

Drug Safety

Exploring the role of guidelines in contributing to medication errors: a descriptive analysis of national patient safety incident data

Online Supplementary Information

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Table S1: Operational definitions used during the pilot coding of 100 reports.

Reports describing an HTA step discrepancy		
HTA step	Error mode	Operational definition
1. Find the right guideline(s)	A1: operation took too long	It took staff an excessively long period of time to find the guideline they needed
	R1: information not obtained	Staff looked for a guideline that did exist, but could not find it
	R2: wrong information obtained	Staff found and used the wrong guideline for the situation, e.g. an adult guideline instead of a paediatric guideline
	R3: incomplete information obtained	Staff needed to use more than one guideline for the situation, but did not find all of them
	R4: information not sought	Staff did not attempt to look for a guideline. Only use this code if there is evidence staff did not attempt to find a guideline. Use C2 if all we know is that staff did something different to the guideline, but we don't know why
R5: information not available	The organisation does not have a guideline for the condition or patient in question. Different to R1, as the assumption in R1 is that the guideline existed but could not be found	
2. Find all relevant information within guideline(s)	A1: operation took too long	Staff found the right guideline, but it took them an excessively long period of time to find the information they needed within it
	R1: information not obtained	Staff found the right guideline but could not find the information they needed within it
	R2: wrong information obtained	Staff found the right guideline, but then found and used the wrong information within it, e.g. use of an adult dose instead of a child dose
	R3: incomplete information obtained	Staff found the right guideline and then needed to use more than one piece of information from it. They found some of these pieces of information, but not all of them
	R4: information not sought	Staff found the right guideline, but then didn't try to find the information they needed within it
R5: information not available	Staff found an appropriate guideline for the patient's situation, but it did not include the information they needed, e.g. guideline did not give dose for patients with renal impairment	
3. Read and correctly use all relevant information	A1: operation took too long	Staff found the right information in the right guideline, but it took an excessively long period of time to understand it
	R1: information not obtained	Staff found the right information in the right guideline. However, after reading the information they did not understand what action they should take and were aware that they did not know what to do
	R2: wrong information obtained	Staff found the right information in the right guideline. However, while they thought they understood this information, they did not understand it and so planned an incorrect action
	R3: incomplete information obtained	Staff found the right information in the right guideline and understood some information but not all of it

R4: information not sought	Staff found the right information in the right guideline, but did not try to understand it or apply it to the patient
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Reports not describing an HTA step discrepancy

Description	Operational definition
Guideline not followed for reason unrelated to the process of retrieving information from a guideline	An appropriate guideline was available, but was not followed for a reason unrelated to difficulties finding or understanding the guideline, e.g. instructed to do something different by a senior colleague
Guideline not followed; reason unknown	An appropriate guideline was available, but was not followed for an unknown reason
Report not related to guideline use	The use or lack of use of guidelines did not contribute to the incident
Insufficient information to determine if guideline followed	The report lacks sufficient detail to determine whether guideline use contributed to the incident

Table S2: Operational definitions amended after pilot coding and used during coding of remaining reports. Additions from the definitions used during pilot coding (Table S1) are highlighted in yellow.

Definition of a guideline		
In this study, a 'guideline' is defined as meeting both the following criteria:		
i) 'Clinical Practice Guidelines' as defined by the Institute of Medicine: "statements that include recommendations intended to optimize patient care" - i.e. guidelines describe best practice to inform clinical decisions, they are not policies or procedures that describe how a task must be undertaken; AND		
ii) a document that provides information on the prescribing, administration or monitoring of a medicine		
Application of the coding system		
When applying the following classification system:		
i) only select an HTA code when there is positive evidence to support this in the NRLS report. Where there is not positive evidence, select a non-HTA step discrepancy code		
ii) where a series of mistakes, slips or lapses have contributed to an error, select the code relevant to the first one		
Reports describing an HTA step discrepancy		
HTA step	Error mode	Operational definition
1. Find the right guideline(s)	A1: operation took too long	It took staff an excessively long period of time to find the guideline they needed
	R1: information not obtained	Staff looked for a guideline that did exist, but could not find it
	R2: wrong information obtained	Staff found and used the wrong guideline for the situation, e.g. an adult guideline instead of a paediatric guideline, or an out-of-date guideline when an up-to-date guideline was available
	R3: incomplete information obtained	Staff needed to use more than one guideline for the situation, but did not find all of them
	R4: information not sought	Staff did not attempt to look for a guideline. Only use this code if there is evidence staff did not attempt to find a guideline. Use C2 if all we know is that staff did something different to the guideline, but we don't know why
	R5: information not available	The organisation does not have a guideline for the condition or patient in question. Different to R1, as the assumption in R1 is that the guideline existed but could not be found
2. Find all relevant information	A1: operation took too long	Staff found the right guideline, but it took them an excessively long period of time to find the information they needed within it
	R1: information not obtained	Staff found the right guideline but could not find the information they needed within it
	R2: wrong information obtained	Staff found the right guideline, but then found and used the wrong information within it, e.g. use of an adult dose instead of a child dose

within guideline(s)	R3: incomplete information obtained	Staff found the right guideline and then needed to use more than one piece of information from it. They found some of these pieces of information, but not all of them
	R4: information not sought	Staff found the right guideline, but then didn't try to find the information they needed within it
	R5: information not available	Staff found an appropriate guideline for the patient's situation, but it did not include the information they needed, e.g. guideline did not give dose for patients with renal impairment
3. Read and correctly use all relevant information	A1: operation took too long	Staff found the right information in the right guideline, but it took an excessively long period of time to understand it
	R1: information not obtained	Staff found the right information in the right guideline. However, after reading the information they did not understand what action they should take and were aware that they did not know what to do
	R2: wrong information obtained	Staff found the right information in the right guideline. However, while they thought they understood this information, they did not understand it and so planned an incorrect action
	R3: incomplete information obtained	Staff found the right information in the right guideline and understood some information but not all of it
	R4: information not sought	Staff found the right information in the right guideline, but did not try to understand it or apply it to the patient

Reports not describing an HTA step discrepancy

Description	Operational definition
Guideline not followed for reason unrelated to the process of retrieving information from a guideline	An appropriate guideline was available, but was not followed for a reason unrelated to difficulties finding or understanding the guideline, e.g. instructed to do something different by a senior colleague
Guideline not followed; reason unknown	An appropriate guideline was available, but was not followed for an unknown reason
Guideline content incorrect or out-of-date	Information contained in the appropriate guideline was incorrect or the advice contained in the current version of the guidelines is now out-of-date. Incomplete guidelines should be coded 2R5
Report not related to guideline use	The use or lack of use of guidelines did not contribute to the incident
Insufficient information to determine if guideline followed	The report lacks sufficient detail to determine whether guideline use contributed to the incident
Does not relate to a medication incident	The report describes an incident that does not relate to the use of medication

Table S3: the number of HTA step discrepancies associated various types of medication error.

HTA step	Adverse drug reaction	Contra-indication	Expired medicine	Omitted medicine	Patient allergic	Wrong/unclear dose or strength	Wrong formulation	Wrong frequency	Wrong medicine	Wrong method of preparation	Wrong patient	Wrong/omitted patient directions	Wrong quantity	Wrong route	Other or unknown
Step 1 – find the right guideline(s)	5	14	2	23	0	75	10	27	18	18	4	1	28	8	67
Step 2 – find all relevant information within the guideline(s)	3	19	0	13	2	53	5	9	9	8	0	2	11	6	26
Step 3 – read and correctly use all relevant information	1	4	0	14	0	56	11	18	4	6	2	1	21	3	35
Total	9	37	2	50	2	184	26	54	31	32	6	4	60	17	128

HTA = hierarchical task analysis

Table S4: medicines associated HTA step discrepancies.

Medicine	Number of associated HTA step discrepancies
Gentamicin	38
Insulins	32
Heparin, vancomycin	19
Paracetamol	18
Dalteparin	17
Enoxaparin	16
Ceftriaxone	14
Amiodarone, morphine	13
Parenteral nutrition	12
Potassium chloride, teicoplanin	11

Glucose	10
Aspirin	9
Phenytoin, piperacillin and tazobactam	8
Cefotaxime, dinoprostone, human normal immunoglobulin, warfarin	7
Acetylcysteine, adrenaline, amoxicillin, hydrocortisone, labetalol, magnesium sulphate, rivaroxaban	6
Benzylpenicillin, co-trimoxazole, methadone, sodium bicarbonate, tinzaparin	5
Aciclovir, amikacin, clindamycin, fentanyl, IV fluids, midazolam, naloxone, octreotide, phytomenadione, salbutamol, sodium chloride	4
Antibiotics, calcium gluconate, ciprofloxacin, desmopressin, digoxin, ferric carboxymaltose, folic acid, glyceryl trinitrate, human albumin, hydralazine, levomepromazine, meropenem, metoclopramide, omeprazole, oxycodone, phosphates, tobramycin, zoledronic acid	3
Aminophylline, amphotericin, artemether and lumefantrine, carboplatin, caspofungin, cefuroxime, clopidogrel, dexamethasone, dexmedetomidine, diamorphine, diazepam, diclofenac, doxycycline, enteral feed, flucloxacillin, Hartmann's solution, hepatitis b immunoglobulin, hyoscine butylbromide, influenza vaccine, levonorgestrel, lidocaine, lorazepam, methylprednisolone, metoprolol, misoprostol, nivolumab, ondansetron, pantoprazole, phenobarbital, posaconazole, pregabalin, ranitidine, risperidone, romiplostin, tranexamic acid, vitamin k, voriconazole	2
Alemtuzumab, alfentanil, alglucosidase alfa, alimemazine, alteplase, anti-d immunoglobulin, antithymocyte immunoglobulin (rabbit), apixaban, aprotinin, argatroban, aripiprazole, atenolol, atorvastatin, azithromycin, aztreonam, baricitinib, Beriplex, bleomycin, calcium chloride, calcium folinate, captopril, cefalexin, ceftazidime, cetirizine, chemotherapy, chloramphenicol, ciclosporin, co-amoxiclav, codeine, colistimethate, cyclophosphamide, dabigatran, daptomycin, daunorubicin, demeclocycline, dihydrocodeine, dinutuximab, docetaxel, dopamine, edoxaban, epoprostenol, ertapenem, erythromycin, ethambutol, felodipine, ferric derisomaltose, filgrastim, flumazenil, flupentixol, fondaparinux, fosfomycin, furosemide, gabapentin, Gelofusine, high purity factor VIII, hydromorphone, hydroxocobalamin, ibuprofen, ipilimumab, ipratropium, iron sucrose, isoprenaline, isosorbide dinitrate, ketamine, ketoralac, LAT gel, levofloxacin, levosimendan, linezolid, liothyronine, lisinopril, lithium, mannitol, meptazinol, mesalazine, methotrexate, metronidazole, mexiletine, monteleukast, nerve block, nifedipine, nitrofurantoin, noradrenaline, Nutrison energy, nystatin, ofloxacin, oxytocin, paliperidone, palivizumab, pamidronate, pentoxifylline, Pepti-Junior, Plasma-Lyte 148, prochlorperazine, prokinetics, promethazine, propranolol, quetiapine, raltegravir, rituximab, salbutamol and ipratropium, sarilumab, saxagliptin, sildenafil, sodium dihydrogen phosphate, sodium nitropursside, sodium thiosulphate, somatropin, tacrolimus, thickening products, tocilizumab, urokinase, ustekinumab, valganciclovir, vasopressin, vecuronium, vincristine, vitamin D, Voncento, water for injections, zidovudine, zuclopentixol decanoate	1

Some discrepancies were associated with more than one medicine.