

BMJ Open Quality **Bundled de-implementation of recurring hospital orders with a novel electronic medical record order set**

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ABSTRACT

Introduction High-frequency recurring orders placed through the electronic medical record (EMR) may contribute to unnecessary care in hospitalised patients. This quality initiative sought to develop and pilot test a hospital order set for bundled review and de-implementation of common recurring orders.

Methods A voluntary-use EMR order set was developed to display low-frequency order alternatives for common hospital care components. The order set was introduced to hospitalists at a large academic hospital from February to June 2023. Orders for overnight vital signs, tubes/tethers (a composite of telemetry, continuous pulse oximetry and Foley catheter) and daily labs (a composite of complete blood counts and metabolic panels) were monitored twice weekly in hospitalised patients at low risk for clinical decompensation from December 2022 through June 2023. Paired t-test was used to assess for differences in order frequency before and after order set introduction.

Results The order set was used in 48 unique encounters to place 80 de-implementation orders, most commonly for discontinuation of overnight vital signs (n=37). Two or more de-implementation orders were placed during 44% of order set encounters. Mean (SD) total high-frequency orders decreased by 0.22 per patient day (95% CI -0.39 to -0.06; p=0.010) after order set introduction, driven by a reduction in overnight vital sign orders of 0.17 per patient day (95% CI -0.23 to -0.12; p<0.001). There was no statistically significant difference in orders for tubes/tethers or daily labs before and after order set introduction.

Discussion Introduction of a novel order set for bundled review and de-implementation of recurring orders was associated with reduced high-frequency recurring orders in hospitalised patients, driven by a reduction in overnight vital signs. Nearly half of order set use was for two or more de-implementation orders, suggesting that bundling de-implementation orders may be an efficient way to reduce unnecessary orders.

INTRODUCTION

Electronic medical records (EMRs) allow providers to place recurring or continuous orders for a wide range of hospital interventions, such as lab testing and continuous cardiac ('telemetry') monitoring.¹ Recurring and continuous orders placed through the EMR may contribute to unnecessary care in hospitalised patients.²⁻⁴ This may lead to

decreased care quality, such as sleep disruption during overnight vital sign checks, and increased healthcare spending, such as charges from unnecessary repetitive lab testing or costs of treating catheter-associated infections.⁵⁻⁷ This quality initiative sought to develop and pilot test a hospital order set for bundled review and de-implementation of common high-frequency recurring orders. To our knowledge, there have been no similar published 'bundled' order set interventions that address multiple disparate inpatient care elements in a single, unified tool with the goal of decreasing or discontinuing recurring orders.

METHODS

This project was conducted at a large urban tertiary academic hospital. This project was formally determined to be quality improvement, not human subjects research, and was therefore not overseen by the Institutional Review Board, per institutional policy. There was no direct patient or public involvement in the design or administration of this project.

Development

Nine common hospital care components prone to overutilisation and having one or more lower intensity order alternatives were identified using literature review and feedback solicited from hospitalist physicians via workroom and committee discussions (table 1).^{3 4 8 9}

An EMR order set was designed by an Epic physician builder on the study team (KTN) with assistance from an Epic analyst (figure 1), with the alternative lower frequency order options for each care element displayed within a single order set for providers to efficiently review and select. These nine care components were combined into a 'bundled' order set because quality monitoring at our institution revealed that patients hospitalised for several days often had multiple active

**Table 1** Order set components

Order set components	Targeted wasteful order habits	Alternative order option(s)	Order mechanism	Notes on local implementation
1. Vital sign checks	Vital signs every 4 hours, include overnight	Every 4 hours, exclude overnight Every 8 hours, exclude overnight	Radio button	Activates notification indicator if there is an existing order.
2. Continuous cardiac (ie, telemetry) monitoring	Active telemetry monitoring	Discontinue telemetry monitoring	Checkbox (multiple selection)	'Discontinue' order is a nursing communication. Manual discontinuation of active order by provider is required.
3. Continuous pulse oximetry monitoring	Active continuous pulse oximetry monitoring	Discontinue continuous pulse oximetry monitoring	Checkbox	'Discontinue' order is a nursing communication. Manual discontinuation of active order by provider is required.
4. Indwelling bladder (ie, Foley) catheter	Active Foley catheter	Discontinue Foley catheter	Checkbox	'Discontinue' order automatically removes active order.
5. Alcohol withdrawal ie, Clinical Institute Withdrawal Assessment-Alcohol, revised [CIWA-Ar] monitoring	CIWA-Ar monitoring with low scores for >24–48 hours	Discontinue CIWA-Ar monitoring	Checkbox	'Discontinue' order is a nursing communication. Manual discontinuation of active order by provider is required.
6. Point-of-care glucose checks	Glucose monitoring with little to no insulin needs in >24 hours	Discontinue glucose checks Order for glucose checks with meals	Radio button	'Discontinue' order is a nursing communication. Manual discontinuation of active order by provider is required.
7. Basic metabolic panel (BMP)	Daily BMP or other serum electrolyte panel	Monday/Wednesday/ Friday frequency Monday/Thursday frequency	Radio button	Activates pop-up notification to discontinue existing order.
8. Complete blood count (CBC)	Daily CBC order	Monday/Wednesday/ Friday frequency Monday/Thursday frequency	Radio button	Activates pop-up notification to discontinue existing order.
9. Nebulised bronchodilator	Scheduled nebuliser treatments	<ul style="list-style-type: none"> ▶ Albuterol inhaler, every 4 hours PRN ▶ Albuterol nebuliser, every 6 hours PRN ▶ Albuterol-ipratropium nebuliser, every 6 hours as needed 	Checkbox	<ul style="list-style-type: none"> ▶ Activates notification indicator if there is a separate active bronchodilator order ▶ Included as needed nebuliser options to offer step-down from scheduled nebuliser

recurring orders placed on admission and continued without a clear clinical indication. A bundled order set was felt to be a more streamlined approach to addressing all recurring orders simultaneously, as opposed to creating multiple interventions to address individual care components.

Design features to improve order set usability included organising components into appropriate subcategories with directions for use: sleep friendly vital signs, discontinue monitoring and Foley (eg, telemetry and continuous pulse oximetry), reduced frequency labs (ie,

complete blood count (CBC) and basic metabolic panel) and reduce albuterol nebulisation.

Silent automated decision support was integrated to display certain order set components only when there was an active order for that component. This dynamic functionality was accomplished by linking specified patient criteria (eg, presence of an active telemetry order) to devised rules for displaying order set components (eg, 'Discontinue and remove telemetry') and applied to components 2–6 and 9 (table 1). For example, if a provider opens the order set in a patient encounter with

Orders Clear All Orders
 HP De-implementation (Clean Up) Manage User Versions Remove Order Sets

Use this order set to reduce unnecessary monitoring, procedures, and labs for medically stable patients. Duplicate orders should be discontinued by selecting the pink duplicate indicator.

- Sleep Friendly Vital Signs
 - Vital Signs
 - Vital Signs Q8 - No Overnight Check
 - Vital Signs Q4 - No Overnight Check
- Discontinue Monitoring & Foley

Discontinue unnecessary monitoring and Foley orders. Must also manually discontinue the orders within the Manage Order Navigator. Discontinue / reduced options appear if orders are active.

 - Telemetry (Cardiac Monitoring)
 - Discontinue and remove telemetry (adult cardiac monitoring)
ROUTINE, UNTIL SPECIFIED, Starting today at 10:37, Until Specified
 - Continuous Pulse Ox
 - Discontinue and remove continuous pulse oximetry monitoring
ROUTINE, UNTIL SPECIFIED, Starting today at 10:37, Until Specified
 - Foley
 - Discontinue Foley Catheter
 - CIWA
 - Discontinue CIWA Protocol
ONCE
 - Accuchecks
 - Point of Care Glucose
QAC AND QHS
 - Discontinue accuchecks
ONCE
- Reduce Frequency Labs

Reduce unnecessary labs by choosing MWF or M/Th labs. Do not order magnesium or phosphate if those values have been stably normal. Discontinue duplicate lab orders.

 - Labs
 - M Th Labs
 - MWF Labs
- Reduce Albuterol Nebulization

Reduce unnecessary nebulization treatments by ordering a PRN or MDI option. Discontinue unnecessary scheduled or duplicate orders.

 - PRN Nebulization and MDI
 - albuterol sulfate 90 mcg/actuation inhaler
EVERY 4 HOURS AS NEEDED, ROUTINE
 - albuterol sulfate (PROVENTIL) nebulization
EVERY 6 HOURS AS NEEDED, ROUTINE
 - albuterol-ipratropium (DuoNeb) nebulization
EVERY 6 HOURS AS NEEDED, ROUTINE
- Ad hoc Orders

Figure 1 De-implementation order set. Order set includes nine common recurring hospital care components with lower frequency order options for vital signs, telemetry monitoring, continuous pulse oximetry, Foley catheter, alcohol withdrawal protocol, point-of-care glucose checks, complete blood counts, metabolic panels and nebulised bronchodilators. Copyright: 2024 Epic Systems Corporation.

an active order for telemetry but not continuous pulse oximetry, the order set would display the order option to discontinue telemetry but not the option to discontinue pulse oximetry.

The order set was automatically added to the ‘Suggested’ order sets in hospitalists’ Epic user environment and linked to multiple search terms (ie, ‘de-implementation,’ ‘high value care,’ and ‘clean up’).

Pilot testing

The order set was promoted to hospitalists via meeting announcements, group messaging and emails from 20 February 2023 to 30 June 2023. The primary process measure was total number of high-frequency recurring orders, a composite of orders for overnight vital signs, tubes/tethers (ie, telemetry, continuous pulse oximetry and Foley catheter) and daily labs (CBCs and electrolyte panels). Prior quality monitoring at our institution had shown high baseline levels of utilisation for these care components. The balancing measure was recurring electrolyte panel orders of any frequency, since the order set promotes infrequent but recurring lab testing. These orders were monitored twice weekly from 2 December 2022 to 30 June 2023 in patients deemed ‘low risk for decompensation,’ defined as those hospitalised for at

least two midnights on a general medicine service with an Electronic Cardiac Arrest Triage (eCART) score of <50 at the time of chart review.¹⁰ eCART is an early warning score based on 33 clinical parameters developed to predict risk of clinical deterioration in hospitalised patients. A score <50 is highly specific for patients who will not experience in-hospital cardiac arrest. eCART is embedded into our institutions’ EMR and was therefore easily accessible during chart review. Paired t-test was used to assess for differences in mean high-frequency orders per patient each day before and after order set introduction. Patients were not evaluated for or excluded based on potential appropriateness of high-frequency orders, such as daily electrolyte panels in patients receiving intravenous diuretics.

RESULTS

Order set utilisation

The order set was employed in 48 unique hospitalisations. Eighty de-implementation orders were placed, including sleep-friendly vital sign checks (n=37), non-daily lab orders (n=16), telemetry discontinuation (n=12), continuous pulse oximetry discontinuation (n=8) and glucose check discontinuation (n=7). When used, providers place



two or more de-implementation orders during 44% of patient encounters and three or more orders during 21% of patient encounters.

Recurring orders

Recurring order data were collected on 22 separate days prior to and 35 separate days following order set introduction. Mean (SD) total high-frequency orders decreased from 2.09 (0.33) to 1.87 (0.29) per patient-day following order set introduction (delta -0.22, 95% CI -0.39 to -0.06; $p=0.010$). This was driven by a reduction in overnight vital sign orders from 0.88 (0.08) to 0.70 (0.12) per patient-day (delta -0.17, 95% CI -0.23 to -0.12; $p<0.001$). Prospective quality monitoring using run charts confirmed a downward shift in overnight vital sign orders following order set introduction. There was no statistically significant difference in orders for tubes/tethers, daily labs or recurring electrolyte panels following order set introduction.

DISCUSSION

In this single-site quality intervention, an innovative EMR order set was developed to bundle de-implementation decisions for recurring orders in hospitalised patients with low decompensation risk. During pilot testing, the order set was most frequently used to discontinue overnight vital signs and was associated with a reduction in overnight vital sign orders, demonstrating that EMR-based innovations such as order sets can be used to address potentially unnecessary care driven by recurring orders. Although we did not evaluate patient sleep quality, reducing overnight vital sign monitoring has been associated with decreased sleep interruptions and possibly improved sleep quality and patient satisfaction.⁵ In nearly half of order set uses two or more orders were placed, supporting our decision to create a bundled order set to address recurring orders for multiple care components simultaneously. This quality intervention was limited by small sample size and voluntary utilisation of the order set. The key next step is to increase order set utilisation. This may be achieved with automated clinical decision support that links activation of the order set to an objective set of patient criteria.

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Contributors CJM designed the project protocol, provided ongoing oversight of intervention and data collection throughout the project, oversaw data analysis and led the manuscript preparation. VN performed data collection and assisted with data analysis and manuscript preparation. AK performed data collection and

assisted with data analysis and manuscript preparation. MSM assisted with data analysis and manuscript preparation. MTC assisted with the design of project protocol and with manuscript preparation. KTN designed the project protocol, provided ongoing oversight of intervention, developed the order set tool and led the manuscript preparation. All authors reviewed and approved the final manuscript. CJM guarantees and accepts full responsibility for the conduct of the study, had access to the data and controlled the decision to publish.

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Data availability statement The data that support the findings of this study are available from the corresponding author, CJM, on reasonable request.

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