Adverse drug events leading to medical emergency team activation in hospitals: what can we learn?

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Adverse drug events (ADEs) raise major concerns in hospital care by causing morbidity and mortality in patients despite active attention to medication safety.[1–3] However, less attention has been paid to ADEs that lead to medication-related rapid response team (RRT) or medical emergency team (MET) activations, even though this kind of data can be very valuable for learning from incidents and understanding the variety of its contributing factors. In this issue of *BMJ Quality & Safety*, Levkovich[4] estimated the incidence and preventability of medication-related MET activations and described the associated adverse medication events. In this editorial, we summarise the key findings from the study, comment on its strengths and recommend further developments in this field of research.

NEW INSIGHTS INTO ADES LEADING TO MET ACTIVATIONS

Levkovich[4] analysed 146 medication-related MET activations in two academic teaching hospitals in Australia. Levkovich performed an observational cohort study using retrospective case review of MET activation forms, medical records and nursing notes. Cardiac arrest and non-inpatient cases were excluded. MET activation reports were used for the blinded review to assess whether the activation was medication-related or not and, if so, the contributing medication, type of adverse medication events, and preventability. Medications were coded using Anatomical Therapeutic Chemical (ATC) categories.[5] Both hospitals met national medication safety standards and used bar code scanning, smart pump technology and drug libraries for infusion administration. In addition, 24/7 RRT/MET alerting system was in use throughout the hospitals, but no automated monitoring or early warning systems were in place.

One-quarter of MET activations involved medications (n=146, 23.2%). These events often occurred early in a patient's admission and 2 days earlier in an admission when compared with non-medication activations. Up to 62% of the medication-related cases were estimated to be potentially preventable. Furthermore, repeated activations were more frequent in medication-related cases (44%) than in non-medication activations (32%, p=0.023).

The most common ADEs leading to potentially preventable MET activations involved tachycardia due to omission of beta-blocking agents (11%), hypotension due to cumulative toxicity (10%) or inappropriate use of antihypertensives (11%). Medication errors (MEs) contributed to over half (81/146, 55.5%) of medication-related MET activations. Errors of omission, especially omissions of cardiovascular system medications (ATC group C), were the most common. Furthermore, MEs involving inappropriate use of cardiovascular medications were common. Of the adverse drug reactions, dose-related (type A) reactions (18.5%) and dose-related and time-related (type C) reactions (17.8%) most often contributed to medication-related MET activations. Moreover, these reactions were most often due to cardiovascular system medications.

CARDIOVASCULAR MEDICATIONS ARE A COMMON CAUSE OF MET ACTIVATIONS

In this study, the most common medications in MET cases were beta-blocking agents and antihypertensives. While intravenous forms of beta-blocking agents are on the widely used high-alert medication

list for acute care settings according to the Institute for Safe Medication Practices,[6] oral beta blockers and other oral antihypertensives are not.[6 7] This is interesting since most of the illustrative examples in this study were related to oral agents. However, a systematic review by Saedder and colleagues[8] identified beta-blocking agents in the top 10 drugs causing fatal MEs and beta-blocking agents and several antihypertensive agents in the top 20 drugs causing hospitalisations, prolonged hospitalisations, life-threatening conditions and disability due to MEs. Gurwitz and colleagues[9] reported in their randomised controlled trial that cardiovascular agents are among the top three causes of ADEs (opioids, cardiovascular agents and anticoagulants); however, the context was postdischarge from the hospital.

It is surprising that well-known, high-alert medications such as anticoagulants and opioids were not commonly involved in MET activations in this study. These have been found in previous studies to be the most common medications among serious ADEs.[8 10 11] The reason for this might be that these serious ADEs are managed differently, for example, with antidotes, before there is a need for a MET. Another potential reason is that cardiovascular medications can cause rapid haemodynamic changes resulting in a MET/RRT activation, whereas anticoagulant and opiate errors typically do not. The third reason might be that cardiac arrest cases were excluded from the sample, resulting in potential medication-related ADEs being omitted from the sample.

IMPLICATIONS FOR PRACTICE: PREVENTING OMISSION ERRORS

An interesting finding by Levkovich[4] was the high number of omission errors of cardiovascular drugs (n=27/92, 29.3%) leading to serious ADEs. Similarly, a previous study by Härkänen and colleagues[10] using voluntarily reported medication-related incident reports that resulted in patient death found that the leading error type behind these serious incidents was omission of drugs. Therefore, more attention should be paid to avoid these errors. Further information regarding omission errors was not addressed in Levkovich's[4] study. This could be due to omission errors in the medication reconciliation process at admission.[12 13] Levkovich[4] reported that clinical pharmacists achieved medication reconciliation rates exceeding 80% in the study hospital within 24 hours of admission, which is exemplary. It is possible that even though medication reconciliation was performed properly, some medication on the list might be intentionally or unintentionally held during the medication management process by the ordering provider. Another issue contributing to omission errors on hospital admissions is the problem of emergency department (ED) crowding and boarding of admitted patients in the ED.[14]

Due to the potential for medication omissions and inappropriate use of high-alert medications, the role of nursing staff in close monitoring of vital measurements (ABCDE and National Early Warning Scores) and timely documentation of fluid balance is pivotal for ensuring the safety of recently admitted patients. Sometimes, omission errors are due to hectic workload in hospitals, staff shortage affecting medication administration and delays in medication dispensing[15]; sometimes, they are due to patients' inability to take the medicine or medication unavailability.[16] Physicians have an equally important role in monitoring recorded vital signs and other clinical changes to identify the deteriorating patient early. Clinical pharmacy services should be available and should concentrate on reconciling and reviewing medications.

While machine learning solutions for earlier identification of the deteriorating patient show promise and have been described,[17] if clinicians do not respond to the identification with action, the potential advances from these predictive algorithms will be compromised. Effort for advanced interventions and research should be put into the automatisation of bedside measuring, documentation and digital data transfer of vital sign measures from the bedside into digital patient records.

NEXT STEPS FOR RESEARCH

Levkovich[4] highlighted a new time point (ie, MET activations) in which to identify opportunities for improvement in medication safety, and it would be interesting to use similar methods in other hospitals and countries to compare the results. The data collection period in the present study was only 3 weeks; therefore, larger data sets would strengthen the findings. Findings related to risks of cardiovascular medications and omission of drugs leading to life-threatening ADEs should be confirmed by other studies. The challenge can be that many countries do not have similar systems to collect information about MET activations, or, if they have, they are not using them to identify quality improvement opportunities for medication safety in their hospitals. MET activations due to cardiac arrests would be interesting to study regarding potential contributing MEs.

CONCLUSION

The study by Levkovich makes a valuable contribution to the literature about the ADEs leading to MET activations. Hospitals, MET leaders and pharmacists can use this information to review their own MET activations and consider interventions to prevent the most common ADEs while simultaneously preventing patient deterioration. Additional studies should be planned to confirm these interesting findings. More attention should be paid to cardiovascular medications and omission errors to avoid serious ADEs in hospitals.

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REFERENCES

1 WHO. Medication Without Harm - Global Patient Safety Challenge on Medication Safety. Geneva: World Health Organization. Available: https://www.who.int/initiatives/medication-without-harm [Accessed 24 Aug 2022].
2 Bates DW, Singh HSafety P, Aff H, eds. *Two decades since to err is human: an assessment of progress and emerging priorities*. 37, 2018.
3 Elliott RA, Camacho E, Jankovic D, *et al*. Economic analysis of the prevalence and clinical and economic burden of medication error in England. *BMJ Qual Saf* 2021;30:96–105.
4 Levkovich BJ. Medication-Related medical emergency team activations: a case review study of frequency and preventability. *BMJ Qual Saf* 2021:014185.
5 World Health organization collaborating centre for drug statistics methodology (WHOCC). anatomical therapeutic chemical classification system, 2018. Available: http://www.whocc.no/atc/structure_and_principles/ [Accessed 21 Sep 2022].
6 Institute for Safe Medication Practices. ISMP list of High-Alert medications in acute care settings. Available: https://www.ismp.org/sites/default/files/attachments/2018-08/highAlert2018-Acute-Final.pdf [Accessed 12 Aug 2022].
7 Australian Commission on safety and quality in healthcare: APINCHS classification of high risk medicines. Available: https://www.safetyandquality.gov.au/our-work/medication-safety/high-risk-medicines/apinchs-classification-high-risk-medicines [Accessed 26 Aug 2022].
8 Saedder EA, Brock B, Nielsen LP, *et al*. Identifying high-risk medication: a systematic literature review. *Eur J Clin Pharmacol* 2014;70:637–45.
9 Gurwitz JH, Kapoor A, Garber L, *et al*. Effect of a multifaceted clinical pharmacist intervention on medication safety after hospitalization in persons prescribed high-risk medications: a randomized clinical trial. *JAMA Intern Med* 2021;181:610–8 https://doi-org.ezproxy.uef.fi:2443/
10 Härkänen M, Vehviläinen-Julkunen K, Murrells T, *et al*. Medication administration errors and mortality: incidents reported in England and Wales between 2007–2016. *Res Social Adm Pharm* 2019;15:858–63.
11 Schepel L, Lehtonen L, Airaksinen M, *et al*. How to identify organizational High-Alert medications. *J Patient Saf* 2021;17:e1358–63.
12 Schepel L, Lehtonen L, Airaksinen M. 'Medication Reconciliation and Review for Older Emergency Patients Requires Improvement in Finland'. *Int J Risk Saf Med* 2019;320:19–31.
13 Lindén-Lahti C, Kivivuori S-M, Lehtonen L, *et al*. Implementing a new electronic health record system in a university hospital: the effect on reported medication errors. *Healthcare* 2022;10:1020.
14 Mohr NM, Wessman BT, Bassin B, *et al*. Boarding of critically ill patients in the emergency department. *Crit Care Med* 2020;48:1180–7.
15 Leite B, Mistro S, Carvalho C, *et al*. Cohort study for evaluation of dose omission without Justification in a teaching General Hospital in Bahia, Brazil. *Int J Qual Health Care* 2016;28:288–93.
16 Shandilya S, Nizamuddin K, Faisal MW, *et al*. Omitted medications: a continuing problem. *Clin Med* 2015;15:12–14.
17 Churpek MM, Yuen TC, Winslow C, *et al*. Multicenter comparison of machine learning methods and conventional regression for predicting clinical deterioration on the wards. *Crit Care Med* 2016;44:368–74.