HEALTH INNOVATION SERIES

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e-Medication Safety

A compilation of the Health Innovation Series - Issues 1-17

Evidence based recommendations to improve care delivery and outcomes

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Health Innovation Series

The Health Innovation Series communicates research evidence in an easy-to-read, short format with clear recommendations, covering a wide range of topics. This compilation includes Issues 1-17 on e-Medication Safety topics. New Issues are released regularly on our website or sign up to receive the links to your inbox.

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e-Medication Safety topics

Digital health systems are the cornerstone of high-quality care with expectations growing from consumers and the health system for highly integrated systems that support timely access to information, safe medication management and efficient work processes. The e-Medication Safety series provides targeted recommendations, making clear how to improve user satisfaction and patient outcomes through enhanced system usability, increased adherence to clinical guidelines and fewer medication errors.

The recommendations are based on research evidence derived from empirical studies, such as those assessing medication and technology-related errors, direct observational studies of clinical work, usability assessments, trials of digital interventions, conducted in a variety of care settings including paediatric and adult hospitals, and residential aged care.

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Disclaimer: These recommendations are based on issues identified during various programs of research undertaken by Macquarie University. They are not intended to be an exhaustive list and should be considered by individual care settings for appropriateness prior to implementation. A more detailed review of the issue and impact may also be warranted. The content of this document is intended for information purposes only.

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How to use the Health Innovation Series

The recommendations are based on research evidence derived from empirical studies, such as those assessing medication and technology-related errors, direct observational studies of clinical work, usability assessments, trials of digital interventions, conducted in a variety of care settings including paediatric and adult hospitals, and residential aged care.

	Share with teams in your organisation to assess the applicability of each recommendation to your organisation: • health service managers and leaders • clinicians • medication safety teams • IT teams
	Identify strategies to address recommendations to improve your service.
	Prior to implementation, consider the following: These recommendations are based on issues identified during various programs of research undertaken by Macquarie University. They are not intended to be an exhaustive list and should be considered by individual care settings for appropriateness prior to implementation. A more detailed review of the issue and impact may also be warranted. The content of each issue is intended for information purposes only.
	When action is required, set a reasonable time for completion.
	Evaluate the results of the implementation.
	Reconvene to review success of implementation and modify as needed.

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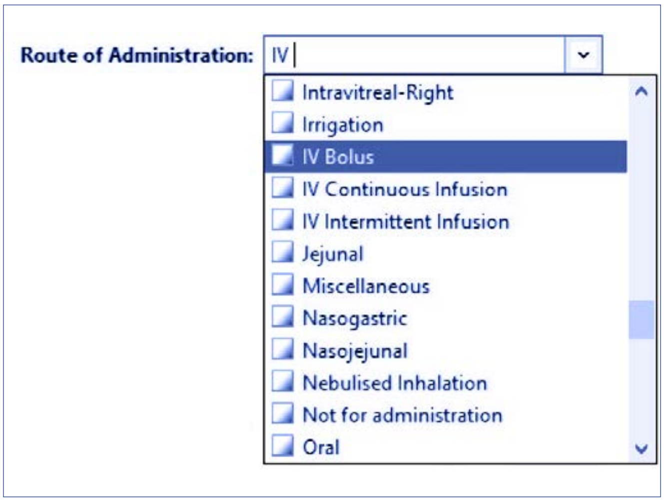
Prescribing an IV in an electronic medication system – What could possibly go wrong?



Electronic medication systems (EMS) may offer a range of options for the intravenous (IV) route, including IV bolus (i.e. rapid IV injection). However, IV bolus may be contraindicated for some medication, or is used only in specialised settings. Giving a prescriber IV bolus as a route option in the EMS can lead to selection of IV bolus when it is contraindicated.

Digital systems can be optimised to reduce this risk.

SYSTEM OPTIMISATION TIP#1

Remove IV bolus route option for medication where IV bolus is not recommended or contraindicated (see Tables 1 and 2).

SYSTEM OPTIMISATION TIP#2

For medication where IV bolus is only used in specialised settings or at specific doses: drop-down menus for route selection should not default to IV bolus; and IV bolus should not be the first option on the drop-down menu (see Table 3).

USER TIP

Consider the medication and context, and check local practice before selecting an IV route.

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Table 1. Examples of medication not recommended or contraindicated for IV bolus administration

MEDICATION	ISSUES WITH IV BOLUS ROUTE
Aciclovir	May cause renal tubular damage.
Ciprofloxacin	Rapid administration may increase risk of local reactions (e.g. thrombophlebitis, burning, pain, pruritus, paresthesia, erythema, swelling).
Clindamycin	May cause hypotension and cardiac arrest.
Infliximab	Slower rates needed due to risk of anaphylaxis and infusion reactions.
Metronidazole	Limited data - not recommended for rapid IV.
Paracetamol	Only available in volumes suitable for infusion.
Vedolizumab	Slower rates needed due to risk of infusion reactions.
Vancomycin	Increased risk of red man syndrome.

Table 2. Examples of medication not recommended or contraindicated for IV bolus administration in paediatric patients

MEDICATION	ISSUES WITH IV BOLUS ROUTE IN PAEDIATRIC PATIENTS
Phenobarbital (phenobarbitone)	Rapid administration may cause respiratory depression, apnoea, laryngospasm, or hypotension.
Piperacillin + tazobactam	May cause hypotension and thrombophlebitis.

Table 3. Examples of medication for which IV bolus injection is only recommended in specialised settings or at specific doses

MEDICATION
Gentamicin, Levetiracetam, Phenytoin, Tobramycin, Sodium Chloride 3% and other Hypertonic Salines

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Suggested citation: Raban MZ, Merchant A, Westbrook JI. Prescribing an IV in an electronic medication system. What could possibly go wrong? Health Innovation Series e-Medication Safety Issue 1 2022. Sydney: Macquarie University; 2022 . https://doi.org/10.25949/N04Z-4Y85

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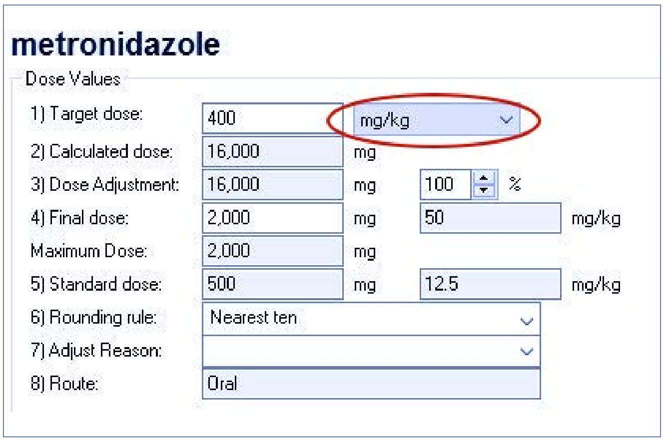
Caution: editing within a dose calculator can result in large dose errors

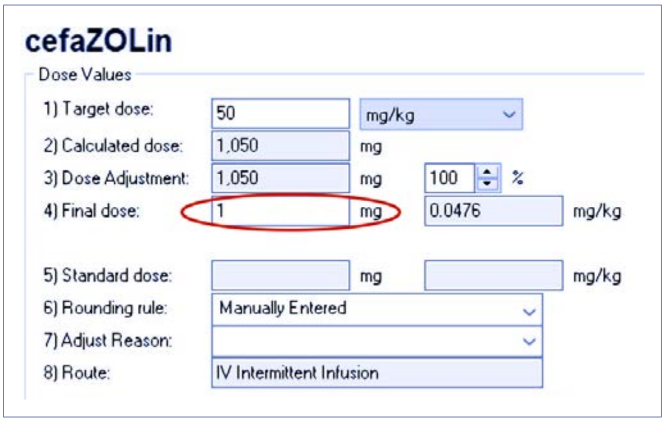
Dose calculators are helpful tools for prescribing, particularly in the paediatric setting. However, errors can occur when prescribers edit fields incorrectly within a dose calculator.

Example 1: Metronidazole for a paediatric patient



In this first example, the dose calculator provides a total metronidazole dose of 500mg (12.5mg/kg for a 40kg child). The prescriber attempts to change the dose to 400mg (one tablet) by editing the target dose field; however fails to note the mg/kg units, creating a final calculated dose of 16,000mg. The dose calculator prevents this dose being prescribed due to a dose limit of 2,000mg, however this was still higher than the intended dose.

Example 2: Cefazolin for a paediatric patient



In this second example, the prescriber edits the final dose down from 1,050mg to 1g, however does not take into account that the units were recorded in mg, thus creating a 1,000-fold underdose.

USER TIP

Exercise caution when editing within a dose calculator. Check the final total dose and dose units before signing the prescription.

Suggested citation: Merchant A, Raban MZ, Westbrook JI. Caution: editing within a dose calculator can result in large dose errors. Health Innovation Series e-Medication Safety Issue 2 2022. Sydney: Macquarie University; 2022. https://doi.org/10.25949/MWNH-P929

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Double dose trouble: systemic intranasal medication– Can you spot the problem?

The drop-down menu for midazolam (see Screenshot 1) contains numerous options including the route 'Intranasal-Both'. However using the route 'Intranasal-Both' potentially doubles the dose.

An intended dose of 0.5mg/kg given in one nostril (once), can easily become a dose given in both nostrils to total 1mg/kg.

Local protocols may vary however reviewing the use of 'Intranasal-Both' for specific medication is recommended.

Alternatively, to prevent potential confusion, consider using a route specifying a single nostril when appropriate (see Screenshot 2).

Screenshot 2. Desmopressin order sentences including intranasal route

desmopressin 10 microg/inh nasal spray
desmopressin 10 microg/inh nasal spray
1 microg, Intranasal-Left, daily
desmopressin 10 microg/inh nasal spray
2 microg, Intranasal-Left, daily

Screenshot 1. Midazolam order sentences

midazolam 0.3 mg/kg, Buccal, ONCE, Seizures/status epilepticus
midazolam 0.2 mg/kg, Intramuscular, ONCE, PRN sedation
midazolam 0.1 mg/kg, IV Bolus, ONCE, Sedation/seizures
midazolam 0.15 mg/kg, IV Bolus, ONCE, Status epilepticus
midazolam 0.5 mg/kg, Intranasal-Both, ONCE, Seizures/status epilepticus

SYSTEM OPTIMISATION TIP#1

Remove the route 'Intranasal-Both' for systemic medication administered via intranasal route (e.g. midazolam nasal inhalation, fentanyl nasal spray) from drop-down menus and order sentences.

SYSTEM OPTIMISATION TIP#2

To prevent potential confusion, use a route specifying a single nostril when appropriate (see Screenshot 2).

USER TIP

Do not use 'Intranasal-Both' for systemic intranasal medication.

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Suggested citation: Merchant A, Fitzpatrick E, Westbrook JI, Raban MZ. Double dose trouble: systemic intranasal medication. Can you spot the problem? Health Innovation Series e-Medication Safety Issue 3 2022. Sydney: Macquarie University; 2022. https://doi.org/10.25949/PRND-F975

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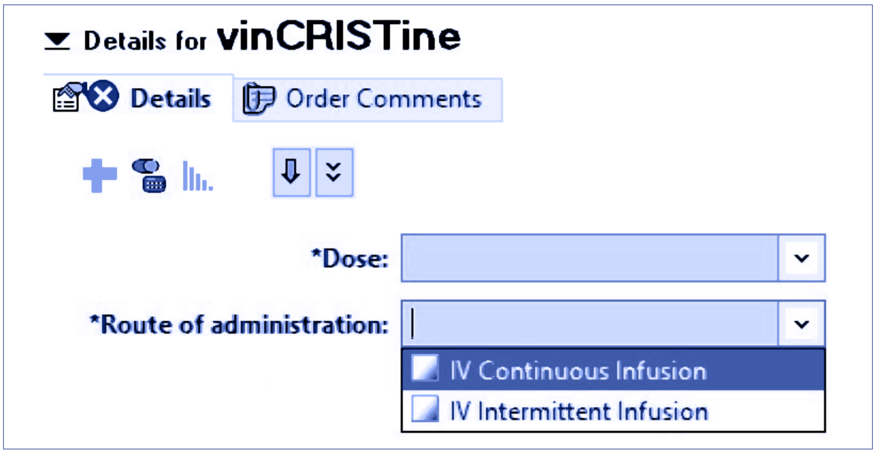
Preventing dangerous intraspinal injections

The Institute for Safe Medication Practices has recently highlighted the issue of accidental tranexamic acid administration via intraspinal injection. Intraspinal injection of tranexamic acid results in severe patient harm with a mortality rate of 50%.

Intrathecal administration is contraindicated for the vinca alkaloids vinblastine, vincristine and vinorelbine. They are for intravenous use only and are fatal if given by other routes.



Screenshot: Restricted route options for vincristine

SYSTEM OPTIMISATION TIP#1

Remove any intraspinal route options (e.g. intrathecal, epidural etc) for tranexamic acid.

SYSTEM OPTIMISATION TIP#2

Remove all route options apart from IV continuous infusion and IV intermittent infusion for vinca alkaloids.

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Suggested citation: Raban MZ, Merchant A, Fitzpatrick E, Westbrook JI. Preventing dangerous intraspinal injections. Health Innovation Series e-Medication Safety Issue 4 2022. Sydney: Macquarie University; 2022. https://doi.org/10.25949/dy3f-pa76

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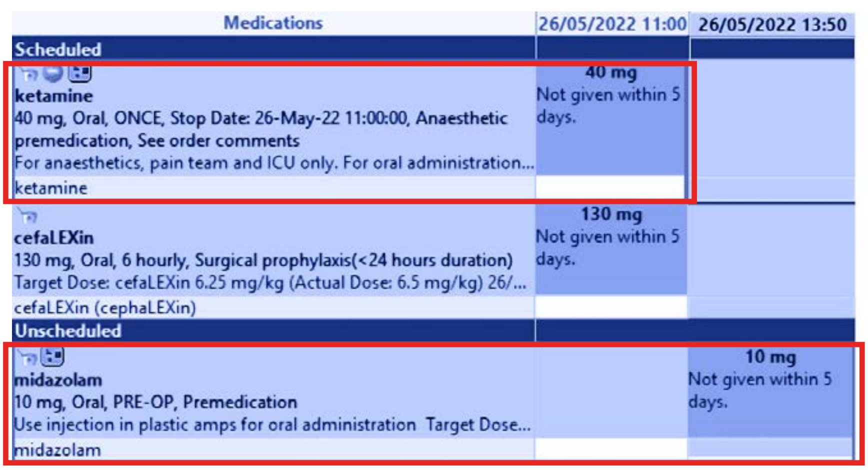
Pre-operative medication frequencies matter

Electronic medication systems can display multiple frequency options when prescribing. Pre-operative medications (e.g. midazolam, ketamine, paracetamol) are often administered at the same time prior to a procedure, and there may be medications to be administered together after the procedure. Use of different frequencies for each medication can result in the medication orders appearing in different sections of the electronic medication administration record and having different suggested administration times (see example). This can lead to a medication not being administered at the required time or being omitted.

SYSTEM OPTIMISATION TIP#1

Ensure orders for medications to be administered at the same time are assigned the same frequency e.g. 'PRE-OP'

Example: Pre-operative orders for ketamine and midazolam displayed on different sections of the administration record



- Pre-operative ketamine and midazolam are to be administered together.
- The ketamine order has the frequency 'ONCE'.
- The midazolam order has a frequency of 'PRE-OP'.
- As a result, the two orders appear in different sections of the record, with different administration time prompts.
- Similar issues may occur with the use of the frequencies 'POST-OP' vs 'ONCE'.

Suggested citation: Raban MZ, Merchant A, Fitzpatrick E, Westbrook JI. Pre-operative medication frequencies matter. Health Innovation Series e-Medication Safety Issue 5 2022. Sydney: Macquarie University; 2022. https://doi.org/10.25949/7yc3-a257

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Accidental prescribing of extended-release opioids

Errors with the prescribing of extended-release opioids in opioid-naïve patients have led to serious patient harm. These errors are number one in the Institute for Safe Medication Practices Top 10 Medication Errors and Hazards from 2020.

To avoid inadvertent selection of fentanyl patches, these should appear below other preparations or be differentiated in the drop-down menu. The example below shows how this can be done. The order sentence has the warning "Do NOT use on opioid naïve patients". High risk medicine order sentences can be further differentiated using coloured font.

SYSTEM OPTIMISATION TIP#1

Change the display of opioid order sentences so that extended-release preparations are not listed first and/or are differentiated.

Example: Order sentence display for fentanyl with information to avoid use of patches in opioid naïve patients

fentanyl
fentanyl 12 microg/hr transdermal modified release patch
fentanyl 12 microg/hr transdermal modified release patch
    1 patch(es), Transdermal, 72 hourly, Modified Release, Persistent Pain, Do NOT use on opioid naive patients
fentanyl 25 microg/hr transdermal modified release patch
fentanyl 25 microg/hr transdermal modified release patch
    1 patch(es), Transdermal, 72 hourly, Persistent Pain, Do NOT use on opioid naive patients
fentanyl 50 microg/hr transdermal modified release patch
fentanyl 50 microg/hr transdermal modified release patch
    1 patch(es), Transdermal, 72 hourly, Modified Release, Persistent Pain, Do NOT use on opioid naive patients
fentanyl 75 microg/hr transdermal modified release patch
fentanyl 75 microg/hr transdermal modified release patch
    1 patch(es), Transdermal, 72 hourly, Modified Release, Persistent Pain, Do NOT use on opioid naive patients
fentanyl 100 microg/hr transdermal modified release patch
fentanyl 100 microg/hr transdermal modified release patch
    1 patch(es), Transdermal, 72 hourly, Modified Release, Persistent Pain, Do NOT use on opioid naive patients
fentanyl additive
fentanyl additive microg, microg/kg/hr
fentanyl injection
fentanyl injection 0.5 microg/kg, IV Bolus, ONCE, Load: Analgesia
fentanyl nasal spray

SYSTEM OPTIMISATION TIP#2

Further actions may include:

- Default to the lowest initial starting dose and frequency on initiation
- Interactive decision support to confirm opioid tolerance

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Suggested citation: Merchant A, Fitzpatrick E, Westbrook JI, Raban MZ. Accidental prescribing of extended-release opioids. Health Innovation Series e-Medication Safety Issue 6 2022. Sydney: Macquarie University; 2022. https://doi.org/10.25949/5KA7-AB42

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Dose calculator: Missing in action!

Dose calculators are an important part of computerised decision support built into electronic medication systems to automate the calculation of a medication dose. Some systems, however, unintentionally omit applying the dose calculator to less common units such as mL/kg. Without the use of a dose calculator, errors can occur, particularly in paediatrics where medications are prescribed and administered according to body weight.

The 'missing dose calculator' scenario can occur because electronic medication systems are programmed to only trigger the dose calculator for specific units of medication e.g., mg/kg, microgram/kg or mg/m^2. In some systems, the automatic trigger may not be applied to less commonly used units such as mL/kg. Example 1 below, shows two orders where the dose calculator was not triggered because the prescriber used mL/kg. As a result, neither of the medication orders have a final total dose to be administered. Example 2 shows the same orders, when the dose calculator has been triggered, allowing the total dose to be displayed.

Example 1: Two orders with no total dose calculated, as 'mL/kg' did not trigger the dose calculator

Medications	26/05/2022 14:14	26/05/2022 20:00
Scheduled		
lactulose 1 mL/kg, Oral, BD, DIOS		**1 mL/kg**
lactulose		
PRN		
PRN **adrenaline (epinephrine) (adrenaline (epinephrine) 1 mg/mL (1:1000) ...** 0.01 mL/kg, Intramuscular, ONCE, PRN anaphylaxis, anaphylaxis, Administer in thigh May be repeated every 5 minutes until there is clinical improvement	**0.01 mL/kg**	
adrenaline (epinephrine)		

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Example 2: Two orders where the use of the dose calculator resulted in the total dose displayed

Medications	26/05/2022 14:14	26/05/2022 20:00
Scheduled		
lactulose 20 mL, Oral, BD, DIOS Target Dose: lactulose 1 mL/kg (Actual Dose: 1 mL/kg) 06/12/2022 07:06:...		20 mL
lactulose		
PRN		
PRN **adrenaline (epinephrine) (adrenaline (epinephrine) 1 mg/mL (1:1000)...** 0.2 mL, Intramuscular, ONCE, PRN anaphylaxis, anaphylaxis, Administer in thigh May be repeated every 5 minutes until there is clinical improvement Tar...	0.2 mL	
adrenaline (epinephrine)		

SYSTEM OPTIMISATION TIP#1

Ensure all units requiring the dose calculator are added to the rule to trigger the dose calculator.

SYSTEM OPTIMISATION TIP#2

Check the unit 'mL/kg' is included in the rule to trigger the dose calculator.

USER TIP #1

When prescribing, check that the total dose is displayed in the order.

Suggested citation: Merchant A, Raban MZ, Fitzpatrick E, Westbrook JI. Dose calculator. Missing in action! Health Innovation Series e-Medication Safety Issue 7 2022. Sydney: Macquarie University; 2022. https://doi.org/10.25949/W6VS-DD62

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Can’t find a medication in the electronic medication system? How to prevent errors and user frustration

When medications are difficult to find in an electronic medication system, errors can occur, users become frustrated and prescribing is less efficient. Here are tips that will reduce these risks.

Understanding why some medications can be difficult to find is useful for averting errors.

Across many jurisdictions, medication names and spellings are being changed to align with the international harmonisation of ingredient names (see examples in Table 1). Clinical staff may also sometimes use brand names for medication, despite the use of generic names being preferred practice in most cases.

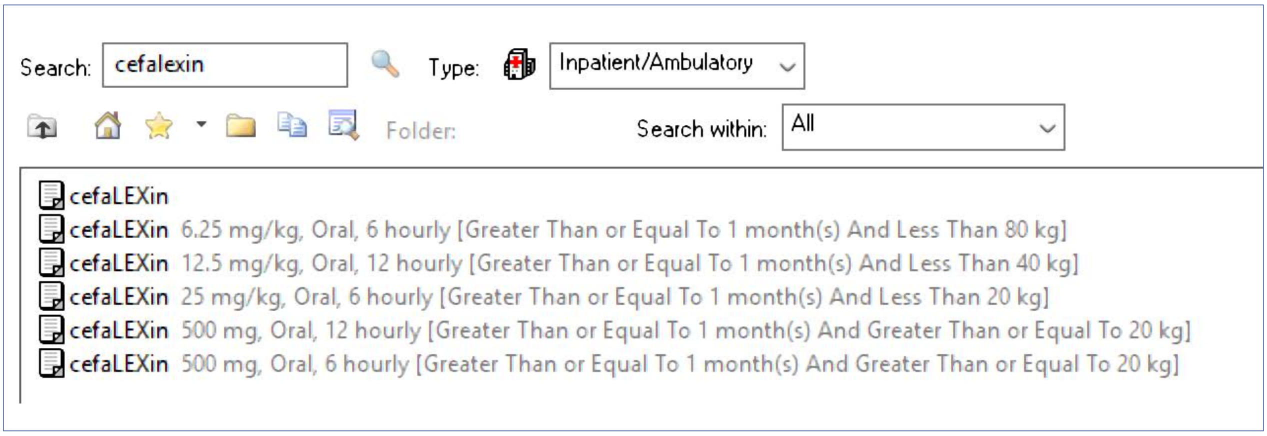
Table 1: Examples of spelling changes and alternate name presentations

Examples of spelling changes	Examples of alternate name presentations
• cephalexin to cefalexin • magnesium sulphate to magnesium sulfate • cyclosporin to ciclosporin	• vasopressin and argipressin • valproate and sodium valproate • hexamine hippurate and methenamine hippurate • thiopentone and thiopental • folinic acid versus calcium leucovorin versus calcium folinate versus folinic acid calcium

Example 1 shows what can happen when a prescriber uses an alternate medication spelling. Here are the options presented to a prescriber when ordering cephalexin versus cefalexin.

Example 1:

a. Typing in ‘cefalexin’ provides users with the intended cefalexin order sentence results.



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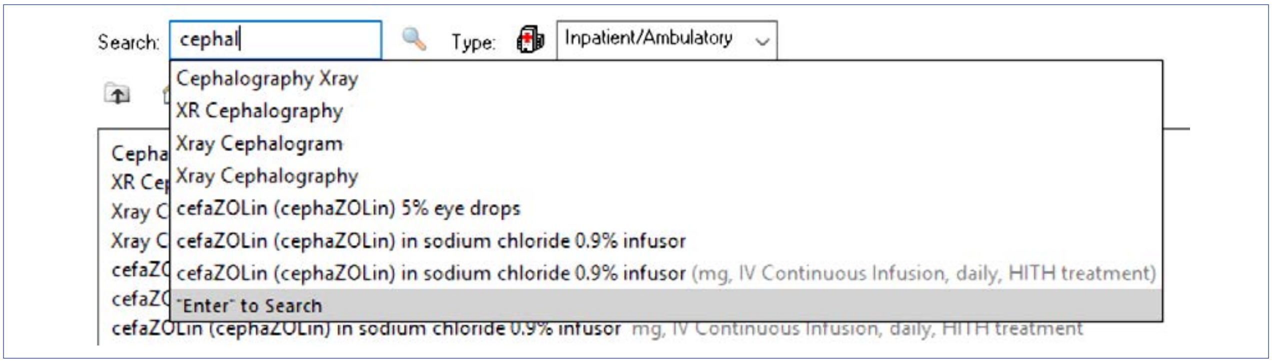
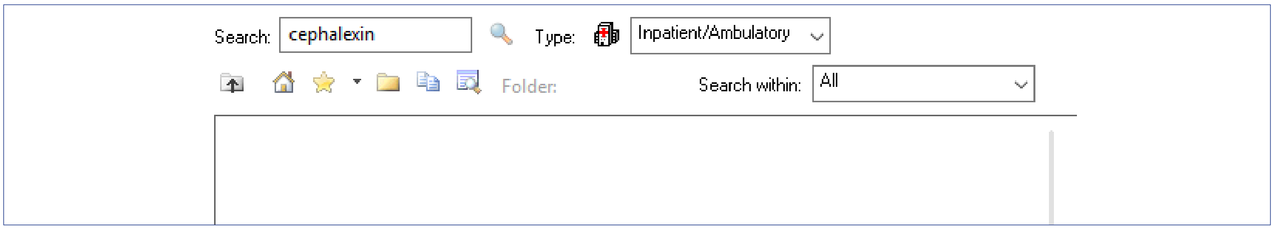
b. Partially typed 'cephalexin' (instead of 'cefalexin') presents users with incorrect results.



c. 'Cephalexin', typed in full, retrieves no results.



Predictive search functionality, as shown in Example 1b, where options are presented to users when only partial drug names are entered can increase the likelihood of error by showing a range of similar but incorrect options. Users may inadvertently be tempted to select one of these incorrect options.

Users unable to find a medication are also more likely to add the medication name using free-text. This increases the risk of spelling errors and does not allow the system to apply decision support. Further, the name on the electronic medication chart may not match the medication name on the physical medication pack and thus errors may occur during drug administration. Overall, users unable to find medications may become frustrated and prescribing will be less efficient.

SYSTEM OPTIMISATION TIP#1

Use dual labelling of medication names in the drop-down menu e.g. argipressin (vasopressin)

SYSTEM OPTIMISATION TIP#2

Create a 'signpost' entry, such as "vasopressin – see argipressin", with a rule preventing prescription of the 'signpost' entry

SYSTEM OPTIMISATION TIP#3

Add alternate names or spelling to the comments or instructions field of the order sentence or template so these are visible to nursing and other staff

References

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Suggested citation: Merchant A, Westbrook JI, Fitzpatrick E, Raban MZ. Can't find a medication in the electronic medication system? How to prevent errors and user frustration. Health Innovation Series e-Medication Safety Issue 8 2023. Sydney: Macquarie University; 2023. https://doi.org/10.25949/m2h3-1w46

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Is the rounding rule in your dose calculator causing dose errors in children?

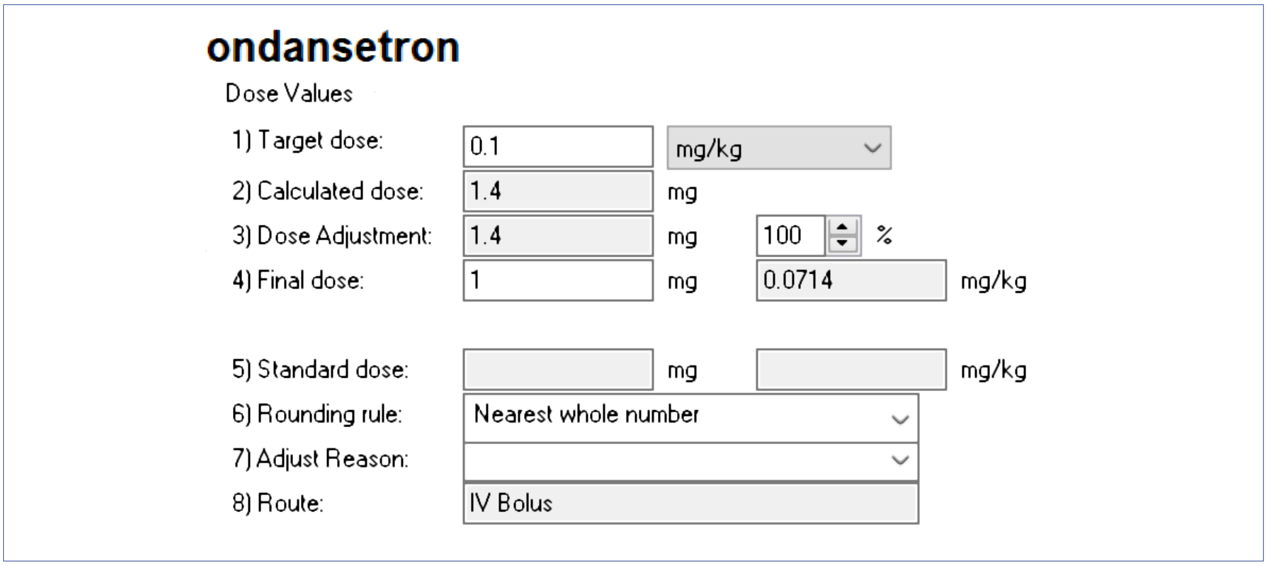
Dose calculators are helpful tools, particularly in the paediatric setting where the majority of medication doses are weight dependent. Calculators can have default rounding rules, which can be useful but can also lead to errors.

A rounding rule in a dose calculator can assist with determining the total dose and rounding a dose to ensure ease of administration, e.g. rounding a paracetamol dose from 495mg to 500mg to be consistent with a 500mg tablet.

While some rounding rules may be suitable when prescribing for adults and older children, these rounding rules may cause unsafe doses for young children of lower weight. For example, if the rounding rule to the "nearest whole number" is used as a default rule for ondansetron, there is the potential for underdosing or overdosing in young children.

In Example 1, for a 14.3kg child with an ondansetron intravenous (IV) target dose of 0.1mg/kg, the dose of 1.4mg will be automatically rounded down to 1mg, resulting in a lower mg/kg dose than intended. Instead of receiving 0.1mg/kg the child would receive 0.07mg/kg, a 30% lower dose than intended.

Example 1: Application of a rounding rule for ondansetron resulting in an underdose for a 14kg child



ondansetron

Dose Values

1) Target dose:	0.1	mg/kg		
2) Calculated dose:	1.4	mg		
3) Dose Adjustment:	1.4	mg	100	%
4) Final dose:	1	mg	0.0714	mg/kg
5) Standard dose:		mg		mg/kg
6) Rounding rule:	Nearest whole number			
7) Adjust Reason:				
8) Route:	IV Bolus			

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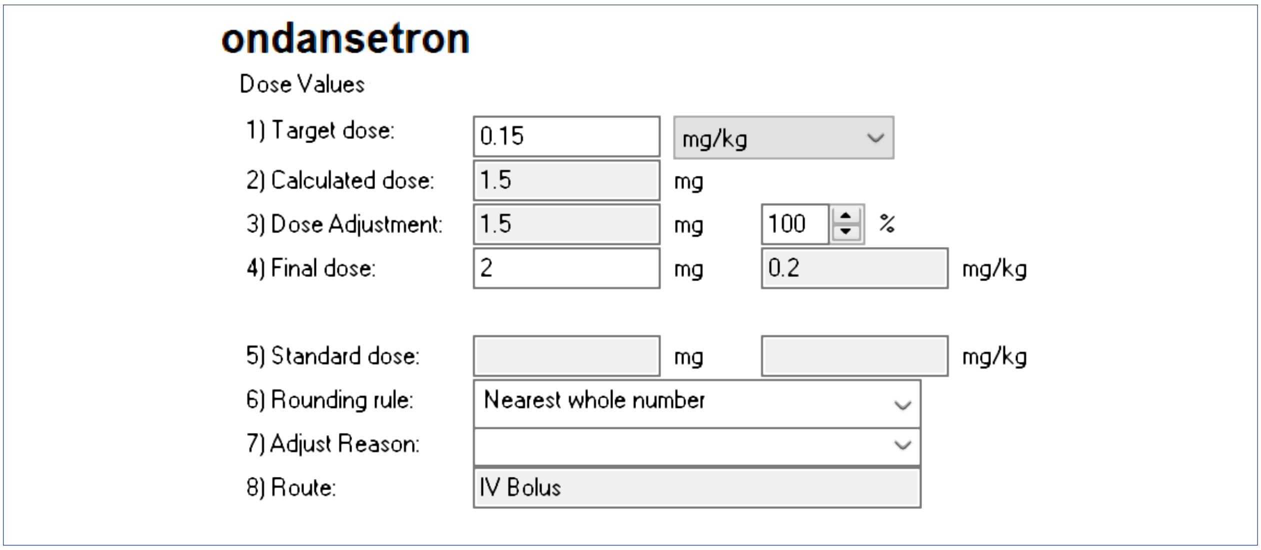
In contrast, in Example 2, a 0.15mg/kg dose in a 10kg child with the same default rounding rule will be rounded up to the nearest whole number. A 1.5mg dose will round up to 2mg (0.2mg/kg), 33% higher than the intended dose.

Example 2: Ondansetron overdose



SYSTEM OPTIMISATION TIP

Choose wisely when selecting default rounding rules for medications, and consider and test the effects on doses for lower weight children.

References

1. AMH Children's dosing companion online [Internet]. Adelaide (AU): Australian Medicines Handbook Pty Ltd; 2022 [cited 2023 Feb 03]. Available from: https://amhonline-amh-net-au/
2. Paediatric injectable medicines handbook [internet]. Westmead (AU): The Children's Hospital at Westmead; 2022 [cited 2023 Feb 03]. Available from: https://pimh.schn.health.nsw.gov.au.acs.hcn.com.au/

Suggested citation: Merchant A, Fitzpatrick E, Raban MZ, Westbrook JI. Is the rounding rule in your dose calculator causing dose errors in children? Health Innovation Series e-Medication Safety Issue 9 2023. Sydney: Macquarie University; 2023. https://doi.org/10.25949/99b1-sk02

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Stop! Is that weight out-of-date?: preventing dose errors in children

A child's weight is important in medication prescribing. Crucially, a child's weight can change in a relatively short period of time, either increasing as they grow, or decreasing with an associated illness.

Medication errors can occur when prescribers rely upon a weight measurement in a patient's medical record that is not current, for example from a previous admission. Errors may also occur when a weight measurement that isn't current is used in a dose calculator.

In example 1, a prescriber has entered a dosing weight of 14kg even though the child's weight during the current admission was 18.7kg. When the patient was admitted in May 2018 they had a weight of 14.3kg. Two years later, during an admission in August 2020, the prescriber inadvertently used the weight from 2018 to calculate a medication dose. The child's actual weight in August 2020 was 18.7 kg, a 25% difference from the dosing weight used by the prescriber.

Example 1: The current patient weight from 2020 is overlooked and the 2018 weight incorrectly used as the dosing weight

Quick View	28/08/2020 09:15 AEST	28/08/2020 09:11 AEST	28/05/2018 12:17 AEST
Height			93.9 cm
Weight		18.7 kg	14.3 kg
Weight Dosing	14 kg		
Weight measure_est	Measured		
Body Surface Area			0.61 m2
Body Mass Index			16.2 kg/m2
BMI Percentile			39.33

Some electronic medication systems require users to enter a 'dosing' weight in the dose calculator. If the 'dosing' weight options displayed include both current and old weights, this may be a source of potential error, as prescribers may input the incorrect weight.

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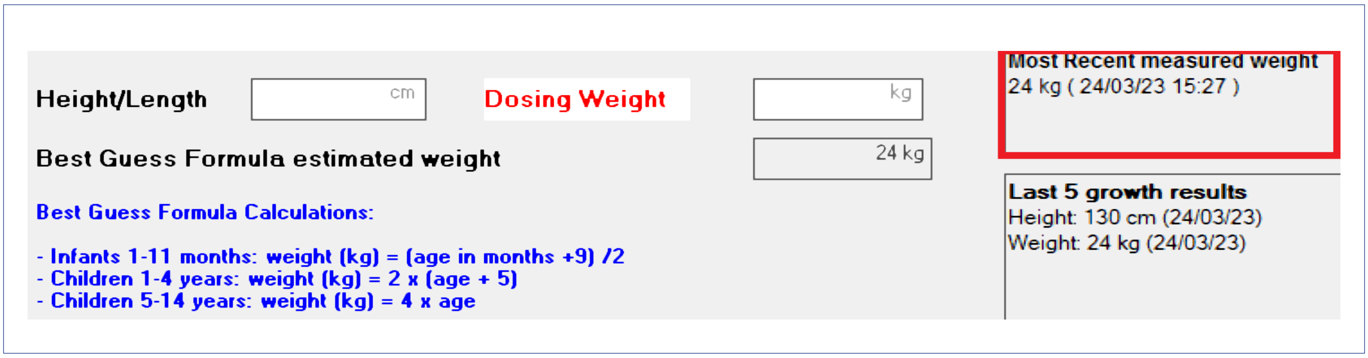
Example 2 below shows a prompt for dosing weight to be entered with only the most recent weight displayed on the screen, which will minimise the risk of prescribers entering an old weight for the child.

Example 2: Dosing weight prompt showing current weight and date of measurement



SYSTEM OPTIMISATION TIP#1

Consider building decision support to alert prescribers to discrepancies between the weight entered in the child's growth chart and the weight entered in the dose calculator.

SYSTEM OPTIMISATION TIP#2

If the system displays weights from previous admissions during prescribing, limit the look back period to avoid unintentional use of out-of-date weight measurements.

USER TIP

If multiple weight measurements are documented, confirm the date of the most recent weight is close to the current date (see example 2).

Suggested citation: Fitzpatrick E, Merchant A, Raban MZ, Westbrook JI. Stop! Is that weight out-of-date?: preventing dose errors in children. Health Innovation Series e-Medication Safety Issue 10 2023. Sydney: Macquarie University; 2023. https://doi.org/10.25949/76Q9-B991

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HEALTH INNOVATION SERIES

Evidence based recommendations to improve care delivery and outcomes

Keeping staff safe when handling hazardous medication – it's not only cytotoxics that are risky

Awareness of the safe handling requirements for cytotoxic medications is high. Our studies observing medication administration, however, have shown that safe handling of non-cytotoxic hazardous oral medications, such as those listed in Table 1, may be overlooked by staff, placing them at risk of exposure to these medications.

Healthcare workers preparing hazardous medication are at risk of ingesting, inhaling or absorbing medication through skin and mucous membranes, if handled incorrectly. Crushing hazardous oral medications can increase the risk of inhalation or skin absorption of fine particles.

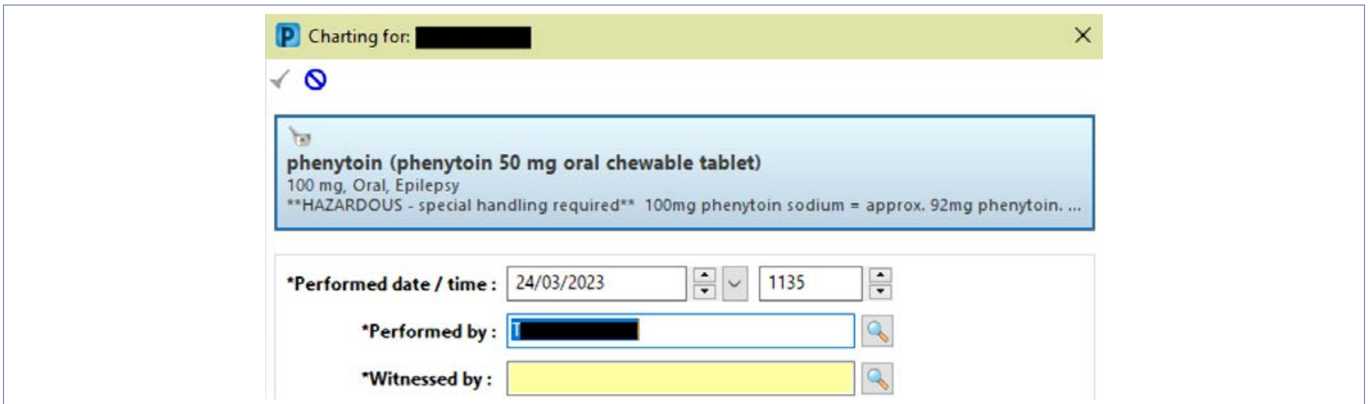
Electronic medication systems (EMS) can alert staff to medication handling risks and provide guidance to keep staff safe. Currently, many systems fail to include safe handling warnings for hazardous non-cytotoxic medications, and thus, should be reviewed and updated. Example 1 shows the addition of a safe handling warning for hazardous non-cytotoxics in an EMS.

Table 1: Examples of oral hazardous non-cytotoxic medication with special handling requirements.

Carbamazepine	**Phenytoin**
Clonazepam	**Sodium Valproate**
Colchicine	**Spironolactone**
Lamotrigine	**Topiramate**
Lisinopril	**Warfarin**
Phenobarbitone	

Note: This list is not intended to be exhaustive and other medications also have hazard warnings.

Example 1: A safe handling warning on an oral phenytoin order



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SYSTEM OPTIMISATION TIP#1

Add safe handling warnings into EMS that will be visible in the EMS during medication administration (e.g. as built-in order comments) for non-cytotoxic hazardous medications. Ideally, this should include the specific safe handling instructions (e.g. wear a mask, gloves and eye protection when crushing).

SYSTEM OPTIMISATION TIP#2

Include a hyperlink to the local safe medication handling reference so that guidelines can be easily accessed during medication administration.

SYSTEM OPTIMISATION TIP#3

Set up a mechanism to ensure that when new medications are added to the healthcare organisation formulary, they are reviewed for occupational exposure risks, and warnings are added to the EMS.

USER TIP

Know where the relevant safe medication handling references can be accessed to reduce occupational exposure risks.

References

1. NIOSH [2020]. NIOSH list of hazardous drugs in healthcare settings 2020. By Connor TH, MacKenzie BA, DeBord DG, Trout DB, O'Callaghan JP, Ovesen JL, Whittaker C. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication Number 2020-xxx (Supersedes 2016-161) Available from: https://www.cdc.gov/niosh/topics/hazdrug/default.html
2. Symons K, Ermer J editors. Don't Rush to Crush, 4th edition. Collingwood: Society of Hospital Pharmacists of Australia; 2021
3. Victorian Therapeutics Advisory Group (VicTAG) Handling of Hazardous Medicines 2021 Available from: https://www.victag.org.au/VicTAG_Handling_of_Hazardous_Medicine_Framework_Nov_2021_Final.pdf

Suggested citation: Woods A, Merchant A, Raban MZ, Fitzpatrick E, Gamboa S, Westbrook JI. Keeping staff safe when handling hazardous medication – it's not only cytotoxics that are risky. Health Innovation Series e-Medication Safety Issue 11 2023. Sydney: Macquarie University; 2023. https://doi.org/10.25949/8RFE-PS46

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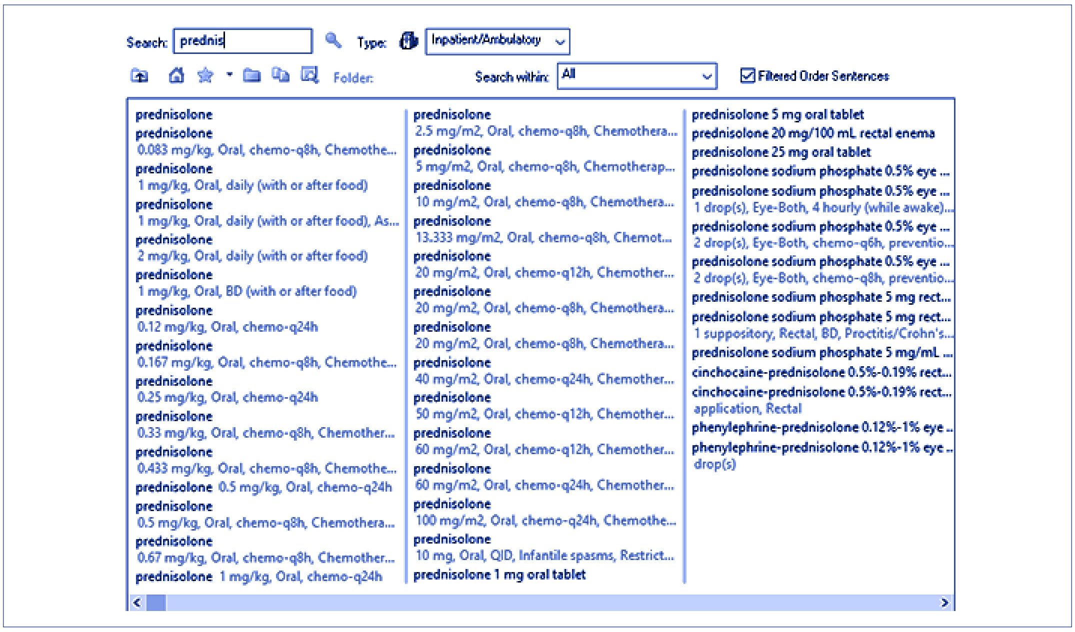
Making order sentences work for you: search tips for prescribers

Electronic medication systems (EMS) can assist prescribers to prevent errors by providing suggested order sentences for common indications. When a drug has multiple uses and comes in different forms, the options displayed in search windows can be difficult to sort through and can lead to users selecting the incorrect option or deciding to prescribe using free-text, which may increase the risk of prescribing errors. Some EMS allow multiple terms to be entered in the search field. By including additional parameters such as indication, route and drug form to the search field, the total number of options displayed may be reduced.

The examples that follow show how the use of additional search terms can improve results, clarifying options for prescribers. Prednisolone has been used to illustrate this.

Example 1: Typing 'prednis' provides users with order sentences for multiple indications, formulations, and routes.



Example 2: The addition of an indication, 'spasm', for 'prednisolone' in the search window reduces the display to a single option.

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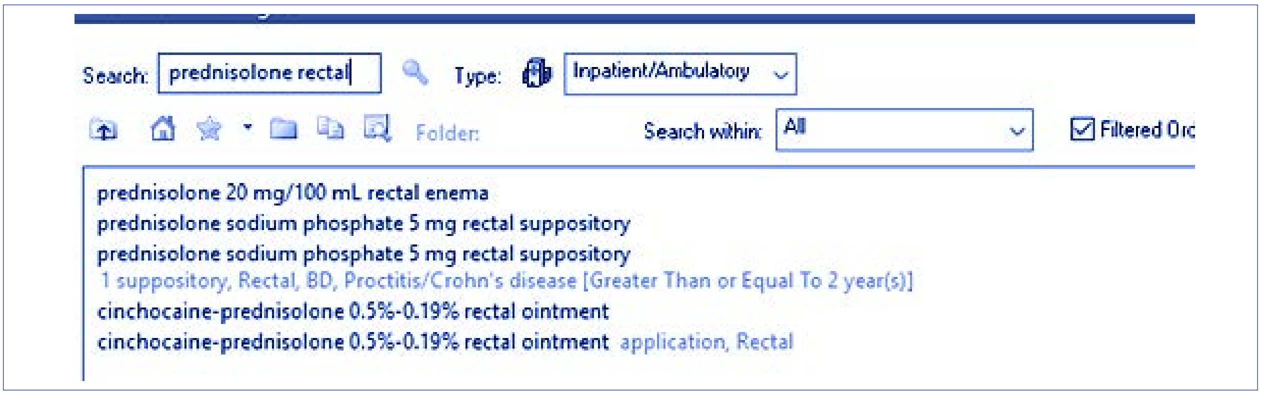
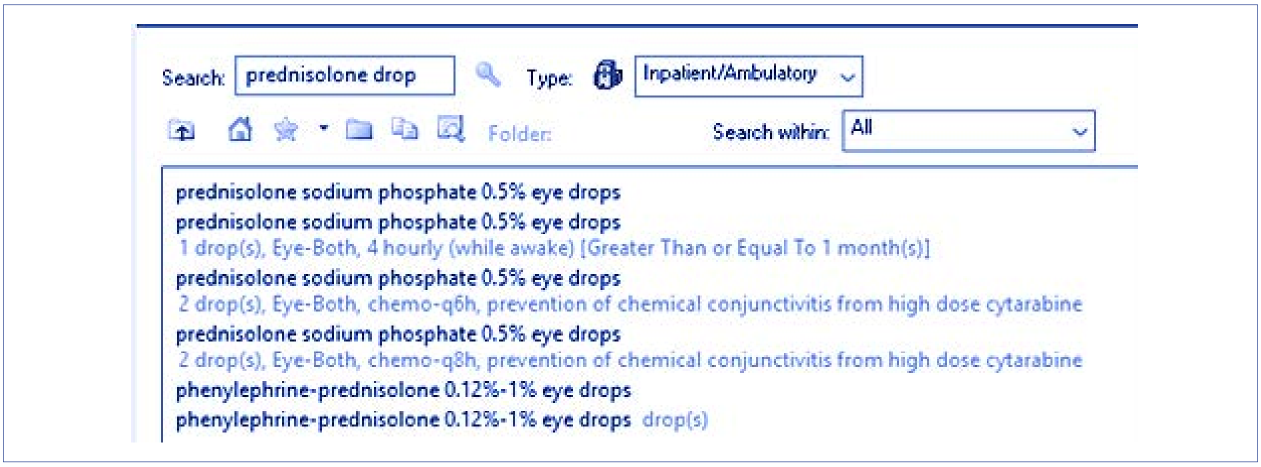
Example 3: The addition of the 'rectal' route in the search field limits the display for prednisolone to orders for rectal use only.



Example 4: The addition of the drug form, 'drop', limits the options for prednisolone to eye drops only.



USER TIP

Where many options are displayed, consider searching with additional terms such as route or indication to minimise the options.

SYSTEM OPTIMISATION TIP

Reduce or hide specialised order sentences from general search fields to minimise options displayed e.g. chemotherapy order sentences should not display for general clinicians.

Suggested citation: Fitzpatrick E, Merchant A, Westbrook JI, Raban MZ. Making order sentences work for you: search tips for prescribers. Health Innovation Series e-Medication Safety Issue 12 2023. Sydney: Macquarie University; 2023. https://doi.org/10.25949/2QEY-3D18

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HEALTH INNOVATION SERIES

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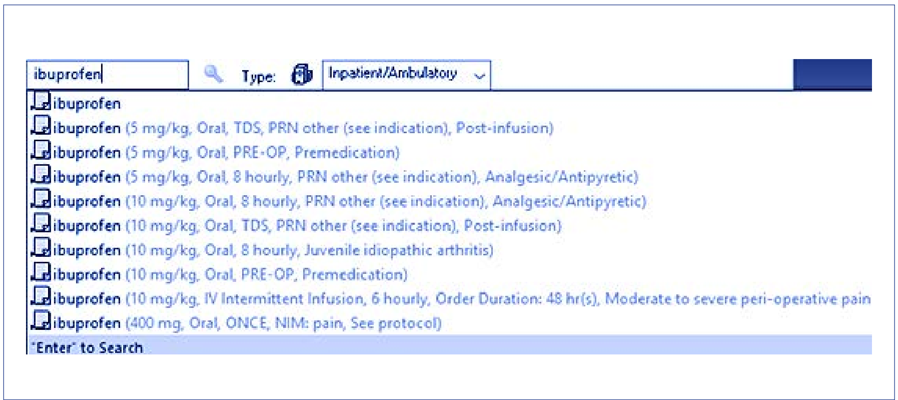
First in line: optimising order sentence display reduces selection errors

The way order sentences display in the search window of an electronic medication system can optimise the prescribing workflow. Evidence suggests that the more options presented to a prescriber in a drop-down menu, the more likely they are to make an error and select the incorrect order. Difficulty in finding a suitable order sentence can also lead to user frustration and prescribers resorting to free-text prescribing, which has been shown to be more error-prone.

Errors in selection and user frustration can be minimised by logically arranging drop-down menu options.

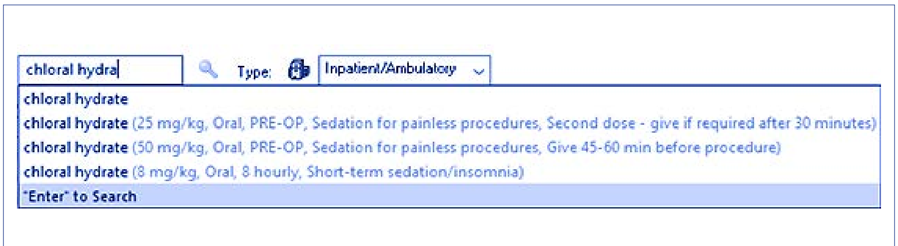
Example 1 shows order sentence options for ibuprofen, which is most frequently used for analgesia or as an antipyretic. However in this example, the order sentences for these indications are displayed below less commonly used order sentences for post-infusion and premedication indications. As a result of this design, orders of ibuprofen intended for pain/fever were prescribed with the indication 'Post-infusion'.

Example 1



Example 2 shows order sentences for chloral hydrate. The order sentence for a second 25mg/kg 'top up' dose of chloral hydrate displays before the initial dose of 50mg/kg dose for sedation. The initial dose is not clearly marked in the order sentence leading prescribers to incorrectly select the 'top up' dose as a primary dose, resulting in an underdose.

Example 2



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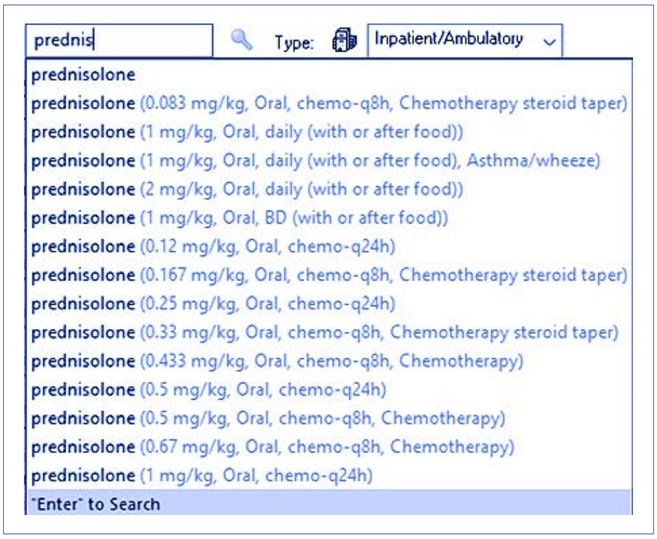
In example 3, the commonly used 1mg/kg and 2mg/kg order sentences for prednisolone are displayed within a list of very specific chemotherapy order sentences, making them difficult to locate. Furthermore, order sentences with the same indication (e.g. chemotherapy steroid taper) are not grouped together which risks the prescriber selecting the first one which appears and missing subsequent options.

Example 3



USER TIP

Where many options are displayed, consider searching using additional terms such as route or indication to minimise the options displayed - see Issue 12 Making order sentences work for you: search tips for prescribers.

SYSTEM OPTIMISATION TIP #1

List more commonly used order sentences first, and group order sentences for the same indications or clinical settings together e.g. pre- and post- operative orders sentences.

SYSTEM OPTIMISATION TIP #2

Regularly audit the use of order sentences for drugs with multiple doses and indications and adjust search result ordering to display most used higher up.

SYSTEM OPTIMISATION TIP #3

Ensure loading doses and sequential doses are clearly indicated in order sentences e.g. before the indication.

SYSTEM OPTIMISATION TIP #4

Where possible, limit order sentences displayed for general prescribing through filtering functions or specialist folders.

References

1. Westbrook JI, Baysari MT, Li L, Burke R, Richardson KL, Day RO. The safety of electronic prescribing: manifestations, mechanisms, and rates of system-related errors associated with two commercial systems in hospitals. J Am Med Inform Assoc. 2013 Nov-Dec;20(6):1159-67. doi: 10.1136/amiajnl-2013-001745. Epub 2013 May 30. PMID: 23721982; PMCID: PMC3822121.

Suggested citation: Fitzpatrick E, Merchant A, Westbrook JI, Raban MZ. First in line: optimising order sentence display reduces selection errors. Health Innovation Series e-Medication Safety Issue 13 2023. Sydney: Macquarie University; 2023. https://doi.org/10.25949/0EFY-SV08

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HEALTH INNOVATION SERIES

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How free-text fields can lead to medication errors

When prescribing in electronic medication systems (EMS), order comment and free-text fields can be useful to communicate additional information about an order. However, incorrect or potentially misleading information in these fields may cause confusion to clinical staff, possibly resulting in errors. Repeated experiences with incorrect or out of date information in free-text fields may lead to nurses ignoring these fields, resulting in pertinent information being missed. Two scenarios follow to illustrate this.

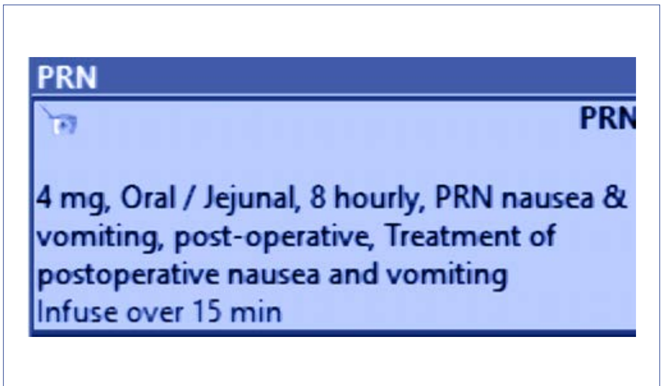
Specificity of information in free-text fields

A major UK inquiry[1] into an incident involving an incorrect dose of dalteparin for a child found that the use of a free-text order comment had contributed to the error. The prescriber used a free text field in an attempt to reassure nurses of the use of the drug dalteparin, which is not commonly prescribed in paediatric patients. The prescriber wrote 'as per discussion with haematology'. This falsely reassured nurses of the dose, which was in fact a 10-fold overdose. Multiple doses were administered to the patient before the error was detected. The inquiry recommended institutions create guidelines standardising the use of free-text fields, including the use of specific information to clearly communicate elements such as dose.

Copying and modifying orders

Copying and modifying previous patient orders may also carry over information in comment fields that is no longer correct. This may lead to errors.

Example 1: An IV order for ondansetron has been modified to be given orally but still contains the free-text infusion instructions from a previous order



Example 2: Copying and modifying the previous order for 40mg of aspirin has resulted in incorrect dilution instructions being carried over to the new order of 60mg

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SYSTEM OPTIMISATION TIP #1

Consider defining the use of free-text fields in prescribing policies and training. The type of information used in free-text fields should be standardised to ensure information is communicated clearly and safely.

SYSTEM OPTIMISATION TIP #2

When an order is modified or copied, prevent the system from copying across free-text fields or prompt the prescriber to check the order comments are still applicable.

USER TIP #1

Consider if a free-text comment is needed or if it has potential to add confusion.

USER TIP #2

If copying or modifying a previous order, check and, if necessary, alter free-text comments carried over from the previous order.

USER TIP #3

If information in order comments or a free-text field is unclear, seek clarification from the prescriber prior to administering the medication.

References

1. Weight-based medication errors in children. United Kingdom: Healthcare Safety Branch (HSIB) 2022. 2023 May 29. Available from: https://hsib-kqcco125-media.s3.amazonaws.com/assets/documents/final-report-weight-based_medication-errors-in-children.pdf

Suggested citation: Fitzpatrick E, Merchant A, Raban MZ, Westbrook JI. How free-text fields can lead to medication errors. Health Innovation Series e-Medication Safety Issue 14 2023. Sydney: Macquarie University; 2023. https://doi.org/10.25949/BEDT-WG68

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Default first dose times can cause deadly double doses

When ordering medication in an electronic medication system, there is usually a default date and time for the first dose which may be easily missed. Failure to check and adjust the default first dose date and time can lead to errors, with the timing of the first dose falling earlier or later than intended.[2] These errors can have catastrophic consequences if they occur for high-alert or high-risk medications (Box 1). Examples 1 and 2 illustrate this issue for two different high-alert medications.

BOX 1 - Definition of high-alert/high-risk medications

"High-alert medications are drugs that bear a heightened risk of causing significant patient harm when they are used in error. Although mistakes may or may not be more common with these drugs, the consequences of an error are clearly more devastating to patients."[1]

Example 1

On admission the prescriber ordered the patient's usual fentanyl 50 microgram transdermal patch every three days. The system default scheduled the first dose administration at 13:46 on Monday. The task fell due immediately, and at 13:46 every three days thereafter. However, the patient's current patch was not due to be removed until 08:00 on Tuesday. This meant the patient was at risk of having two fentanyl patches applied which could cause serious adverse effects, and even death.

Example 2

A phone order was placed for 17 units of insulin once at 07:47, and it was administered soon after. At 08:16 the same prescriber charted a regular ongoing pre-breakfast order of 14 units, intending for it to start the next day. The first dose of this order, however, defaulted in the system to 09:00 the same day, creating a duplicate with the order just given and potentially risking a double dose of insulin.

USER TIP

Check the system default time for the first dose when prescribing and adjust the time of the first dose if needed.

References:

1. ISMP List of High-Alert Medications in Acute Care Settings. ISMP. 2018.
2. Westbrook JI, Baysari MT, Li L, et al. The safety of electronic prescribing: manifestations, mechanisms, and rates of system-related errors associated with two commercial systems in hospitals. J Am Med Inform Assoc 2013;20:1159–1167.

Suggested citation: Merchant A, Fitzpatrick E, Westbrook JI, Raban MZ. Default first dose times can cause deadly double doses. Health Innovation Series e-Medication Safety Issue 15 2023. Sydney: Macquarie University; 2023. https://doi.org/10.25949/H47E-TH56

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HEALTH INNOVATION SERIES

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A mix of prescribing systems may be a recipe for disaster

Medication safety problems can occur when the electronic medication system (EMS) does not cover all areas of a hospital or all medication orders. For example, some specialised prescribing may remain on paper (e.g. patient controlled analgesia and insulin sliding scales). A hospital may also use one EMS on general wards, and a different EMS elsewhere, for example on intensive care units. What results is a hybrid medication system with medication records created and stored in different locations and formats.

Hybrid medication records can lead to errors because a full medication record for each patient is not easily visible to clinical staff.

Example 1 – Omission

Doses of anticoagulation were missed for two days when a patient was transferred from intensive care to a general ward, because medication was not transcribed from the ICU EMS to the ward medication chart.

Example 2 – Duplication

After a patient was transferred from the operating theatre to the ward, the in-theatre intravenous (IV) order for paracetamol was entered into the ward's EMS to reflect a dose given on a paper anaesthetic record during theatre. Once on the ward, oral paracetamol was also prescribed on the EMS, resulting in potential for paracetamol overdosing.

Example 3 – Duplication

A patient was prescribed a fentanyl infusion and oral oxycodone on a paper pain chart. There was no documentation in the EMS to notify users of the paper pain chart. The patient was then prescribed oxycodone in the EMS, resulting in potential for duplication of opioid dosing.

USER TIP#1

Conduct a thorough medication reconciliation on transfer of patients arriving from areas of the hospital that use a different EMS (e.g. from intensive care units or emergency departments).

USER TIP#2

Before prescribing or administering medication, always check you have access to all the patient's medication records and ensure local practices for alerts such as placeholders are used.

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SYSTEM OPTIMISATION TIP#1

Organisations should minimise the time when paper and EMS systems exist together in an organisation due to the risk of errors.

SYSTEM OPTIMISATION TIP#2

Consider building electronic flags or placeholders that can be added to the patient's record when another medication record (e.g. a paper chart) exists for this patient.

SYSTEM OPTIMISATION TIP#3

To ensure continuity of care, administrators should avoid having more than one EMS in the organisation.

SYSTEM OPTIMISATION TIP#4

System developers should include functionality in the EMS that supports use across different levels of care and populations such as intensive care, paediatrics, emergency, and operating theatres.

REFERENCES

1. Westbrook JI, Li L, Raban MZ et al. Short- and long-term effects of an electronic medication management system on paediatric prescribing errors. NPJ Digit Med. 2022 Dec 13;5(1):179. doi: 10.1038/s41746-022-00739-x.

Suggested citation: Merchant A, Fitzpatrick E, Raban MZ, Westbrook JI. A mix of prescribing systems may be a recipe for disaster. Health Innovation Series e-Medication Safety Issue 16 2023. Sydney: Macquarie University; 2023. https://doi.org/10.25949/WN2B-BX78

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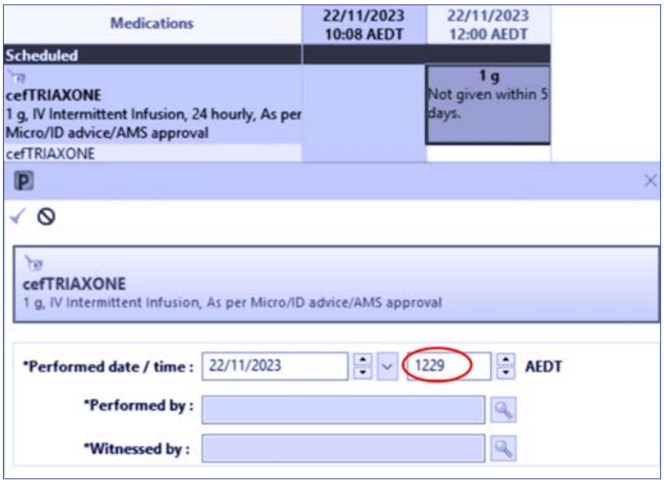
HEALTH INNOVATION SERIES

Evidence based recommendations to improve care delivery and outcomes

Is your administration documentation accurate? Check fields that auto-populate!

Auto-population of information in an electronic medication system (EMS) can be efficient for users. It is important, however, to ensure this information correctly documents what was actually done. A failure to accurately document information before signing off in the medical record may result in delayed or inappropriate treatment and may have medicolegal consequences. Here are three examples where auto-populated EMS fields did not accurately reflect what was actually done.

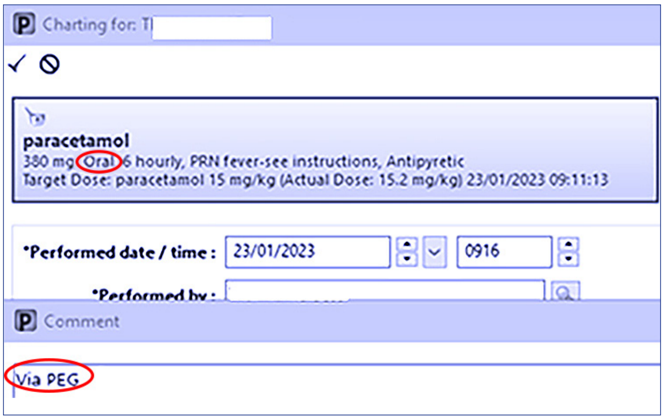
Example 1: Timing defaults



Depending on EMS settings, the medication administration time that is recorded on the medication administration record (MAR) by default may be either the time the EMS scheduled the medication to be given, or the time the administration was documented by staff on the MAR. Both these times may be different to the time the medication was actually administered to the patient.

In example 1, the order was due at 12:00 and administered at 12:05 but the dose was not documented until 12:29. The administration time was auto-populated as 12:29. The administration time needed to be manually changed to 12:05, overriding the auto-populated time generated when the dose was documented.

Example 2: Route defaults



An EMS may auto-populate the route by which a medication was administered when documenting an administration. However, sometimes the actual route of administration may be different to what was ordered.

In example 2, the order was prescribed to be given orally, but was administered via a feeding tube. When signing off on the administration, a comment was added manually to indicate the actual route of administration as this was the only way to document this information. Consequently, there is conflicting information in the record.

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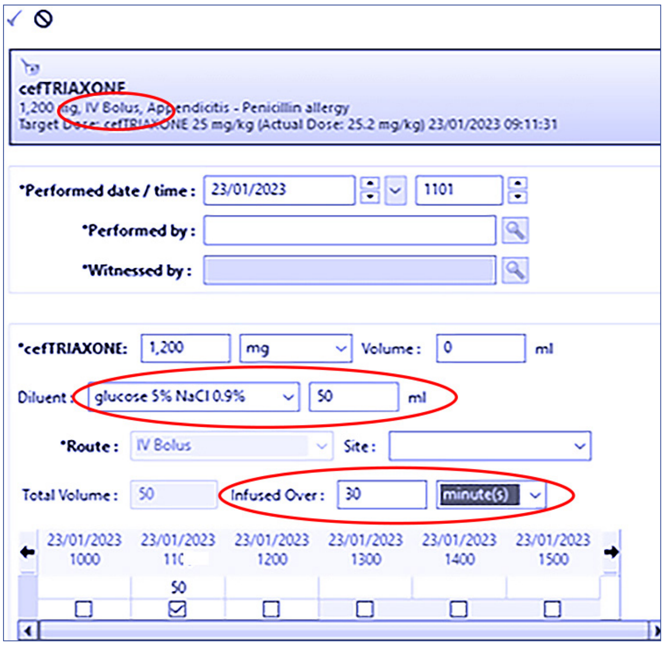
Example 3: Route defaults

In example 3, the medication was administered via an intravenous (IV) infusion, not an IV bolus as on the order. To document the actual method of administration, the rate of infusion or diluent details can be manually added when signing off on the administration. Not providing this information would result in an inaccurate administration record.



SYSTEM OPTIMISATION TIP#1

Ensure that all fields that are auto-populated in the medication administration workflow can be edited to allow users to create an accurate record of medication administration.

SYSTEM OPTIMISATION TIP#2

Users should be made aware of which fields in the medication chart are auto-populated.

USER TIP#1

Ensure all information fields are correct before signing documentation on the medication administration record.

REFERENCES

1. Australian Commission on Quality and Safety in Health Care. Documentation of Information. 2022. https://www.safetyandquality.gov.au/standards/nsqhs-standards/communicating-safety-standard/documentation-information Accessed 27 Jan 2023.

Suggested citation: Fitzpatrick E, Merchant A, Raban MZ, Westbrook JI. Is your administration documentation accurate? Check fields that auto-populate! Health Innovation Series e-Medication Safety Issue 17 2023. Sydney: Macquarie University; 2023. https://doi.org/10.25949/E5OT-VD39

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