BRIEF ORIGINAL RESEARCH

Reduction of urea test ordering in the emergency department: multicomponent intervention including education, electronic ordering, and data feedback

Pamela Mathura[1,3] · Cole Boettger[1] · Reidar Hagtvedt[2] · Colleen Sweeney[3,4,5] · Stephen Williams[6] · Yvonne Suranyi[3] · Narmin Kassam[1,3] · Manpreet Gill[1,3,4]

Abstract

Introduction In the emergency department (ED), laboratory testing accounts for a significant portion of the medical assessment. Although excess laboratory test ordering has been proven to be prevalent, different types of interventions have been used to encourage a behavioural change in how physicians order tests. In one western Canadian hospital medicine program, a quality improvement project aimed to reduce the total monthly blood urea nitrogen (BUN) test ordered by physicians was found to be successful. The objective of this project was to evaluate a similar multicomponent intervention aimed at ED physician ordering, with the primary goal of reducing the number of monthly BUN tests ordered per ED visit.

Methods A pre post intervention design was conducted over 12-months. The first intervention component was an educational presentation conducted by physician leaders. Second, a regularly used order panel within the ED electronic order system was modified, removing the BUN test. The third component involved audit and feedback; the total monthly BUN test ordered for the ED department post intervention start was shared with all ED physicians twice (at 5 and 12 months).An interrupted time series analysis was completed to evaluate the multicomponent intervention effect.

Results The total monthly ordered BUN test declined from an average of 1905 pre-intervention to 448 post-intervention, and the total monthly BUN test to total ED visit ratio declined from 0.46 to 0.1. These results were a statistically significant reduction in physician BUN test ordering.

Conclusions Targeted education, order panel design and data feedback interventions can impact physician ordering behaviour in the emergent healthcare context, where diagnostic tests are often over used.

Keywords Physician order behaviour · Quality improvement · Resource stewardship · Unnecessary testing

✉ Pamela Mathura
pam.mathura@ahs.ca

1 Department of Medicine, University of Alberta Hospital, University of Alberta, Edmonton, AB, Canada

2 University of Alberta, Alberta School of Business, Edmonton, AB, Canada

3 Alberta Health Services, Edmonton, AB, Canada

4 Covenant Health, Edmonton, AB, Canada

5 Department of Emergency Medicine, University of Alberta, Edmonton, AB, Canada

6 Department of Medicine, University of Calgary, Calgary, AB, Canada

Résumé

Introduction Dans les services d'urgence (SU), les analyses de laboratoire représentent une part importante de l'évaluation médicale. Bien qu'il ait été prouvé que la prescription excessive d'examens de laboratoire est répandue, différents types d'interventions ont été utilisés pour encourager un changement de comportement dans la façon dont les médecins commandent des examens. Dans un programme de médecine hospitalière de l'Ouest canadien, un projet d'amélioration de la qualité visant à réduire le nombre total de tests mensuels d'azote uréique du sang (BUN) demandés par les médecins s'est avéré fructueux. L'objectif de ce projet était d'évaluer une intervention similaire à plusieurs composantes visant les ordonnances des médecins des urgences, avec pour objectif principal de réduire le nombre d'analyses mensuelles de BUN commandés par visite aux urgences.

Méthode Une conception pré-post-intervention a été menée sur 12 mois. Le premier volet de l'intervention consistait en une présentation éducative menée par des médecins chefs de file. Deuxièmement, un panneau de commande régulièrement utilisé dans le système de commande électronique du SU a été modifié, supprimant le test BUN. Le troisième volet concernait l'audit et le retour d'information : le nombre total de tests mensuels d'azote uréique sanguin commandés pour le service des urgences après le début de l'intervention a été communiqué à tous les médecins des urgences à deux reprises (à 5 et 12 mois). Une analyse de séries chronologiques interrompues a été réalisée pour évaluer l'effet de l'intervention multicomposante.

Résultats Le nombre total mensuel d'analyses BUN commandés a baissé d'une moyenne de 1905 avant l'intervention à 448 après l'intervention, et le rapport entre le nombre total mensuel de test BUN et le nombre total de visites aux urgences a baissé de 0,46 à 0,1. Ces résultats représentaient une réduction statistiquement significative des ordonnances de test BUN par les médecins.

Conclusions Des interventions ciblées en matière d'éducation, de conception de panels de commandes et de retour d'informations peuvent avoir un impact sur le comportement des médecins en matière de commandes dans le contexte des soins de santé émergents, où les tests de diagnostic sont souvent surutilisés.

Mots-clés Comportement d'ordonnance du médecin · Amélioration de la qualité · Gestion des ressources · Tests inutiles

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Clinician's capsule

What is known about the topic?

Over-ordering of laboratory testing is prevalent; methods to identify over-ordering and reduce its impact are needed.

What did this study ask?

Can we decrease physician ordering of the BUN test, using an evidence-based multicomponent quality improvement (QI) intervention?

What did this study find?

Monthly average BUN ordering declined 1905 to 448, and BUN test to ED visit proportion reduced from 0.46 to 0.1.

Why does this study matter to clinicians?

Reduces cost to the health care system and improves patient safety by reducing the risk of over-investigation.

Introduction

In Canada, laboratory testing is a high volume medical procedure accounting for approximately 4% of the Canadian healthcare budget [1]. Excess ordering of blood tests has financial implications, and can negatively affect the patient through hospital-acquired anaemia, unnecessary transfusions, prolonged hospitalizations, and over-investigation of false positive results [2]. Different types of interventions have been used to encourage a behavioural change in how physicians order tests [2]. Education alone, education combined with interventions such as redesigning paper-based order forms, electronic order panels, and data feedback have also been shown to have an effect on laboratory test ordering behaviour [2].

The blood urea nitrogen (BUN) test is commonly ordered with a creatinine test, and often adds little value to patient management [3]. According to a provincial laboratory-test utilization report, hospital ordering of the BUN test was high in the Canadian province of Alberta. Quality improvement (QI) projects on inpatient medicine units in various hospitals in this province were successful in reducing medicine physician ordering of the BUN test [4]. As a result, one community hospital in one health zone in Alberta, which had already completed this QI project in the medicine program, sought to expand the intervention to include the hospital ED. The objective of this project was to evaluate a similar multicomponent intervention targeting ED physician ordering with the primary goal of reducing the monthly BUN test ordered per ED visit.

Methods

Design and setting

A pre post intervention design over 12-months (September 2020 to September 2021) was completed at one community

hospital that provides acute inpatient care and emergency services located in an urban health zone in Alberta, Canada. This ED has over 50,000 patient visits annually and is a teaching site for residents and medical students [5]. This hospital uses paper charting with an ED specific electronic ordering system for laboratory tests, and there are no nurse-initiated blood test orders. This project focused on ED physician ordering therefore only laboratory-test orders for patients under the care of an ED physician were included. A multidisciplinary project team was developed in July 2020 comprised of an ED physician lead, medicine physician, nursing manager, medical student, and QI specialist. Approval was obtained from the University of Alberta Health Research Ethics Board (Pro00106594).

Data collection

Total monthly BUN test data from the provincial laboratory database was accessed by a laboratory-analyst retrospectively for the 12-months in 2019, 8-months in 2020 and from September 2020 to September 2021. To inform clinical ordering decisions with regards to BUN ordering, a brief literature review and consultation with local specialists including general internists, nephrologists, haematologists, and the local provincial laboratory biochemistry team was completed. The result was a consolidated list of appropriate clinical indications for BUN ordering (Fig. 1). A chart audit applying the appropriate clinical indications was completed for 2-weeks to understand baseline physician ordering behaviour. This audit varied the days of the week for data collection and randomly selected charts were reviewed. The audit confirmed that BUN ordering was frequently not aligned to the appropriate clinical indications and was often included as part of a general laboratory test panel.

Multicomponent intervention

A multifaceted intervention was developed that included three components; first, an educational presentation was given to physicians and unit clerks by the ED physician lead and the medicine physician on the first week of September 2020. A one-page project overview was emailed to all ED physicians and nurse managers and an infographic outlining the clinical indications for BUN ordering was posted at the physician desk where most ordering occurs. The second component began two weeks later on September 15, 2020 which involved an update to the ED electronic ordering system. A commonly used one-click order panel was altered to replace the traditional 'P7' option which included sodium, potassium, chloride, bicarbonate, urea, creatinine, and glucose, to a 'P6' one-click option which removed BUN from this grouping. The BUN test remained as a separate option. The third component was audit and feedback at 5
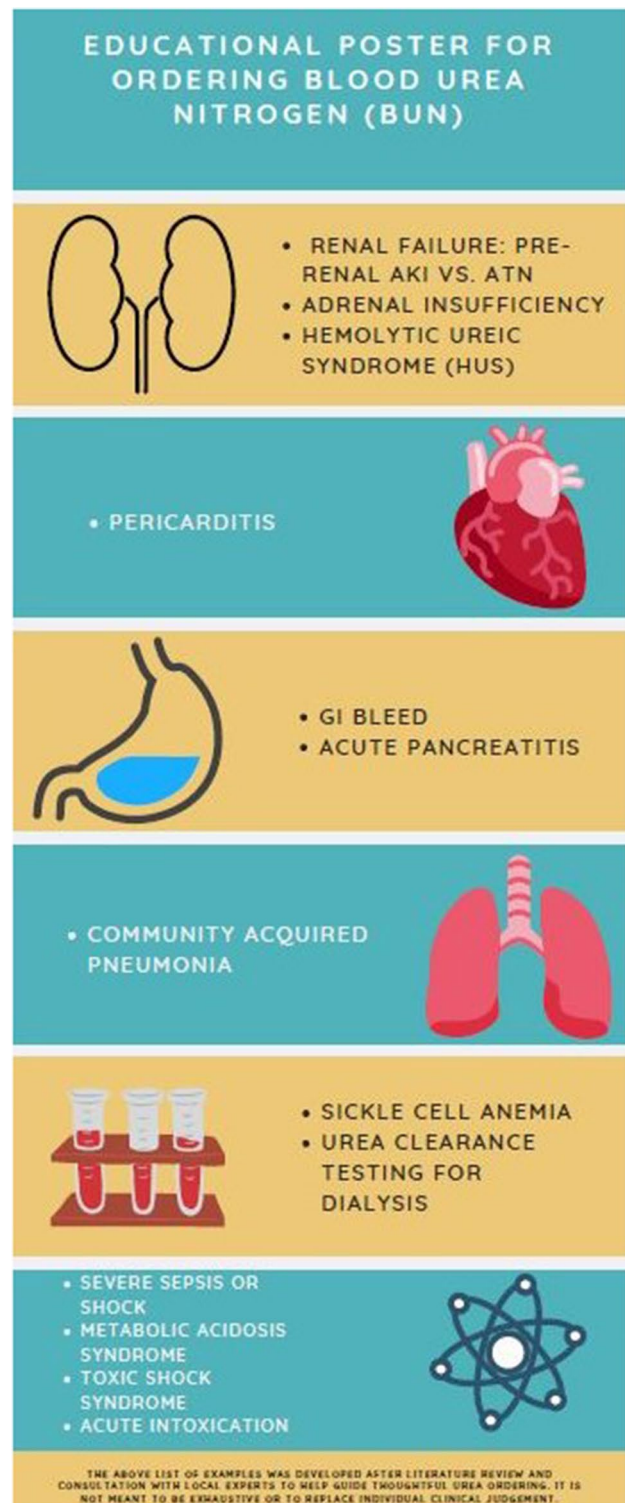
Fig. 1 Educational Poster. Educational infographic produced and posted in the target hospital Emergency Department to remind ordering physicians of clinical indications for ordering blood urea nitrogen laboratory tests

and 12 months (March and September 2021). The ED physician lead shared BUN test and ED visit data with staff physicians via email, and BUN test ordering was discussed at staff meetings.

Data analysis

We used an interrupted time series (ITS) analysis to evaluate the effect of the intervention on the total monthly BUN test ordered as recommended in a systematic review [6]. This analysis identifies changes in level and trend, before and after an intervention, in a time series [6]. To calculate power, a simulation study was used and a total of 33 months (data points) were collected [7]. Statistical analysis was performed using STATA V.15. First we used Newey-West standard errors in a Cumby–Huizenga hypothesis test for autocorrelation. If we find no autocorrelation, ordinary least squares (OLS) is appropriate to estimate changes in the slope and intercept post-intervention; otherwise, the Prais–Winsten model is appropriate [6] (Online Resource 2).

Two change points: (1) March 2020 to April 2020, the start of the pandemic, and (2) August 2020 to Sept 2020, the start of the intervention are illustrated in a time series graph (Online Resource 1). For two months, July and August 2020, the ED was temporarily closed due to the pandemic resulting in a rapid decline in the number of monthly BUN test ordered. Several diagnostic regressions were completed to check for autocorrelation which included the two data points that were artificially reduced due to the pandemic closure. Therefore, the mean was adjusted using the previous year's data.

Results

In the pre-intervention period, thirty-five charts were reviewed and the findings validated that BUN orders did not align with appropriate clinical indications for BUN testing, confirming excess ordering. Post-intervention, the total monthly BUN tests ordered declined from an average of 1905 pre-intervention to 448, and the total monthly BUN test to total ED visit ratio declined from 0.46 (715/1558) to 0.1 (392/3814). The pandemic resulted in an unusual pattern in the interrupted time series analysis. Using Newey–West errors and testing for autocorrelation using a Cumby–Huizinga test showed no autocorrelation, even with multiple specifications. Therefore, we used ordinary least squares regression with an indicator for the COVID-19 period, and found a statistically significant reduction in BUN tests (from the pre-intervention period to the post-Covid and post-intervention start phase) of 1106.6 (p value < 0.001, CI-95% CI 1364.1, −849.1]). No statistically significant change in trend was found, which was already sloping downwards due to ED

closure. There was a statistically significant, but ephemeral, effect from the pandemic closure (a reduction of 1223.6 from the pre-pandemic and pre-intervention level; p value < 0.001, CI-95% CI 1504.8, −942.4]). An immediate drop in BUN tests was observed due to the pandemic closure, with subsequent recovery once the department reopened, followed by another reduction upon intervention start; which was confirmed by statistical analysis (Online Resource 2).

Discussion

The use of an educational presentation, updated electronic order panel and data feedback had an immediate impact on excess BUN test ordering by ED physicians. Even though the global pandemic presented challenges such as the ED closing for 2 months, changes in patient disposition and visit variability [8], BUN ordering was reduced by 76% (448/1905) in comparison to the pre-pandemic intervention timeframe. To increase awareness of excess ordering in the ED, the educational presentation shared why this change was needed, ED specific utilization data, the results of a hospital project with a similar aim. The ED physician leader participation in the project, and support from a medicine physician involved in a similar project, may have influenced colleague physicians to change their ordering behaviour [9].

Previous research indicates social comparison feedback improves physician test ordering patterns and resource utilization; similar to our findings [10]. This feedback approach was used to motivate physicians by providing ED program specific BUN data in comparison to the medicine program, with a focus on clinically indicated BUN ordering during the educational presentation. Additionally, ED program total monthly BUN test data reports were distributed up to 12 months post intervention to encourage continued change in physician order behaviour.

The strengths of this project were the straightforward physician-led intervention approach, minimal ED physician leader time commitment, medicine physician QI-project mentorship, access to support personnel (QI and data) and no clinical workflow disruption. Project limitations include the lack of weekly BUN test order data during the intervention timeframe making it difficult to ascertain the exact relationship between the different intervention components and measured effect. The volume and acuity of patients accessing emergency services has varied over the pandemic and may have influenced BUN ordering [8].

The clinical implications were that reducing excess laboratory testing can reduce cost to the health care system and improve patient safety by reducing the risk of over-investigation. The research implication is that multicomponent interventions do have a role in reducing over-investigation.

Targeted education, order panel design and data feedback interventions successfully reduced the number of BUN orders in the ED of a community hospital. A similar approach could be used to improve physicians' ordering of other laboratory tests in the ED, where diagnostic tests are often overused.

Declarations

Conflict of interest The authors declare that there is no conflict of interest. This manuscript is related to PM's doctoral mixed methods study, which is partial requirement for the PhD Health Quality degree (Queen's University); it will be presented in a dissertation as a chapter.

Ethical approval The project was approved by the University of Alberta Health Research Ethics Board (Pro00106594).

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