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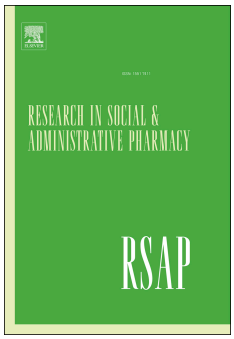

Medication administration errors and mortality: Incidents reported in England and Wales between 2007– 2016

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Medication administration errors and mortality: incidents reported in England and Wales between 2007–2016

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ABSTRACT

Background: Medication administration errors may contribute to patient mortality, thus additional understanding of such incidents is required.

Objectives: To analyse medication administration errors reported in acute care as resulting in death, to identify the drugs concerned, and to describe medication administration error characteristics (location of error, error type, patient's age) by drug group.

Methods: Medication administration errors reported in acute care in 2007– 2016 (n=517,384) were obtained from the National Reporting and Learning System for England and Wales. Incidents reported as resulting in death (n=229) were analysed. Drugs were classified by two researchers using the British National Formulary. Drug categories were described by medication administration errors' year, location, patient age, and error category based on the incidents' original classification.

Results: Errors were most often reported on wards (66.4%, n=152), and in patients aged over 75 years (41.5%, n=95). The most common error category was omitted medicine or ingredient (31.4%, n=72); most common drug groups were cardiovascular (20.1%, n=46) and nervous system (10.0%, n=23). Most errors in patients under 12 years concerned drugs to treat infection; cardiovascular drugs were most common among other age groups.

Conclusions: In order to prevent these most serious of medication administration errors, interventions should focus on avoiding dose omissions, and administration of drugs for patient over 75 years old, as well as safe administration of parenteral anticoagulants and antibacterial drugs.

Keywords: adverse event, death, drug, incident reporting, medication administration, patient safety

Abbreviations

ADE = adverse drug event
BNF = British National Formulary
ISMP = Institute for Safe Medication Practices
MAE = medication administration error
NHS = National Health Service
NRLS = National Reporting & Learning System

INTRODUCTION

In 2017, The World Health Organization (WHO) launched a third global patient safety challenge "Medication Without Harm", aimed at improving medication safety, on the basis that medication errors are a leading cause of injury and avoidable harm in health care systems globally generating costs that has been estimated at 42 billion USD annually.[1] In February 2018, the report of the prevalence and burden of medication errors in England was published in response to the WHO challenge, estimating that 237 million medication errors at all stage of medication process occur in England per annum.[2]

The United States National Coordinating Council for Medication Error Reporting and Prevention[3] defines medication error as "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". The medication administration stage of the medication process is known to be prone to errors. Half or more of all medication incidents are medication administration errors (MAEs).[2 4 5] MAEs can be defined as "a deviation from the prescriber's medication order as written on the patient's chart, manufacturers' preparation/administration instructions, or relevant institutional policies".[6] Direct observations of the inpatient medication process produce the most rigorous data on the prevalence of medication errors, and suggest that MAEs occur in 5% of non-intravenous and 35% of intravenous doses[7] or up to 20% of all doses given.[8 9] Fortunately, the majority of MAEs do not result in harm[2 10], but some are serious or even fatal. An adverse drug event (ADE) is defined as "an injury resulting from medical intervention related to a drug".[11]

Medication errors as well as ADEs during hospitalization are more likely in the presence of co-morbidity and polypharmacy,[2 12] and among older people.[2 13] Some drugs are more likely to cause significant patient harm when used in error. These are listed as high-alert medications by the US Institute for Safe Medication Practices (ISMP).[14] In acute care settings, these drug classes include anaesthetics, anti-arrhythmics, anti-thrombotics, chemotherapeutics, dialysis solutions, epidural or intrathecal medications, insulin, narcotics/opioids, and parenteral nutrition.[14] The UK's high risk drug list includes administration of methotrexate, diamorphine and morphine injections, low molecular weight heparins, anticoagulants, insulin, lithium, midazolam injection, opioids, injectable medicines, and liquid medicines as well as omitted doses.[15] Additionally, a systematic review

revealed that 47 % of all serious medication errors were caused by seven drugs / drug classes. Those were methotrexate, warfarin, nonsteroidal anti-inflammatory drugs (NSAIDS), digoxin, opioids, acetylic salicylic acid, and beta-blockers.[16]

Analysis of reported medication errors have traditionally included all medication incidents, whether or not they result in harm[4 5]. By focussing on the most serious MAEs, the aim was to specifically study the characteristics of MAEs reported as resulting in patient death. This study's objectives were 1) to analyse medication administration errors reported in acute care as resulting in death, 2) to identify the drugs concerned, 3) to describe MAE characteristics by drug group, and 4) to identify potential areas for intervention.

METHODS

Design & setting

This was a retrospective study of MAEs reported to the National Reporting & Learning System (NRLS) for England and Wales. The NRLS collects national data on all patient safety incidents that are voluntarily and anonymously reported by staff employed in the National Health Services (NHS) and other health care organisations. Incidents (including near misses and incidents causing harm) can also be reported directly to the NRLS. Data reported for incidents include both categorical data (e.g. type, severity of incident) and a free text description of what happened.

The original classification of the NRLS incidents were used. Based on this classification, location of error included: ward, intensive care unit, operating theatre, recovery room, anaesthetic room, therapy department, pharmacy, mortuary, hospital buildings, other, or the information was missing. Types of errors were: omitted medicine / ingredient, wrong / unclear dose or strength, wrong drug / medicine, wrong frequency, wrong quantity, wrong route, adverse drug reaction (when used as intended), patient allergic to treatment, contra-indication to the use of the medicine in relation to drugs or conditions, mismatching between patient and medicine, wrong storage, wrong method of preparation / supply, wrong / omitted verbal patient directions, wrong / omitted / passed expiry date, other, or unknown.

92

93

94 **Data acquisition**

95 A data sharing agreement was signed after applying and receiving acceptance from NRLS for
96 data access. NRLS extracted the data (medication administration errors reported to the
97 NRLS between 1 January 2007 and 31 December 2016) in December 2017. Inclusion criteria
98 were that the incident was documented as involving: 1) medication, 2) administration /
99 supply of a medicine from a clinical area, and 3) acute NHS trust (either a specialist or non-
100 specialist organisation). Of all incidents (n=517,384), 94.3% concerned an acute non-
101 specialist Trust, and only 5.7% acute specialist Trust. The total number of incidents extracted
102 was 517,384. Of these, only MAEs reported as resulting in death caused by a patient safety
103 incident (n=229, 0.04%) were analysed. Only the categorical data fields within the NRLS data
104 were acquired.

105

106 **Data analysis**

107 Descriptive statistics of the data (n=229 MAEs reported as resulting in death) were
108 calculated using IBM SPSS (version 23.0). Characteristics of the data were described using
109 frequencies and percentages, and relationships amongst factors explored via cross-
110 tabulation. Reports including the name of the drug were classified using the British National
111 Formulary (BNF) classification.[17] The BNF classification's main groups are divided under the
112 following sections: 1. Gastro-intestinal system, 2. Cardiovascular system, 3. Respiratory
113 system, 4. Nervous system, 5. Infection, 6. Endocrine system, 7. Genito-urinary system, 8.
114 Malignant disease, 9. Blood and nutrition, 10. Musculoskeletal system, 11. Eye, 12. Ear,
115 nose, and oropharynx, 13. Skin, 14. Vaccines, 15. Anaesthesia, and 16. Emergency treatment
116 of poisoning. MH classified the drugs into BNF groups which were then verified by BDF. Drug
117 categories were cross-tabulated by MAEs' year, location, patients' age, and error category.
118 The age bands used within the NRLS were amalgamated into six broader groups: 1) under 12
119 years, 2) 12-17 years, 3) 18-25 years, 4) 26-55 years, 5) 56-75 years, and 6) over 75 years.

120

Ethics

King's College London ethics committee approved the study (LRS-17/18-5150). The data did not include any personal or organisational identifiers, thus anonymity of the reporters, patients, other involved persons, and organisations could be guaranteed.

RESULTS

Characteristics of MAEs resulting in death

MAEs resulting in death (n=229) occurred most often in 2008 (n=28, 12.2% of all MAEs reported as causing death) and 2016 (n=28, 12.2%), and less often 2012 (n=13, 5.7%). Overall 66.4% of MAEs were reported as occurring on non-critical care wards, and 41.5% (n=95) occurred amongst patients aged over 75 years. The most common error category was omitted medicine or ingredient (n=72, 31.4%). (Table 1.)

Drugs related to MAEs

The name of the related drug was mentioned in 58.1% (n=133) of all MAEs. The most common group of drugs in MAEs reported as resulting in death were cardiovascular drugs (20.1%, n=46). Of these 26 involved parenteral anticoagulants, six oral anticoagulants, and six sympathomimetics. The second most common were drugs of the central nervous system (10.0%, n=23). Of those, analgesics (n=10) were most common. Other common drug groups were antibacterials (n=20), cytotoxic drugs (n=8), and insulin (n=7). (Tables 2.) More specific information by name of drugs concerned (as written in the reports) is presented in Table 3.

MAE characteristics by drug groups

MAEs reported as resulting in death in general ward areas were most often reported for cardiovascular drugs (34 cases of 152 incidents at ward) followed by nervous systems drugs

(19 of 152). MAEs occurring in intensive care units most commonly concerned drugs used in blood and nutrition (4 of 18 incidents in intensive care units) and infection (3 of 18). Most MAEs in patients under 12 years were drugs to treat infection (3 of 10 incidents in patients under 12 years) whereas for patient's aged 26-55 years cardiovascular drugs (6 of 29 incidents in patients aged 26-55 years) were the most common. Cardiovascular drugs (9 of 58 of incidents in patients aged 56-75) or drugs to treat infection (10 of 58) featured most often for patients aged 56-75, and cardiovascular drugs (23 of 95 incidents in patients aged over 75 years) and nervous system drugs (11 of 95) for patients aged over 75. (Online appendix.)

The most common error categories for cardiovascular drugs were omitted medicine / ingredients (18 of 46 incidents with cardiovascular drugs), followed by wrong / unclear dose or strength (6 of 46). For nervous system drugs the most commonly reported errors were wrong / unclear dose or strength (4 of 23 incidents with nervous system drugs), wrong quantity (3 of 23), and wrong drug / medicine (3 of 23). For drugs to treat infection the most commonly reported errors were omitted medicine /ingredient (5 of 21 incidents with drugs to treat infection), adverse drug reaction (4 of 21), and patient allergic to treatment (4 of 21). (Online appendix.)

DISCUSSION

In this study, MAEs most commonly reported as causing mortality in acute cate Trusts over the 10-year period 2007 to 2016 were omissions of drugs. They occurred more often on hospital wards than other locations and amongst patients aged over 75 years. The drugs most commonly involved were parenteral anticoagulants followed by antibacterial drugs. Interventions to reduce MAEs, should therefore focus on those areas.

Almost one third of MAEs were related to omissions of drug doses. A previous study analysing all medication errors reported to the NRLS between 2005 and 2010 also found that omissions were the most commonly reported type, accounting for around 15% of incidents,[4] which is much lower than in the present study. In addition, a previous systematic review using observational evidence demonstrated that omission errors are the most common MAE type internationally.[18] More attention is needed on omissions since the

consequences can be serious. The risks of delay or omission of drugs have been categorised by the English National Patient safety Agency (NPSA),[19] which suggests that omission of anticoagulants, insulins, and cytotoxic agents, as identified in this study, can cause significant or catastrophic long-term patient impact. Reasons for medication omissions are manifold, such as staff shortages and delays in medication dispensing,[20] patients' inability to take the medicine, or medication unavailability.[21] More active solutions for problems related to medication omissions should be implemented with the development of technology, improving work processes, flow of information, verification systems and availability of drugs. Still, it is challenging to recommend any specific interventions, as a previous systematic review and meta-analysis demonstrated that interventions developed to decrease MAEs, including nurse training and education, automated delivery systems and barcode-assisted medication administration systems, did not find clear effect of the interventions.[22]

Cardiovascular drugs, particularly parenteral anticoagulants, were the most common drug group involved in MAEs reported as resulting in death. Many of those were omitted or administered in the wrong dose, strength, frequency, or quantity. Cardiovascular drugs were associated with the highest median proportion of preventable adverse drug reactions (PADR) also in a previous review of systematic reviews of inpatients' PADRs[23]. Those were also found to be the most frequent types of drugs involved in preventable ADEs[24], and commonly related to observed MAEs [18]. Similarly, heparin and low molecular weight heparin were amongst the most common drugs reported as causing death in other previous studies,[4] [5] demonstrating that the consequences of an error are more devastating for patients receiving these types of drugs as there is only a narrow difference between an effective and a toxic dose.[5] In addition, omission of such drugs may have a significant or catastrophic long-term impact[19] and the risk of ADEs has ben found to increase especially for inpatients with coronary disease and using related drugs.[12] Thus, efforts to avoid dose omissions should focus on these patients.

Antibacterial drugs were also a common group of drugs identified in the present study. Most MAEs related to these drugs were omissions, adverse drug reactions, and administration to patients with a documented allergy. These drugs have been previously found to be related to medication errors causing death,[4] but are not amongst ISMP's list of

high-alert medications.[14] The data in the present study show that patients' allergies and other adverse reactions of drugs may not be verified as carefully as required. Other common drugs related to patients' deaths were opioids, insulins, and cytotoxic drugs, all in ISMP's list of high-alert medications[14]. The most common error types for nervous systems drugs (including opioids) were wrong or unclear dose or strength, wrong drug, or wrong quantity. Further research is needed to understand the reasons for these error types.

Each death caused by medication error is one death too many. There should also be some focus on rare and unusual MAEs. For example two MAEs resulting in death were caused by the administration of potassium permanganate (orally instead of topically). An NPSA Patient Safety Alert produced in 2014 was based on death caused by a patient ingesting potassium permanganate.[25] One incident in our data occurred before this alert and another afterwards, in 2016. More knowledge and competence in handling drugs and administration of drugs should be provided to all health professionals, especially nurses, as they are usually the final step in the medication use process. Educating patients about the medications they are receiving may help to reduce MAEs.

Strengths and limitations

This study was of a sufficient size to be able to identify rare MAEs that result in death. Drugs were classified into BNF category by two researchers, which supports reliability and validity. It is known that reported incidents do not represent all those that occur, and it is assumed that self-reporting systems (such as the NRLS) detect only a very small proportion of all medication incidents[2]. The incident reporting system has further possible weaknesses in that reporters may evaluate the consequences of incidents incorrectly such that some of the MAEs reported as resulting in death incidents may allude to possible rather than actual consequences. It was only possible to identify the name of the drug for 56% of all reports and only the categorical fields from the NRLS data were used in this analysis. In addition, the original classification of NRLS incidents was used, and it is thus impossible to evaluate what error types are hidden under the 'other' category. A further issue is whether an 'adverse drug reaction' may be an MAE when medication is administered for the first time to the patient, but descriptions of reported incidents did not include enough information to allow

re-classification. The free text descriptions could have provided a more detailed understanding of each incidents and further information about the drugs involved.

CONCLUSION

In order to prevent the most serious MAEs, additional studies and interventions should focus on dose omissions and administration of drugs to patients over 75 years old, as well as safe administration of parenteral anticoagulants and antibacterial drugs. Checking patient allergies and undertaking required verification procedures before medication administration, as well as additional education for safe handling and administration of drugs should be mandatory. Additional studies using observational research methods are important for exploring further the dynamics of serious MAEs.

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347 Table 1. Characteristics of medication administration incidents resulting in death (n=229)

Variable	No.	%
Year		
- 2007	23	10.0
- 2008	28	12.2
- 2009	19	8.3
- 2010	22	9.6
- 2011	26	11.4
- 2012	13	5.7
- 2013	25	10.9
- 2014	24	10.5
- 2015	21	9.2
- 2016	28	12.2
Location		
- Ward	152	66.4
- Intensive care unit / high dependency unit	18	7.9
- Operating theatre	10	4.4
- Other	4	1.7
- Recovery room	2	0.9
- Hospital buildings (inside)	2	0.9
- Therapy department	2	0.9
- Pharmacy	1	0.4
- Anaesthetic room	1	0.4
- Mortuary	1	0.4
- Missing information	36	15.7
Patient's age		
- under 12	10	4.4
- 12-17	0	0.0
- 18-25	2	0.9
- 26-55	29	12.7
- 56-75	58	25.3
- over 75	95	41.5
- Missing	35	15.2
Medication error category		
- Omitted medicine / ingredient	72	31.4
- Other	37	16.2
- Wrong / unclear dose or strength	24	10.5
- Adverse drug reaction (when used as intended)	21	9.2
- Wrong drug / medicine	16	7.0
- Wrong frequency	13	5.6
- Wrong quantity	13	5.6
- Wrong route	8	3.5
- Patient allergic to treatment	7	3.1
- Contra-indication to the use of the medicine in relation to drugs or conditions	5	2.2
- Mismatching between patient and medicine	3	1.3
- Unknown	3	1.3
- Wrong storage	2	0.9
- Wrong method of preparation / supply	2	0.9
- Wrong / omitted verbal patient directions	2	0.9
- Wrong / omitted / passed expiry date	1	0.4

348

349

350 Table 2. Classified drugs related to death causing medication administration incidents
351 (n=229)

BNF Drug classes	No.	%
1. Gastro-intestinal system	0	0.0
2. Cardiovascular system - 2.2 (n=1) Diuretics - 2.3 (n=2) Anti-Arrhythmic Drugs - 2.5 (n=2) Hypertension and Heart Failure - 2.7 (n=6) Sympathomimetic - 2.8 (n=26) Parenteral Anticoagulants, (n=6) Oral Anticoagulants - 2.10 (n=1) Stable Angina, Acute/Coronary Synd&Fibrin - 2.11 (n=2) Antifibrinolytic Drugs & Haemostatics	46	20.1
3. Respiratory system - 3.6 (n=2) Oxygen	2	0.9
4. Nervous system - 4.1 (n=3) Hypnotics And Anxiolytics - 4.2 (n=1) Drugs Used In Psychoses & Rel.Disorders - 4.3 (n=1) Antidepressant Drugs - 4.6 (n=1) Drugs Used In Nausea And Vertigo - 4.7 (n=10) Analgesics - 4.8 (n=6) Antiepileptic Drugs - 4.9 (n=1) Drugs Used In Parkinsonism/Related Disorders	23	10.0
5. Infection - 5.1 (n=20) Antibacterial Drugs - 5.3 (n=1) Antiviral Drugs	21	9.2
6. Endocrine system - 6.1.1 (n=7) Insulin - 6.3 (n=1) Corticosteroids (Endocrine)	8	3.5
7. Genito-urinary system	0	0.0
8. Malignant disease - 8.1 (n=8) Cytotoxic Drugs - 8.2 (n=1) Drugs Affecting The Immune Response	9	3.9
9. Blood and nutrition - 9.1 (n=1) Anaemias + Other Blood Disorders - 9.2 (n=4) Fluids And Electrolytes - 9.3 (n=2) Intravenous Nutrition - 9.5 (n=4) Minerals	11	4.8
10. Musculoskeletal system - 10.2 (n=1) Drugs Used In Neuromuscular Disorders	1	0.4
11. Eye - 11.8 (n=1) Miscellaneous Ophthalmic Preparations	1	0.4
12. Ear, nose, and oropharynx	0	0.0
13. Skin - 13.11 (n=3) Skin Cleansers, Antiseptics & Desloughing	3	1.3
14. Vaccines	0	0.0
15. Anaesthesia - 15.1 (n=1) General Anaesthesia	1	0.4
16. Emergency treatment of poisoning	2	0.9
Multiple	2	0.9
Other	3	1.3
Missing	96	41.9
Total	**229**	**100**

352

Table 3. Names of the drugs related to death causing incidents (as written in reports)

BNF code	Drug names (as written in incident reports)
2. Cardiovascular system	
2.2 Diuretics	bumetanide
2.3 Anti-Arrhythmic Drugs	Digoxin [digitalis], amiodarone
2.5 Hypertension and Heart Failure	doxazosin and ramipril, verapamil
2.7 Sympathomimetic	noradrenaline x6, adrenaline x2, isoprenaline, metaraminol
2.8 Parenteral Anticoagulants & Oral Anticoagulants	enoxaparin x 7, Clexane [enoxaparin] x 6, heparin x 6, tinazaparin x 3, Fragmin [dalteparin sodium] x 4, warfarin x 3, rivaroxiban x 2, apixaban
2.10 Stable Angina, Acute/Crnry Synd&Fibrin	alteplase
2.11 Antifibrinolytic Drugs & Haemostatics	factor VIII, vitamin K
3. Respiratory system	
3.6 Oxygen	oxygen x 2
4. Nervous system	
4.1 Hypnotics And Anxiolytics	midazolam x 2, lorazepam
4.2 Drugs Used In Psychoses & Rel.Disorders	haloperidol
4.3 Antidepressant Drugs	mirtazapine
4.6 Drugs in Nausea And Vertigo	prochlorperazine / cyclizine,
4.7 Analgesics	aspirin, oxycodene x 3, fentanyl, remifentanil, morphine x 2, diamorphine, buprenorphine
4.8 Antiepileptic Drugs	phenytoin x 4, phenobarbital, thiopentone
4.9 Park'ism/Related Disorders	co-careldopa
5. Infection	
5.1 Antibacterial Drugs	co-amoxiclav x 4, gentamicin x 3, Augmentin [amoxicillin and clavulanate] x 3, Tazocin [piperacillin sodium /tazobactam sodium] x 2, cefuroxime, flucloxicillin x2, daptomycin, benzylpenicillin, rifampicin, trimethoprim, levofloxacin, linezolid
5.3 Antiviral Drugs	abacavir
6. Endocrine system	
6.1.1 Insulin	insulin x 7
6.3 Corticosteroids (Endocrine)	hydrocortisone
8. Malignant disease	
8.1 Cytotoxic Drugs	chemotherapy x 2, cyclophosphamide x 2, eribulin, vinorelbine, ifosfamide, bleomycin
8.2 Immune Response Drugs	alemtuzumab
9. Blood and nutrition	
9.1 Anaemias + Blood Disorders	iron dextran
9.2 Fluids And Electrolytes	potassium chloride x2, 0.9% normal saline 1000ml, sando K
9.3 Intravenous Nutrition	glucose, Vamin [amino acids]
9.5 Minerals	magnesium x2, calcium chloride x 2
10. Musculoskeletal system	
10.2 Drugs In Neuromusc. Disord.	pyridostigmine
11. Eye / Miscellaneous Ophthalmic Preparations	fluorescein
13. Skin	
13.11 Clean., Antisep. & Desloughing	chlorhexidine, potassium permanganate
15. Anaesthesia	
15.1 General Anaesthesia	atropine
16. Emerg. treatment of poisoning	flumazenil, protamine sulphate

Online appendix. Medication administration incidents (n=229) characteristics by drug groups

BNF Drug classes Charecteristics	2. Cardio-vascular system	3. Respi-ratory system	4. Nervous system	5. Infec-tion	6. Endocrine system	8. Malignant disease	9. Blood and nutrition	10. Musculo-skeletal system	11. Eye	13. Skin	15. Anaest-hesia	16. Emergency treatment	Missing / other / multiple	TOTAL
Incidents' location														
Ward	34	1	19	11	6	5	5	1	0	2	1	2	65	152
Intensive care unit	3	0	1	3	1	0	4	0	0	0	0	0	6	18
Operating theatre	0	0	1	2	0	0	0	0	0	1	0	0	6	10
Other	2	0	0	1	0	0	0	0	0	0	0	0	1	4
Recovery room	0	0	1	0	0	0	0	0	0	0	0	0	1	2
Hospital buildings	0	0	0	0	0	2	0	0	0	0	0	0	0	2
Therapy depart.	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Pharmacy	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Anaesthetic room	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Mortuary	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Missing	6	1	1	4	1	2	2	0	1	0	0	0	18	36
TOTAL	46	2	23	21	8	9	11	1	1	3	1	2	101	229
Patient's age														
under 12	2	0	1	3	0	0	2	0	0	0	0	0	2	10
18-25	0	0	1	0	0	0	0	0	0	0	0	0	1	2
26-55	6	0	3	1	0	2	1	0	0	0	0	1	15	29
56-75	9	1	3	10	0	5	4	0	0	1	1	0	24	58
over 75	23	1	11	4	5	1	3	1	0	2	0	1	43	95
Missing	6	0	4	3	3	1	1	0	1	0	0	0	16	35
TOTAL	46	2	23	21	8	9	11	1	1	3	1	2	101	229
Error Category														
Omitted medicine / ingredient	18	0	2	5	2	1	5	1	0	0	0	1	37	72
Other	4	0	2	0	3	2	1	0	0	0	1	1	23	37
Wrong / unclear dose or strength	6	1	4	0	1	2	2	0	0	0	0	0	8	24
Adverse drug reaction (when used as intended)	2	0	1	4	0	1	1	0	1	1	0	0	10	21
Wrong drug / medicine	4	0	3	1	1	0	0	0	0	0	0	0	7	16
Wrong frequency	3	0	1	1	0	1	1	0	0	0	0	0	6	13

Wrong quantity	4	1	3	1	0	0	1	0	0	0	0	0	3	13
Wrong route	2	0	1	0	0	1	0	0	0	2	0	0	2	8
Patient allergic to treatment	0	0	0	4	0	0	0	0	0	0	0	0	3	7
Contra-indication ..	1	0	1	2	0	1	0	0	0	0	0	0	0	5
Mismatching	1	0	1	1	0	0	0	0	0	0	0	0	0	3
Unknown	0	0	3	0	0	0	0	0	0	0	0	0	0	3
Wrong storage	0	0	0	1	0	0	0	0	0	0	0	0	1	2
Wrong preparation	0	0	0	0	1	0	0	0	0	0	0	0	1	2
Wrong verbal patient directions	0	0	1	1	0	0	0	0	0	0	0	0	0	2
Wrong / omitted / passed expiry date	1	0	0	0	0	0	0	0	0	0	0	0	0	1
TOTAL	46	2	23	21	8	9	11	1	1	3	1	2	101	229