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# Factors contributing to reported medication administration incidents in patients' homes – A text mining analysis

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## Abstract

**Aims:** To describe the characteristics of medication administration (MA) incidents reported to have occurred in patients' own homes (reporters' profession, incident types, contributing factors, patient consequence, and most common medications involved) and to identify the connection terms related to the most common contributing factors based on free text descriptions.

**Design:** A retrospective study using descriptive statistical analysis and text mining.

**Methods:** Medication administration incidents ($N$ = 19,725) reported to have occurred in patients' homes between 2013–2018 in one district in Finland were analysed, describing the data by the reporters' occupation, incident type, contributing factors, and patient consequence. SAS® Text Miner was used to analyse free text descriptions of the MA incidents to understand contributing factors, using concept linking.

**Results:** Most MA incidents were reported by practical (lower level) nurses (77.8%, $N$ = 15,349). The most common category of harm was 'mild harm' (40.1%, $N$ = 7,915) and the most common error type was omissions of drug doses (47.4%, $N$ = 9,343). The medications most commonly described were Marevan [warfarin] ($N$ = 2,668), insulin ($N$ = 811), Furesis [furosemide] ($N$ = 590), antibiotic ($N$ = 446), and Panadol [paracetamol] ($N$ = 416). The contributing factors most commonly reported were 'communication and flow of information' (25.5%, $N$ = 5,038), 'patient and relatives' (22.6%, $N$ = 4,451), 'practices' (9.9%, $N$ = 1,959), 'education and training' (4.8%, $N$ = 949), and 'work environment and resources' (3.0%, $N$ = 598).

**Conclusion:** There is need for effective communication and clear responsibilities between home care patients and their relatives and health providers, about MA and its challenges in home environments. Knowledge and skills relating to safe MA are also essential.

**Impact:** These findings about MA incidents that have occurred in patients' homes and have been reported by home care professionals demonstrate the need for medication safety improvement in home care.

KEYWORDS
home care, incident report, medication administration, nursing, text mining

## 1 | INTRODUCTION

Care provided by health professionals in patients' own homes (referred to here as 'home care') poses challenges in medication administration (MA), as patients mostly self-administer their own medicines (Olaniyan, Ghaleb, Dhillon, & Robinson, 2015). This is provided sometimes with the help of relatives or informal caregivers who do not have any formal education for MA and with the support of educated home care professionals.

Medication errors are common in the home context and can threaten patient safety resulting in morbidity and mortality (Berland & Bentsen, 2017). In this study, we use the term 'incident' to include near misses that are prevented before they reach the patient as well as errors that reach the patient, whether or not they cause harm.

### 1.1 | Background

Home care aims to enable patients to live at home for as long as possible (Turjamaa, Hartikainen, Kangasniemi, & Pietilä, 2014). This presents new challenges as a growing number of medically complex patients with multiple medications are receiving care in their own homes with the support of home care professionals together with informal caregivers. Many informal caregivers, such as family members, have limited skills for managing complex medications (ISMP, 2014). Based on a previous systematic review of carers' MA errors in the domiciliary setting (Parand, Garfield, Vincent, & Franklin, 2016), home MA errors made by carers are common and carers made similar errors to those made by professionals in other contexts. Home care professionals in Finland are usually trained practical (licensed, lower level) or Registered (higher level) Nurses. They practice independently in patients' homes where no other healthcare workers are accessible to consult with (Absulem & Hardin, 2011; Olaniyan et al., 2015).

The medication management process in home care can be challenging and complex with unclear boundaries of responsibilities and variable work conditions (Lindblad, Flink, & Ekstedt, 2017; Norri-Sederholm, Saranto, & Paakkonen, 2016). Communication failures are common (Absulem & Hardin, 2011; Berland & Bentsen, 2017; ISMP, 2014), as are medication reconciliation problems at hospital discharge (Kuusisto, Asikainen, & Saranto, 2014). Based on the findings of Hale et al. (2015), almost all home care patients (94%) have at least one medication discrepancy following hospital discharge based on comparison of the hospital discharge medication list and what the patient was taking at the first home healthcare visit. Almost half of these discrepancies are omissions (46%), where the patient is not taking medication as indicated on their discharge medication list. In addition, lack of competence in home care professionals (Berland & Bentsen, 2017) can contribute to these incidents.

Home settings can be disorganized environments, with noise and other distractions. Older patients can be physiologically and psychologically frail, such that medication incidents can have a greater impact on their health (Absulem & Hardin, 2011). In addition, home care patients have risk factors for medication-related problems, including multiple co-morbidities, cognitive impairment, polypharmacy, and use of high-risk medicines (Elliot, Lee, Beanland, Vakil, & Goeman, 2016). Based on previous findings (Sears et al., 2018), patients' knowledge about their medications decreases as the number of medications increases. Therefore, these patients may be at high risk of medication errors, although it is often difficult to determine these contributing factors as most of the care provided in patents' homes is unobserved (Doran et al., 2013). To avoid home care MA incidents, there should be transparency, openness, and accurate reporting of incidents to identify risk factors associated with the process (Berland & Bentsen, 2017).

Nowadays, many healthcare organizations worldwide gather information on such incidents using incident reporting schemes (Härkänen, Vehviläinen-Julkunen, Franklin, Murrells, & Rafferty, 2020; Härkänen, Vehviläinen-Julkunen, Murrells, et al., 2020). However, only limited data are available about MA incidents that occur in patients' homes (Sears, Baker, Barnsley, & Short, 2013) and are reported by the home care staff responsible for those patients. The information in incident reports is typically both structured (e.g. categories for type of incident) and unstructured (e.g. free text descriptions). Free text information can include valuable information about contributing factors that may remain hidden if solely relying on structured information (Verma & Maiti, 2018). However, manual analysis of free text found in the incident reports is challenging using traditional qualitative text-based analysis methods, as the text can include considerable amounts of extraneous information and incident report datasets can also be much larger than those normally analysed manually or using qualitative software. Thus, this study aimed to use text mining for analysing home care MA incidents.

## 2 | THE STUDY

### 2.1 | Aim

The aim of this study was to describe the characteristics of MA incidents reported to have occurred in patients' own homes, including reporters' professions, incident types, contributing factors, patient consequences, and the most common medications involved. In addition, we aimed to identify the terms that are closely connected

to the most common contributing factors based on free text descriptions.

## 2.2 | Design and setting

We conducted a retrospective study of an existing dataset, using descriptive statistical analysis and text mining. The Home Care Services (domestic services and home nursing) unit of the Helsinki Health Centre organizes nursing, care, and the necessary support services to maintain the health, functionality, and offer care in cases of illness or disability of older people, convalescents, patients suffering from chronic illnesses, and disabled people over the age of 18. Home nursing entails nursing and rehabilitation services prescribed by a doctor, taking place at the patients' home. A doctor's referral is required to receive home nursing services (City of Helsinki, 2020). Some of the home care visits are conducted remotely using two-way video and audio via a tablet computer. At the beginning of 2019, there were approximately 790 clients receiving remote care in Helsinki, with approximately 24,500 remote visits per month. These typically include reminder and monitoring of medication intake, nutrition and health monitoring, and supporting physical activity.

Most of the home care nurses are licenced practical nurses (upper secondary level qualification at vocational school, 180 ECTS credits); few are Registered Nurses (higher education at the University of Applied Sciences, 210–270 ECTS credits). Both nurse groups take care of basic MA, but intravenous administration is usually the responsibility of Registered Nurses, who receive greater training in their use. In Finland, nurses need to pass medication tests at the beginning of their employment and then every third or fifth year (depending on their employer) to be allowed to administer medication. Nurses need written permission from their employer to administer more complex medications after their competence has been verified, for example practical nurses need to have permission for administration of injections and Registered Nurses for administration of intravenous medications (Valvira, 2020).

## 2.3 | Sample

The HaiPro incident reporting system is used for reporting patient safety incidents in Finland; it is anonymous, voluntary, computerized, and is used in over 200 social service and healthcare organizations (HaiPro, 2020). The data in this study comprised MA incidents ($N = 19{,}725$) reported to HaiPro as having occurred in patients' own homes between 2013–2018 in Helsinki, including where patients lived in sheltered housing.

## 2.4 | Data collection

The license for use of the HaiPro data was obtained from the City of Helsinki. IT company Awanic Company (Ltd) provided the data for analysis.

## 2.5 | Data analysis

The incident report data included both structured information and free text. For this study, pre-specified structured categories analysed included: Reporters of incidents (Practical nurses, Registered nurses, Supervisors/directors, Public health nurses, Students, Social workers, Physicians, Other, and Missing data. Reporters of incidents may or may not be the same as the person involved with an incident); Consequences of incidents (No Harm, Mild harm, Moderate harm, Serious harm, and Not known. Consequences are described by the reporter in free text and later classified by the handler of the incident; this describes the perceived severity of the consequences that actually occurred to the patient); Type of incidents (Omission, Patient did not take the drug, Wrong timing, Wrong dose, Wrong patient, Wrong drug, Expired drug administered, Wrong administration technique, Other, Not known, or missing. The type of incident is classified by the reporter and later verified by the handler); and Contributing factors (Communication and flow of information, Patient and relatives, Practices, Education and training, Work environment and resources, Team, Medications, Equipment and supplies, Organization and leadership, Not known, or no identified contributing factors. Contributing factors are described by the reporter in free text and later classified by the handler, multiple categories are possible). Examples of the contributing factors can be found in online file 1. First, this structured information was described using IBM SPSS statistics 25 (frequencies & percentages).

Second, we divided incident reports into samples based on predefined contributing factors and chose incident reports that had the most common contributing factors (Communication and flow of information, Patient and relatives, Practices, Education and training, Work environment, and resources). These samples of incident reports' free text descriptions (what happened) were read by the first author of this paper and the common terms (keywords) for describing these incidents were identified and manually recorded until new terms were no longer required. Finally, the research group agreed these selected terms.

Then, SAS® Enterprise Miner 13.2 and its Text Miner tool were used to analyse the free text descriptions across the whole dataset. 'Text parsing' (processing unstructured text to a structured form, including tokenization, stemming, and part-of-text tagging) and 'text filtering' (reducing the total number of parsed terms and check the spellings) were conducted automatically using SAS Text Miner. The method is described more detail in our previous studies (Härkänen, Paananen, Murrells, Rafferty, & Franklin, 2019; Härkänen, Vehviläinen-Julkunen, Murrells, et al., 2020; Härkänen, Vehviläinen-Julkunen, Murrells, Rafferty, & Paananen, 2019). The Finnish language was chosen for parsing and filtering the text. A SAS Text Miner stop list was used to ignore some parts of the text such as auxiliary verbs, conjunctions, possessive pronoun, interjections, numbers, participles, and prepositions. Using an interactive filter viewer, synonyms were combined manually. Unwanted terms (such as most abbreviations) were excluded, as well as terms occurring in

fewer than in 10 reports. The medications most commonly mentioned in the free text descriptions were identified using the interactive filter viewer. A screenshot of the interactive filter viewer page can be found in online material 2.

A specific focus of this study was to explore connection terms related to the most common contributing factors; thus, the number of each of previously (manually) identified keywords describing contributing factors was determined using SAS Text Miner and its interactive filter viewer. The concept linking method was then used for identifying terms that are highly connected (connection terms) with these selected terms. In concept linking, the selected term is shown at the centre of a link diagram and the terms that circle this are those that occur together most often with that central term (Härkänen, Paananen, et al., 2019; SAS, 2012). The strength of association between terms in a corpus of documents is calculated using the binomial distribution (SAS, 2020). An example of concept linking with expanded links for the term 'Marevan' can be found in online material 3 (Finnish language). Finally, verbatim quotes were used to illustrate these findings (Figure 1).

## 2.6 | Validity and reliability/rigour

The text mining approach allowed for analysis of a large dataset including about 19,000 free text descriptions that would be difficult to analyse manually. Text mining applications' algorithms were effective for identifying the concept links between terms. The credibility of text mining has already been recognized and tested (Verma & Maiti, 2018). Its accuracy, sensitivity, and specificity have been shown to be high when compared with manual analysis (Ruud, Johnson, Liesinger, Grafft, & Naessens, 2010), which was also confirmed in our previous study comparing automated concept linking and manual analysis (Härkänen, Vehviläinen-Julkunen, Murrells, et al., 2020).

Data analyses were discussed within the research group to ensure methodological coherence, adequate sampling, and responsiveness. The first author of this paper conducted the analyses independently, but the other authors of this paper critically reviewed the findings and consensus was reached on the themes.

## 2.7 | Ethical considerations

According to the guidelines of the Finnish National Advisory Board on Research Ethic (TENK, 2019, 62), the use of existing anonymous (register) data does not require an approval from the National Committee of Research Ethics. Permission to access the register of incident reports was granted from the relevant hospital district in 2019. Incident reports were anonymous; thus, anonymity of the reporters, patients, and other involved persons could be guaranteed. All data handling was conducted following the 'responsible conduct of research' (TENK, 2012).

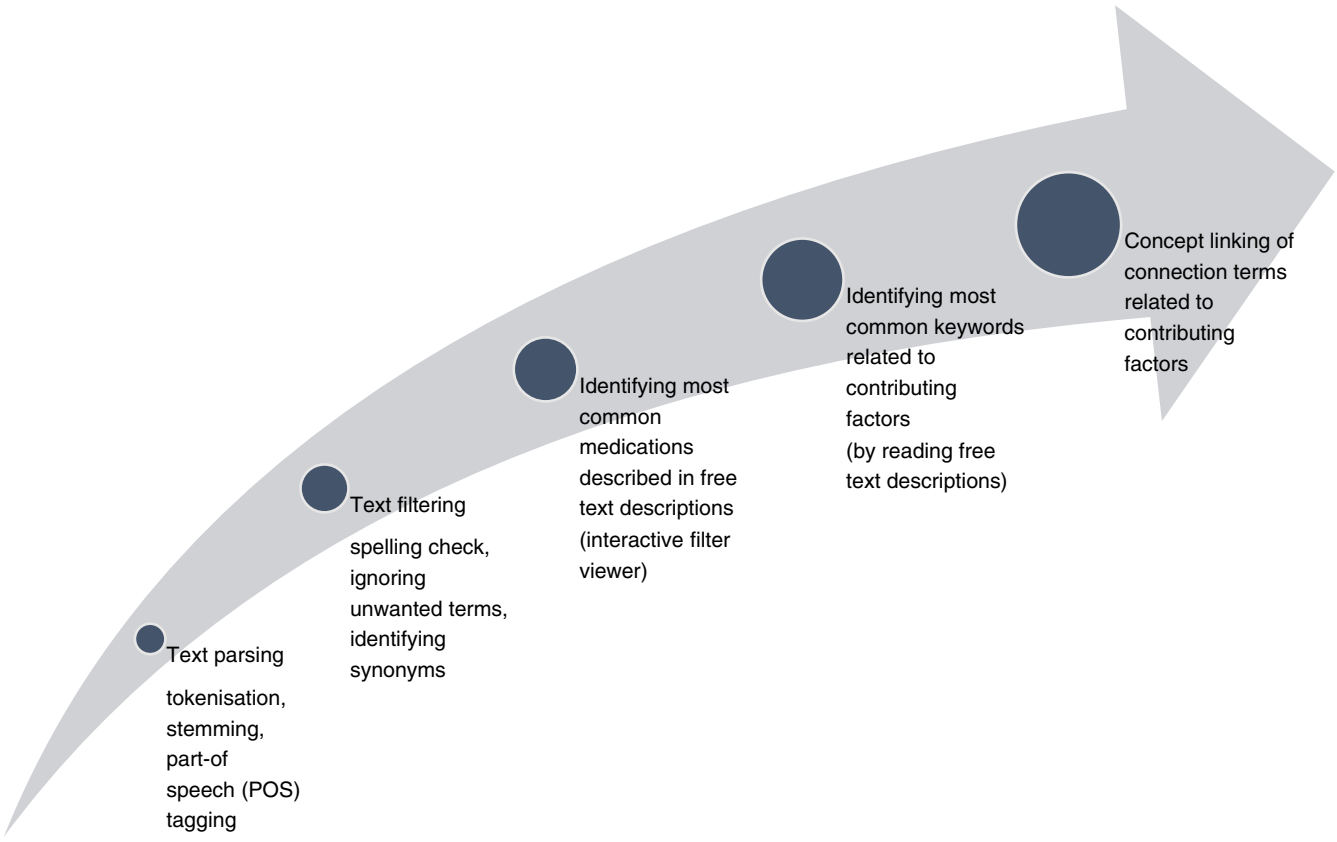


**FIGURE 1** Analysis process of home care medication administration incident reports' free text descriptions

## 3 | RESULTS

### 3.1 | Characteristics of MA incidents in home care

The reporters of the home care MA incidents were mostly (77.8%, *N* = 15,349) practical nurses, with 14.9% (*N* = 2,935) Registered Nurses and only three incidents reported by physicians. Of these incidents, 40.1% (*N* = 7,915) caused mild harm to the patient based on the handler's evaluation. Moderate harm was caused in 5.3% (*N* = 1,047) and serious harm in 0.1% (*N* = 22). For 27.3% (*N* = 5,387) of incidents, it was evaluated that 'no harm' resulted.

The most common error types based on the pre-specified categories were omissions of drug doses (47.4%, *N* = 9,343) and 'patient did not take the drug' (29.6%, *N* = 5,843), followed by wrong time errors (6.1%, *N* = 1,202). Wrong patient incidents (drug administered to wrong patient) were the rarest, occurring in only 0.6% (*N* = 128) of incidents (Table 1).

The most commonly reported contributing factor based on the pre-specified categories was 'communication and flow of information', reported in 25.5% (*N* = 5,038) of incidents. Other common reported contributing factors were 'patient and relatives' (22.6% of incidents, *N* = 4,451), followed by 'practices' (9.9%, *N* = 1,959), 'education and training' (4.8%, *N* = 949), and 'work environment and resources' (3.0%, *N* = 598) (Table 1). The most common medications described in the free text descriptions were Marevan [warfarin] (*N* = 2,668), insulin (*N* = 811), Furesis [furosemide] (*N* = 590), 'antibiotic' (*N* = 446), and Panadol [paracetamol] (*N* = 416) (Table 2).

### 3.2 | Connection terms related to the most common contributing factors

#### 3.2.1 | Communication and flow of information

The most common terms (identified manually and counted by text mining) as being related to the contributing factor 'communication and flow of information' were: information (*N* = 2054), tell (*N* = 1859), call (*N* = 1,201), and say (*N* = 1,080) (Table 3). Other terms and connection terms can be found in online material 4.

Connection terms identified using text mining for the term 'information' were: 'anomaly, find, occurrence, information about when, precise information, factor, contributing factors':

> "Antibiotic eyedrops have been prescribed to the resident starting on 21 May 2018. Due to an information breakdown, the nurses did not receive the information in time and the drops were not given. The error was detected on 28 May 2018 and the eyedrops were ordered from a pharmacy… Information breakdown among nursing staff."
>
> [Incident report (IR) 123635].

**TABLE 1** Home care medication administration incidents' (*N* = 19,725) pre-specified categories about reporters, severity, type, and contributing factors

| | Home care medication administration incidents (No., % of all incidents) |
|---|---|
| Reporters of incidents | |
| Practical nurses | 15,349 (77.8) |
| Registered Nurses | 2,935 (14.9) |
| Supervisors | 170 (0.9) |
| Public health nurses | 359 (1.8) |
| Students | 227 (1.2) |
| Social workers | 62 (0.3) |
| Physicians | 3 (0) |
| Other | 185 (0.9) |
| Missing data | 435 (2.2) |
| Total | 19,725 (100) |
| Consequences of incidents | |
| No Harm | 5,387 (27.3) |
| Mild harm | 7,915 (40.1) |
| Moderate harm | 1,047 (5.3) |
| Serious harm | 22 (0.1) |
| Not known | 5,354 (27.1) |
| Total | 19 725 (100) |
| Type of incidents | |
| Omission | 9,343 (47.4) |
| Patient did not take the drug | 5,843 (29.6) |
| Other | 1,685 (8.5) |
| Wrong timing | 1,202 (6.1) |
| Wrong dose | 804 (4.1) |
| Wrong patient | 128 (0.6) |
| Wrong drug | 182 (0.9) |
| expired drug administered | 152 (0.8) |
| Wrong administration technique | 189 (1.0) |
| Not known/missing | 197 (1.0) |
| Total | 19 725 (100) |
| Contributing factors[a] | |
| Not known/no identified contributing factors | 6,508 (33.0) |
| Communication and flow of information | 5,038 (25.5) |
| Patient and relatives | 4,451 (22.6) |
| Practices | 1,959 (9.9) |
| Education and training | 949 (4.8) |
| Work environment and resources | 598 (3.0) |
| Team | 234 (1.1) |
| Medications | 56 (0.2) |
| Equipment and supplies | 15 (0) |
| Organization and leadership | 4 (0) |
| Total | 19 725 (100) |

[a]classified based on the first contributing factor, if many factors were mentioned.

**TABLE 2** Twenty of the most commonly mentioned medications in the free text descriptions of incidents ($N = 19{,}725$)

| | freq | docs[a] |
|---|---|---|
| Marevan [warfarin] | 2,668 | 1,334 |
| insulin | 811 | 341 |
| Furesis [furosemide] | 590 | 435 |
| 'Antibiotic' | 446 | 227 |
| Panadol [paracetamol] | 416 | 315 |
| Norspan [buprenorphine] | 272 | 195 |
| Thyroxin [levothyroxine] | 229 | 166 |
| Exelon [rivastigmine] | 228 | 153 |
| Mirtazapin [mirtazapine] | 222 | 182 |
| Para-tabs [paracetamol] | 219 | 185 |
| Novorapid [aspart insulin] | 218 | 135 |
| Klexane [enoxaparin] | 198 | 90 |
| Calcichew [calcium carbonate] | 183 | 165 |
| Bisoprolol [bisoprolol] | 174 | 157 |
| Lantus [glargine insulin] | 167 | 97 |
| Risperidon [risperidone] | 161 | 131 |
| Madopar [levodopa/benserazide hydrochloride] | 152 | 125 |
| Lyrica [pregabalin] | 126 | 108 |
| Kaleorid [potassium chloride] | 126 | 102 |
| Ketipinor [quetiapine] | 119 | 96 |

[a]a drug might get mentioned more than once in the same document

Connection terms for the term 'tell' were: 'visit, home care, evening, contributing factors, take, anyway, issue, client, also':

> "The resident was not given his/her daytime medications as there was an interruption in the information flow. The person working the morning shift failed to **tell** that he/she had not given the client his/her daytime medications. The person presumed that the evening shift worker was responsible for giving the client daytime medications. The worker was unsure that the team had agreed that the morning shift worker was responsible for giving the client daytime medications…"
>
> [IR 132278].

Connection terms for the term 'call' were: 'morning, day, blood glucose, nurse, visit, home care, family member, issue':

> "The virtual nurse calls clients in the evenings and makes sure that the clients take their medications. The entries say that the client has taken his/her evening medications, but the medications were actually still in a sachet on a table."
>
> [IR 124122].

**TABLE 3** Most common keywords related to contributing factors

| Keywords in English | Original keywords in Finnish | Freq | Docs |
|---|---|---|---|
| 'Communication and flow of information' | | | |
| Information | tieto | 2,054 | 1,885 |
| Tell | kertoa | 1,859 | 1,587 |
| Call | soittaa | 1,201 | 1,020 |
| Say | sanoa | 1,080 | 970 |
| Read | lukea | 965 | 843 |
| Consult | konsultoida | 505 | 460 |
| 'Patient and relatives' | | | |
| Refuse | kieltäytyä | 420 | 370 |
| Forgetful | muistamaton | 232 | 206 |
| Memory-disordered | muistisairas | 272 | 218 |
| Alcohol | alkoholi | 139 | 119 |
| Tired | väsynyt | 213 | 206 |
| Spouse | puoliso | 357 | 215 |
| Daughter | tytär | 310 | 178 |
| Practices | | | |
| Guide, instructions | ohje | 980 | 820 |
| Treatment plan | hoitosuunnitelma | 793 | 666 |
| Under supervision | valvotusti | 764 | 706 |
| Virtual care | virtuaalihoito | 248 | 190 |
| Remote care | etähoito | 154 | 92 |
| Education and training | | | |
| Temporary employee (fill-in) | sijainen | 613 | 482 |
| Know | tietää | 381 | 360 |
| Know-how/Can | osata | 220 | 217 |
| Deputy | keikkalainen | 171 | 147 |
| Student | opiskelija | 131 | 82 |
| Work environment | | | |
| Hurry, rush | kiire | 523 | 543 |
| Negligence | huolimattomuus | 327 | 324 |
| Excessive | liian | 236 | 213 |
| Much | paljon | 247 | 232 |

Connection terms for the term 'say' were: 'tell, know, no, part, ask, call, take, issue':

> "The client had not taken the previous nights' medication at 22 (Ketipinor [quetiapine] 25 mg). The medication was in a cup. The client was unable to say why he/she had not taken the medication and regretted always forgetting it. The client uses virtual remote care."
>
> [IR 115676].

### 3.2.2 | Patient and relatives

Most common terms identified as being related to the contributing factor 'Patient' were; refuse (*N* = 420), memory-disordered (*N* = 272), and forgetful (*N* = 232), and terms related to substance use such as alcohol (*N* = 139). Most common terms related to 'relatives' were relative (*N* = 494), spouse (*N* = 357), and daughter (*N* = 310) (Table 3). Other terms and connection terms can be found in online material 5.

Connection terms by concept linking for the term 'refuse' were 'negative towards care, persuade, many, agree, offer, try to take'. Identified similar terms were 'negative towards care' and 'negative towards medications':

> "The client often neglects taking medications. The client is often aggressive and negative towards treatment and gets angry if you mention that he/she should take his/her medications…"
>
> [IR 131601].

Connection terms for the term 'memory-disordered' were 'live, remember, spouse, client, well, home care, take', and for 'forgetful' were 'negative towards medications, visit, client, still, home care, well, take, leaving':

> "The client has failed to take his/her medications [negative towards medications] put in a cup for today and yesterday. The client is forgetful and unable to take care of his/her medication. The client's closest family member also has memory problems."
>
> [IR 112567].

Terms explaining substance use of patients were 'alcohol', 'intoxicated', and 'drunkenness'. Connection terms for the term 'alcohol' were 'drunkenness, use, effect, enjoy, drink, under influence, use':

> "The client is considerably intoxicated and has failed to take his/her medications… The client passed out and, on the afternoon, after sobering up a bit, took his/her medications again."
>
> [IR 132064].

Most common terms explaining relatives were 'relative', 'spouse', and 'daughter'. Connected terms for these explained their roles as caregivers, such as connection terms for the term 'relative' were 'told, agree, client, relative, place, inform, call, home care' (online material 2):

> "The wife had put on one of her own Norspan [buprenorphine] 10 mikrog/h patches on her husband even though the husband is not under that medication. The wife had informed the nurse of this issue after the nurse had noticed the patch on the husband's arm. The wife said that the patch had reduced the client's use of Opamox [benzodiazepine]. The patch caused no obvious harm to the client. The client has Alzheimer's disease, while the wife has no memory disorder."
>
> [IR 110642].

### 3.2.3 | Practices

Most common terms identified as being related to the contributing factor 'Practices' were guide, instructions (*N* = 980), treatment plan (*N* = 793), under supervision (*N* = 764), virtual care (*N* = 248), and remote care (*N* = 154) (Table 3). Other terms and connection terms can be found in online material 6. Connection terms by concept linking for 'guide, instructions' were 'next, day, blood glucose, keep, nurse, thing, also, Marevan [warfarin]':

> "During a morning visit, the client's blood glucose levels revealed that the client had been given an extra medicine (Novorapid [insulin] 2 IU [international units]) even though his/her blood glucose levels did not indicate that this was necessary. The list of medications and treatment plan included clear instructions by a physician for mealtime insulin…"
>
> [IR 125006].

Connection terms for the term 'treatment plan' were 'medication list, read, controlled, keep, nurse, visit, contributing factors, also':

> "The client should have been given eyedrops in both eyes in the morning. Pred Forte [prednisolone acetate] and Oftagel [carbomerum]. The treatment plan had not been brought up to date."
>
> [IR 127175].

Connection terms for 'under supervision' were 'table, visit, cup, treatment plan, read, morning medicine, give':

> "A nurse gives the client medications each morning from dose sachets and a pill dispenser under supervision. The medications are kept in a locked medication kit at the client's home. During my visit this morning, I noticed that the client's Marevan [warfarin] for the previous evening was still in the pill dispenser, which means that the nurse had failed to give it when visiting the client in the morning…It seems that the nurse had not read the list of medications or treatment plan."
>
> [IR 124173].

Connection terms for the term 'virtual care' were 'call, sample, evening, client, remind, call, take'. Connection terms for the term 'remote care' were quite similar to those for virtual care:

> "The remote care service was not used. The client has diabetes and the purpose of the remote visit is to check how the client is doing. However, the remote care services did not contact the client during the entire evening. The remote care services also failed to inform the home care provider of the failure to contact the client. The client also noted that this was not the first time when the remote care services had failed to contact him/her…"
>
> [IR 124599].

### 3.2.4 | Education and training

The most common terms identified as being related to the contributing factor 'Education and training' were: temporary employee (*N* = 613), know (*N* = 381), know-how/can (*N* = 220), deputy (*N* = 171), and student (*N* = 131) (Table 3). Other terms and connection terms can be found in online material 7.

Connection terms by concept linking for the term 'temporary employee' were 'do, evening shift, work shift, treatment plan, permanent (staff), visit'. Some of the new employees and temporary staff members were not permitted to administer medications causing medication to be omitted:

> "Forgot to put in a vaginal suppository, no knowledge of the consequences to the client. A temporary employee had been working the shift for a short time, was unaware of the issue."
>
> [IR 133978].

> "On Friday morning, it was observed that the client had not been given an Innohep [tinzaparin] injection. A public health nurse was called and consulted to decide what to do. The nurse visiting the client on Thursday had no medication permit and did not give the client the injection because of this."
>
> [IR 105928].

Some of the terms described lack of knowledge, skills, and lack of experience ('know-how', 'can', and 'inexperience') by health professionals:

> "Home care services inject the client with long-acting insulin every morning. The client uses safety needles in his/her insulin pen. The nurse did not know how to use the needle/ensure that the needle is used correctly, as a result of which the client was probably not given the day's insulin dose."
>
> [IR 102118].

Connected terms to keyword 'student' were 'injury, insulin, "put in a cup", instantly, instructor, screen, inject, nurse':

> "A student gave the client eyedrops that are meant to be given in the evenings. The nurse noticed that the student had done this. A registered nurse was informed about this and it was agreed that Xalatan [latanoprost] drops would not be given in the evening. A situation involving student supervision."
>
> [IR 108116].

### 3.2.5 | Work environment and resources

The most common terms identified as being related to the contributing factor 'Work environment and resources' were hurry, rush (*N* = 523), negligence (*N* = 327), much (*N* = 247), and excessive (*N* = 236) (Table 3). Other terms and connection terms can be found in online material 8.

Connection terms by concept linking for 'hurry, rush' were 'tiredness, maker, a lot, error, nurse, busy nurse, negligence, contributing'. Connection terms for the term 'busy' were 'day, new, go, contribute, other, client, situation, morning shift, evening shift':

> "Simvastatin 10 mg, in the client's pill dispenser, not given to patient. Shift with excessive workload. The nurse who made the mistake is typically careful and diligent. Things happen when you are busy."
>
> [IR 63560].

Connection terms for 'negligence' were 'fuss, error, maker, nurse negligence, nurse, rush, contributing':

> "During an evening visit, I forgot to give the client Klexane [dalteparin] 40 mig. Negligence, stressful evening, high stress level, prone to errors"
>
> [IR 114609].

Connection terms for 'excessive' were 'reach, a lot, inject, get, short, too little, late' and for 'much' were 'work, also, how, goods, visit, too, time, rush':

> "The nurse working the morning shift had so many visits between 8 and 10 a.m. that this client could only be visited so late as to get his/her morning medications at 10:30 a.m. Excessive workload in the morning"
>
> [IR 130510].

## 4 | DISCUSSION

The aim of this study was to describe the characteristics of home care MA incidents and analyse the factors most commonly reported as contributing factors, based on the free text descriptions. The number of 'no harm' situations was relatively low in this dataset, representing only a third of all reported incidents, with other incidents

causing at least mild harm. The corresponding number of 'no harm' MA incidents was over 80% in over 500,000 acute care MA incidents reported within 10 years in England and Wales (Härkänen, Vehviläinen-Julkunen, Franklin, et al., 2020). Based on previous analysis of medication incidents that occurred at home in Canada, 37% resulted in harm to the patient (ISMP, 2014). Our finding, therefore, raises the questions as to whether home care incidents are more likely to cause patient harm or whether this difference can be explained by differences in reporting cultures. Based on previous findings, it has been estimated that self-reporting systems detect only 7–15% of all medication incidents (Elliott et al., 2018), but the actual percentage may be even lower.

Reporting of home care incidents is still a relatively new practice in Finland, which may result in near miss situations being even less likely to be reported. It may also be more difficult to identify incidents in the home care setting. Additionally, there may be differences in evaluating the reported severity, which should relate to the actual harm resulting directly from the incident rather than perceived potential harm (Härkänen, Vehviläinen-Julkunen, Franklin, et al., 2020).

The most common MA error types in this study were 'omissions of drugs' representing almost half of the incidents and 'patient did not take the drug' representing a third of incidents. Interestingly, omission cases were divided into these two groups, probably for the purposes of highlighting the patient's role in the case of the latter. Findings are similar to Hale et al. (2015), who found that almost half of medication discrepancies in home care were omissions. Patients in home care mostly self-administer their own medicines; thus, patients' coping with medication management should be encouraged in accordance with individual patient preferences (Bucknall et al., 2019). One of the key challenges in home care is how to bridge unclear boundaries of responsibility in the patient's home and maintain a safe medication process, while at the same time preserving the patient's autonomy and integrity (Lindblad et al., 2017). This means clear distribution of MA responsibilities among health professionals, patients, and families and understanding that not all patients are interested in taking more control (Bucknall et al., 2019).

'Communication and flow of information' was the most common contributing factor for MA home care incidents, as is also the case in acute care incidents (Syyrilä, Vehviläinen-Julkunen, & Härkänen, 2020). We found communication challenges among health professionals, and between health professionals, patients, and family members. Other studies have highlighted insufficient exchange of information and poor communication between home care health services and professionals (Absulem & Hardin, 2011; Berland & Bentsen, 2017). Suitable means of communication among home care professionals is required to ensure safe care for home care patients.

Our study demonstrated that patients who decline to take medications, people with memory disorders, and substance abuse were associated with MA incidents, such as omission of drugs. Other research found that patients who are visually impaired or who live alone with cognitive impairment, the presence of polypharmacy, and the lack of an individual caregiver who can assume the professional role for MA are also risk areas (HPNA, 2011). An obvious contributing factor is the lack of around-the-clock supervision by a professional at home. Home care professionals have previously reported that patients may not have taken their medication because it was felt to be burdensome or not needed based on the patient's or his/her caregiver's opinion (HPNA, 2011). Based on our findings, even caregivers and family members have very important roles in home care patients' everyday coping, they were sometimes sources of MA incidents. Thus, patients and family caregivers need to have competence for safe MA and they should be active partners in the medication process for resilient home care (Lindblad et al., 2017). It is also important to understand that informal caregivers might experience a considerable burden associated with managing medications, a task which they may not be equipped to do.

Lack of health professional competence (Berland & Bentsen, 2017) can also contribute to home care MA incidents. Our data suggested that temporary staff were not always well inducted into the workplace. Some new employees did not have the required qualification for MA, contributing to medication errors. Findings related to work environmental issues, such as rushing because of excessive workload or lack of (competent) employees, were found in our free text descriptions. Similar issues have been found in other studies concerning MA incidents demonstrating that inadequate staffing levels, workload, and working in haste (Härkänen, Vehviläinen-Julkunen, Murrells, et al., 2020), as well as nurse workload or distractions during medication tasks (Sessions, Nemeth, Catchpole, & Kelechi, 2019) may increase the risk of omissions and other types of errors.

### 4.1 | Limitations

Our analysis required the researchers to make some subjective decisions, such as identifying and selecting the keywords for analysis. It is possible that some have been missed as there is no previous guidance to follow. Verbatim quotes were translated from Finnish to English in this paper, thus, because of the difference between linguistic expressions, some connection terms might be expressed slightly differently in these examples than in original expression in Finnish. In addition, incident report data were not originally meant for research purposes and thus poses several limitations, as incidents are likely to be under-reported which may introduce bias (Härkänen, Vehviläinen-Julkunen, Murrells, et al., 2020). The quality of the reports may also vary in terms of detail and accuracy (NHS, 2014).

## 5 | CONCLUSIONS

Challenges in home care MA process are manifold and reported MA incidents seem to be more serious compared with acute care settings, although this may reflect lack of reporting of near misses.

There is need for effective communication between patients and home care professionals to guarantee timely information of the current state of MA fulfilment and its challenges. Complex roles and responsibilities among health professionals, patients, and their family members exist in the MA process in home care. However, it might not be possible to control all patients changing preferences around taking their medications to ensure practice is safe; we may need to accept some inherent risks in medication management in patients' homes to preserve their autonomy and integrity.

## Peer Review

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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