergrensesnitt, oppdateringer, integrasjoner, mobile løsninger)
   - longitudinale studier

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Westbrook, Johanna I, and Valentina Lichtner. "Why is measuring the effects of information technology on medication errors so difficult?." *The Lancet. Digital health* vol. 1,8 (2019): e378-e379.
Slight, Sarah P et al. "Medication errors and adverse drug events in a UK hospital during the optimisation of electronic prescriptions: a prospective observational study." *The Lancet. Digital health* vol. 1,8 (2019): e403-e412.

14

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Forskerperspektivet: Hvorfor er det vanskelig å måle effektene av teknologi (på pasientsikkerheten)?

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15