Retrospective validation of Digital Evaluation of Ketosis and Other Diabetes Emergencies (DEKODE) algorithm: automated auditing system for diabetic ketoacidosis (DKA) management

Authors: Lucretia Thomas,[A] Andrii Kolenysk,[B] Eka Melson,[C] Agnes Johnson,[A] Joht S Chandan,[B] Sandip Ghosh,[B] Parth Narendran[D] and Punith Kempegowda[C]

Introduction

Effective management of diabetic ketoacidosis (DKA) in line with national guidelines improves clinical outcomes and may reduce length of hospital stay.[1] Regular auditing and performance feedback are key to achieving sustained and significant improvement in the management of DKA.[2,3] One of the major limitations for maximal impact of an audit is the delay from initiation to results as the latter may not be applicable to the then current practice. In order to overcome this, our department of diabetes collaborated with the hospital's health informatics team and created an automated auditing system called Digital Evaluation of Ketosis and Other Diabetes Emergencies (DEKODE). This system identifies DKA episodes based on prescriptions for fixed rate intravenous insulin infusion (FRIII). In this study, we aimed to retrospectively validate DEKODE system for monitoring DKA management.

Materials and methods

To retrospectively validate DEKODE model, all episodes identified by DEKODE from September 2018 to August 2019 was manually verified for confirmation of diagnosis. DKA duration was defined as the difference in time between FRIII prescription time and end time for DEKODE. For manually collected data, the difference in the time from diagnosis (serum glucose ≥11 mmol/L, ketones ≥3 mmol/L and pH ≤7.3 or bicarbonate ≤15 mmol/L) to resolution (serum glucose <11 mmol/L, ketones <0.6 mmol/L and pH >7.3 or bicarbonate >15 mmol/L) was considered as DKA duration.[1] Further, appropriateness of glucose and ketone measurements during entire DKA duration and fluids prescribed in the first 12 hours of diagnosis were compared between the two datasets. The difference between manual and automated data for DKA duration, FRIII appropriateness, hourly glucose and ketone measurements were analysed using Prism v6.0 (Graphpad, San Diego, USA) and results are presented as mean and standard error of mean (SEM). Difference in frequencies of hypokalaemia and hyperkalaemia between manual and automated data were analysed by chi-squared test.

Results and discussion

A total of 150 episodes were identified by DEKODE during the study period. Of these, 147 had confirmed DKA. There was no significant difference in DKA duration between DEKODE and manual data (mean±SEM 16.0±1.0 hours and 17.5±0.9 hours, respectively; p=not significant (ns)); similarly, there was no difference in FRIII appropriateness (mean±SEM 98.3%±1.2% and 97.9%±1.1%, respectively; p=ns), hourly glucose (mean±SEM 98.5%±2.6% and 105.6%±2.5%, respectively; p=ns) and ketone measurements (mean±SEM 43.3%±2.1% and 47.1%±2.2%, respectively; p=ns) between the two systems. DEKODE also accurately predicted the frequency of kalaemic complications with no significant difference in the number of patients recorded with hyperkalaemia (7/147 and 6/150, respectively; p=ns) and hypokalaemia (9/147 and 9/147, respectively; p=ns). However, DEKODE over-predicted proportion of fluids prescribed (mean±SEM 96.9%±3.2% and 84.4%±3.1%, respectively; p=0.0047). These results prove that DEKODE system could reliably predict DKA duration and management. This can help in monitoring DKA management by cutting time from collecting data to analysis, thus providing real-time performance results.

Conclusion

The DEKODE automated system uses an indigenously built algorithm that reliably predicted DKA duration and management. DEKODE has great potential as an auditing tool for providing regular performance feedback and significantly reduces the time spent collecting data. Further prospective validation is currently underway. ■

Conflicts of interest

None declared.

Authors: [A]University of Birmingham Medical School, Birmingham, UK; [B]University Hospitals Birmingham NHS Foundation Trust, Birmingham, UK; [C]Institute of Metabolic and Systems Research, Birmingham, UK; [D]Institute of Immunology and Immunotherapy, Birmingham, UK

References

1 Savage MW, Dhatariya KK, Kilvert A *et al*. Joint British Diabetes Societies guideline for the management of diabetic ketoacidosis. *Diabet Med* 2011;28:508–15.

2 Kempegowda P, Coombs B, Nightingale P *et al*. Regular and frequent feedback of specific clinical criteria delivers a sustained improvement in the management of diabetic ketoacidosis. *Clin Med* 2017;17:389–94.

3 Kempegowda P, Chandan JS, Coombs B *et al*. Regular performance feedback may be key to maintain good quality DKA management: Results from a five-year study. *BMJ Open Diabetes Res Care* 2019;7:e000695.