



Clinical Decision Support (CDS)

Changing Provider Behavior One Order at a Time



An Imperative to Help Physicians Make **Better Informed** Decisions

Clinical Research



New article published every 26 seconds

Doubling time of medical knowledge

1950: 50 years

TO

2020: 73 days



Precision Medicine

Too Much **Information** to Keep Up With



Pressure to Reduce **Costs & Improve Outcomes**

Declining Reimbursement



1/3rd care is waste - **\$1 trillion/year**

10% care is overtreatment - **\$248 billion/year**



Competitive Forces

It is Difficult to Change Clinical Behavior

We understand from Behavioral Economics that we need to:
“Make it Easier to Do the Right Thing and Harder to Do the Wrong Thing”



Importance of System Design
Lessons from the airline industry



Alerts are **not relevant** to the clinical scenario



Alerts are displayed at the **wrong time** in the workflow



Alerts are **not evidence-based**



Alerts are **poorly maintained**; broken alerts are still live



Alert **burden is too high**

Midwest Health System
reduced alert volume by

>10M/year

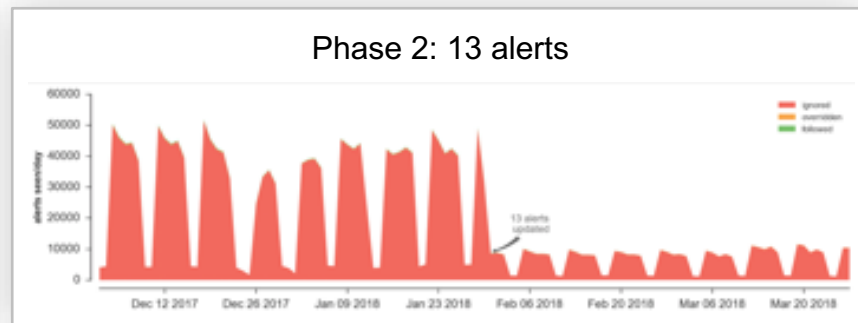
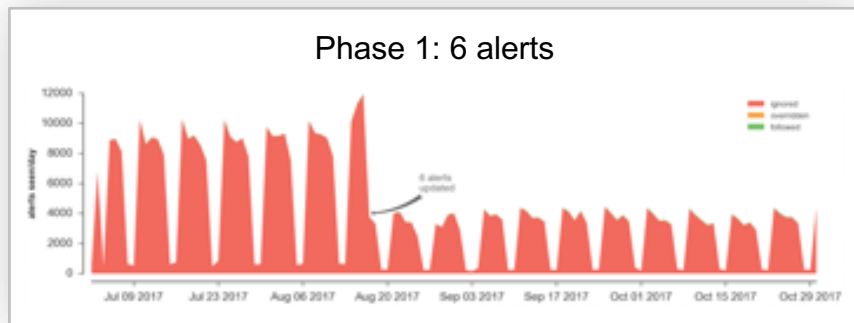
using CDS analytics

Audited highest firing alerts

37,245K/day
baseline alert burden

Changed or retired 19 alerts

9,473K/day
after changes



Concern about overuse than underuse

(e.g., opioids)

- Order sets/preference lists are checklists designed to prevent underuse
- A side effect is that they can promote overuse
- Orders that trigger alerts sometimes come from order sets/preference lists
- There may be evidence to suggest harm or lack of benefit in a number of patients

Vitamin D intervention, Kaiser Permanente

“Making it harder to do the wrong thing”

- Interventions
 - *Education*
 - *Removing items from preference list*
 - *Alerts*

Results

Screening declined 3-fold, from 74 tests/1,000 to 24 tests/1,000 ($p < 0.001$), 67% decrease

Appropriate care increased 56% to 70%

Inappropriate care decreased 44% to 30%

Followed rates decreased 10% to 4%, best practice internalized



Decrease in unnecessary vitamin D testing using clinical decision support tools: making it harder to do the wrong thing

Andrew H Felcher , Rachel Gold, David M Mosen, Ashley B Stoneburner

Journal of the American Medical Informatics Association, Volume 24, Issue 4, 1 July 2017, Pages 776–780, <https://doi.org.offcampus.lib.washington.edu/10.1093/jamia/ocw182>



Oct. 04, 2017

TELEMETRY MONITORING

order source	download csv	orders
IP ADMISSION order set [26]		575
IP OTHER ORDERS preference list [3049990620]		262
IP CARDIAC SURGERY TRANSFER order set [3040002058]		258
IP TRANSFER ORDERS order set [1357]		232
IP PERCUTANEOUS CORONARY INTERVENTION (PCI)/PERCUTANEOUS PERIPHERAL INTERVENTION (PPI), POST PROCEDURE order set [3040002025]		191
NURSING ORDERS preference list [3049990618]		180
IP POST OP ORDERS FOR THORACIC SURGERY order set [3040002019]		142

Standards for Inpatient Electrocardiographic Monitoring

\$3.7M
Annualized Savings
"Hard Green"

1. Identified cardiac monitoring/telemetry in order sets & preference lists
2. Utilized BPAs to guide practice
3. No change in mortality, rapid response times or code blues

AMITRIPTYLINE HCL 10 MG PO TABS

medication [432]

1,002 orders

67% no source (671)

- order set (-)

33% preference list (331)

JAMA Internal Medicine | [Original Investigation](#)

Anticholinergic Drug Exposure and the Risk of Dementia A Nested Case-Control Study

Carol A. C. Coupland, PhD; Trevor Hill, MSc; Tom Denning, MD; Richard Morris, MD; Michael Moore, MSc; Julia Hippisley-Cox, MD

order sources

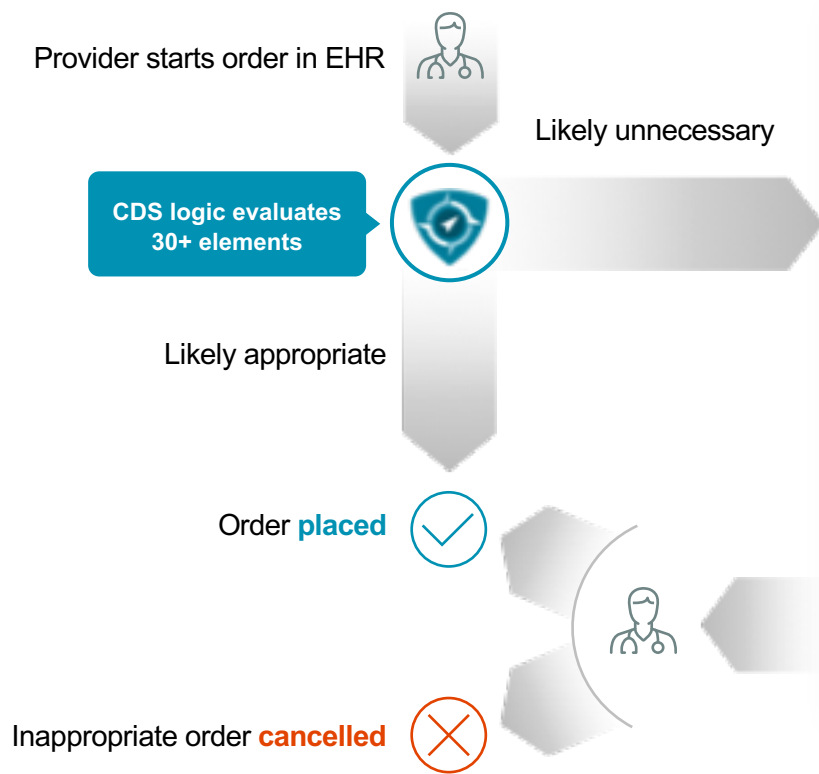
grid options | 11 order sources found

order source	orders -
RX AMB DEPARTMENT MEDS preference list [4082010003]	164
██████████ ORDERS PREFERENCE OP preference list [148549]	109
RX AMB FACILITY MEDICATIONS preference list [4082010001]	32
██████████ MEDICATIONS PREFERENCE OP preference list [61957]	10
██████████ ORDERS PREFERENCE OP preference list [385841]	10

Central nervous system

Antidepressants, alone or in combination	Avoid
<ul style="list-style-type: none"> ■ Amitriptyline ■ Amoxapine ■ Clomipramine ■ Desipramine ■ Doxepin >6 mg/d ■ Imipramine ■ Nortriptyline ■ Paroxetine ■ Protriptyline ■ Trimipramine 	Highly anticholinergic, sedating, and cause orthostatic hypotension; safety profile of low-dose doxepin (<6 mg/d) comparable with that of placebo QE = High; SR = Strong

There was nearly a 50% increased odds of dementia associated with total anticholinergic exposure of more than 1095 TSDDs within a 10-year period, which is equivalent to 3 years' daily use of a single strong anticholinergic medication at the minimum effective dose recommended for older people



Choosing Wisely: Don't perform population based screening for 25-OH-Vitamin D deficiency. [1](#) [2](#) [3](#)
(American Society for Clinical Pathology)

Hyperlink: [Choosing Wisely – American Society for Clinical Pathology](#)
Information for Patients: [Vitamin D Tests \(ASCP\)](#)

Reasons for override:

Malabsorption syndromes	Meds (glucocorticoids, antifungals, etc.)	Diet excludes dairy products
Monitoring of known vitamin D deficiency	Dark skin complexion	See comments

Comments:

[remove order](#) [keep order](#)



Choosing Wisely®:

“Don’t perform population based screening for 25-OH-Vitamin D deficiency.”

Clinical logic

Translation

Inclusion criterion

Vitamin D test ordered

IF Lab test order = LAB535

Exclusion criteria

Males age >70 years OR females age >65 years

NOT (gender = female & age ≥70 years) OR (gender = male & age ≥65 years)

NOT ICD-9 OR ICD-10 diagnosis codes

osteomalacia, vitamin D deficiency, osteoporosis, pathologic fracture, chronic kidney disease, intestinal malabsorption, cirrhosis, chronic liver failure, cystic fibrosis, inflammatory bowel disease, radiation enteritis, unspecified non-infections colitis, bariatric surgery, hyperparathyroidism, chronic pancreatitis, COPD, obesity/BMI >30, sarcoidosis, tuberculosis, histoplasmosis, coccidiomycosis, other fungal infections, berylliosis, malignant lymphomas, other malignant lymphomas, diabetes, history of falls

268.0, 268.1, 268.2, 268.9, 733.00, 733.01, 733.02, 733.03, 733.09, 733.10, 733.11, 733.12, 733.13, 733.14, 733.15, 733.16, 733.19, 585.1, 585.2, 585.3, 585.4, 585.5, 585.6, 585.9, 579.0, 579.1, 579.2, 579.3, 579.4, 579.8, 579.9, 571.2, 571.5, 571.6, 572.2, 572.3, 572.4, 572.8, 573.0, 573.5, 277.00, 277.01, 277.02, 277.03, 277.09, 555.0, 555.1, 555.2, 555.9, 556.0, 556.1, 556.2, 556.3, 556.4, 556.5, 556.6, 556.8, 556.9, 558.1, 558.9, V45.86, 588.0, 588.81, 252.00, 252.01, 252.02, 252.08, 577.1, 491.0, 491.1, 491.20, 491.21, 491.22, 491.8, 491.9, 492.0, 492.8, 278.00, 278.01, 278.03, 135, 010.00, 010.01, 010.02, 010.03, 010.04, 010.05, 010.06, 010.10, 010.11, 010.12, 010.13, 010.14, 010.15, 010.16, 010.80, 010.81, 010.82, 010.83, 010.84, 010.85, 010.86, 010.90, 010.91, 010.92, 010.93, 010.94, 010.95, 010.96, 011.00, 011.01, 011.02, 011.03, 011.04, 011.05, 011.06, 011.10, 011.12, 011.13, 011.14, 011.15, 011.16, 011.20, 012.1, 011.22, 011.23, 011.24, 011.25, 011.26, 011.30, 011.31, 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Visit related to pregnancy

NOT medication orders

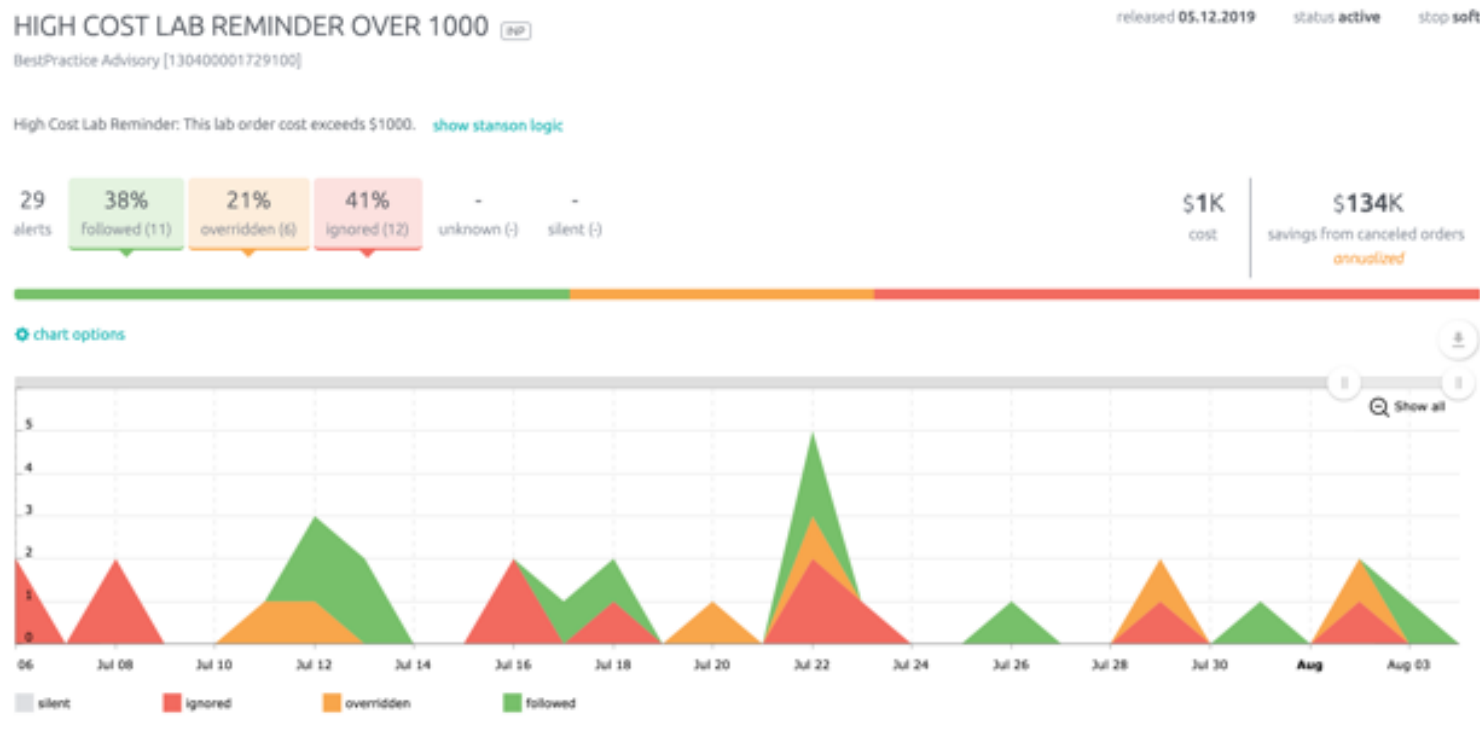
Active anti-seizure, antifungal, anti-retroviral medications, glucocorticoids, or bile acid sequestrants

10440, 10441, 10443, 10444, 10445, 10446, 10447, 10448, , 10011, 10012, 10013, 10879, , 10015, 10016, 10017, 10018, , 3910, , 11074

NOT BMI >30 kg/m²

THEN fire Best Practice Advisory with 11 override reasons

Informational alerts: High Cost Lab Reminder >\$1000 or >\$500



Forecasted
>\$400,000
savings/yr

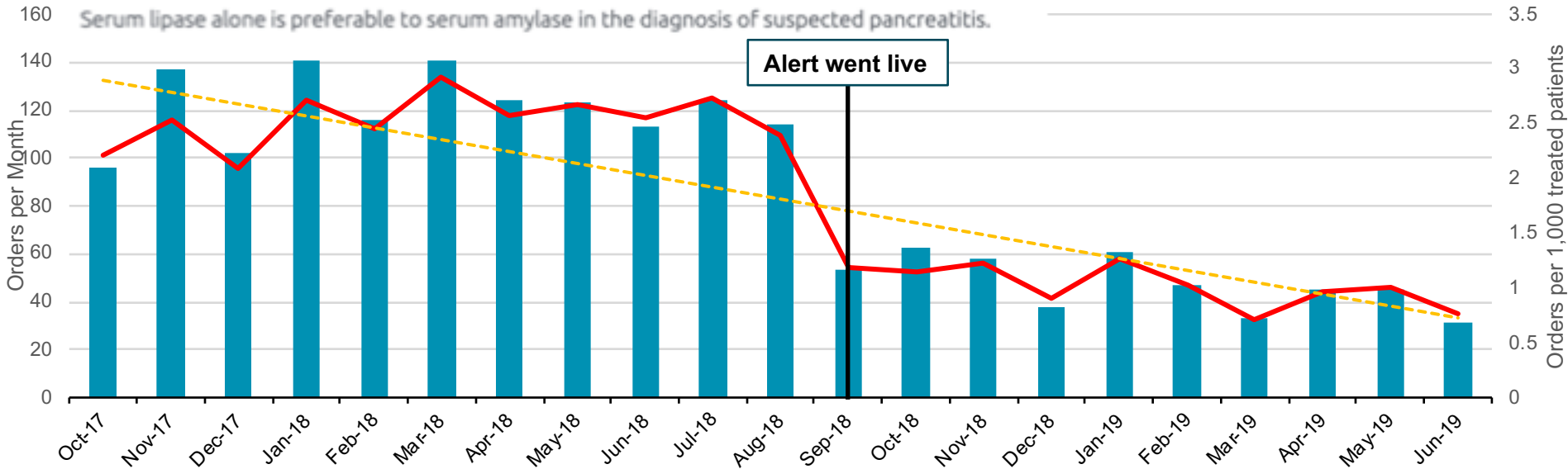


Behavior Change: Sustained Reduction in Inappropriate Orders

60% decrease in Serum Amylase orders per 1,000 treated patients

SERUM AMYLASE FOR SUSPECTED PANCREATITIS AMB

Serum lipase alone is preferable to serum amylase in the diagnosis of suspected pancreatitis.



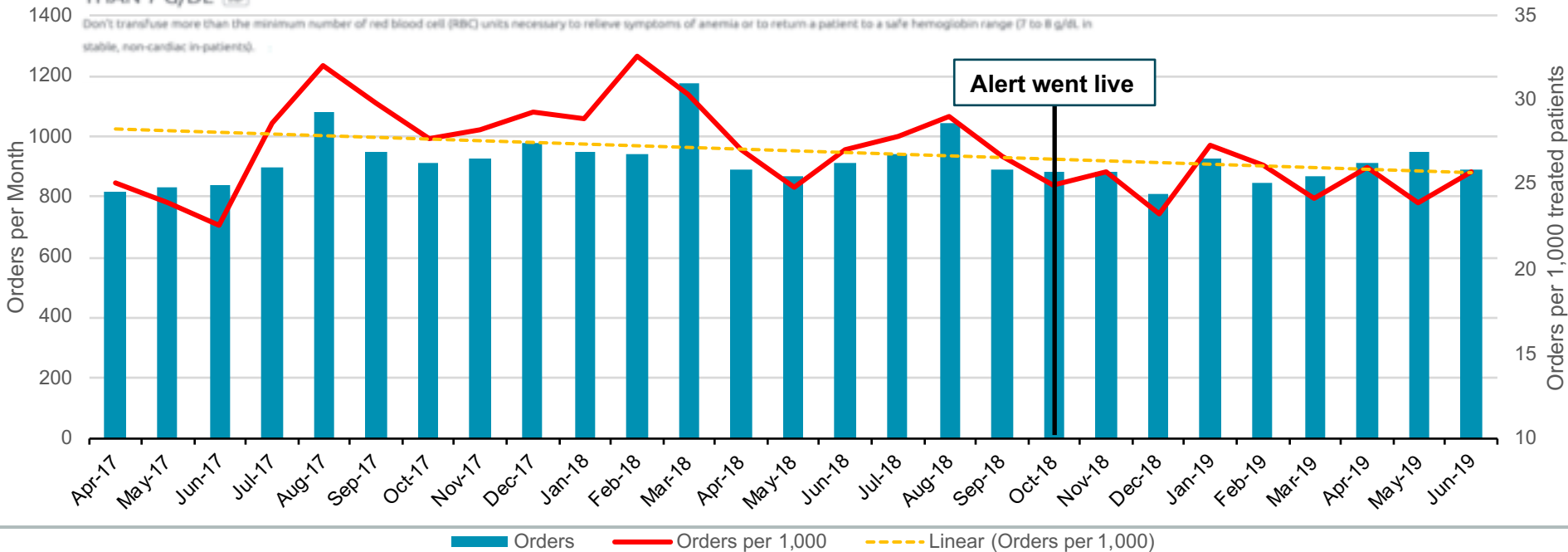


Behavior Change: Sustained Reduction in Inappropriate Orders

9% decrease in Blood Transfusion orders per 1,000 treated patients

BLOOD TRANSFUSION IN PATIENTS WITH HGB GREATER THAN 7 G/DL ^(AP)

Don't transfuse more than the minimum number of red blood cell (RBC) units necessary to relieve symptoms of anemia or to return a patient to a safe hemoglobin range (7 to 8 g/dL in stable, non-cardiac in-patients).



Who:

Clinical leadership

What:

Targeted conversations with providers using data on how they compare to their peers for CDS alert compliance

Why:

Peer comparison feedback works best to encourage sustained behavior change



Research

Original Investigation

Effect of Behavioral Interventions on Inappropriate Antibiotic Prescribing Among Primary Care Practices: A Randomized Clinical Trial

Daniella Meeker, PhD; Jeffrey A. Linder, MD, MPH; Craig R. Fox, PhD; Mark W. Friedberg, MD, MPH; Stephen G. Persell, MD, MPH; Noah J. Goldstein, PhD; Tara K. Knight, PhD; Joel W. Hay, PhD; Jason N. Doctor, PhD

JAMA Psychiatry | Original Investigation

Effect of Peer Comparison Letters for High-Volume Primary Care Prescribers of Quetiapine in Older and Disabled Adults: A Randomized Clinical Trial

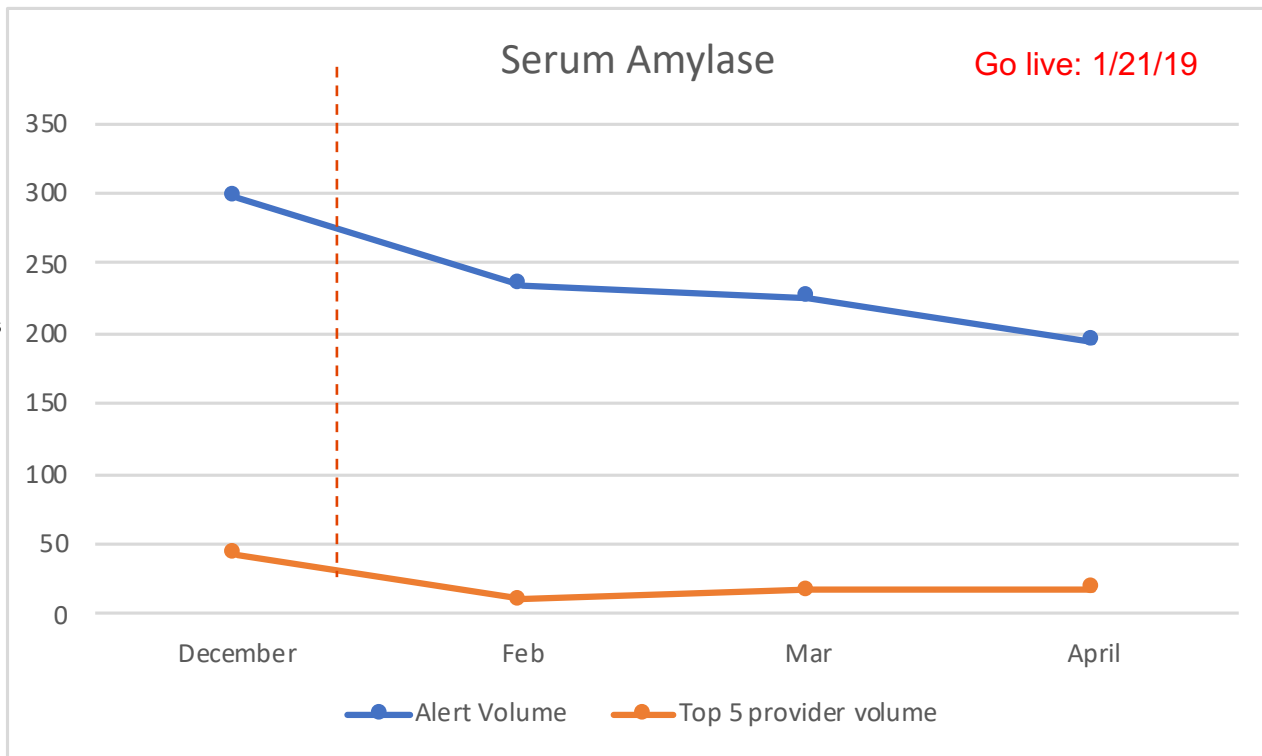
Adam Sacary, PhD; Michael L. Barnett, MD, MS; Jackson Le, PharmD; Frank Tokoski, MPH; David Yukun, PhD; Shantanu Agrawal, MD

TREATMENTS

'Dear Doctor' Letters Use Peer Pressure, Government Warning To Stop Overprescribing

August 7, 2018 · 4:59 AM ET
Heard on [Morning Edition](#)

Serum lipase alone is preferable to serum amylase in the diagnosis of suspected pancreatitis



**34% decrease
overall alert
volume**

**58% decrease
top 5 provider
alert volume**

44% of potentially inappropriate orders caused by 4 providers

42% of potentially inappropriate orders caused by 2 providers

T3 LEVELS IN HYPOTHYROID PATIENTS AMB 238

provider	alerts caused +	% of total
██████████ Physician - Internal Medicine	44	18%
██████████ Physician - Family Practice	31	13%
██████████ Physician - Family Practice	20	8%
██████████ Physician - Radiology	12	5%

ROUTINE 25-OH-VITAMIN D DEFICIENCY SCREENING FEMALE AMB 60

provider	alerts caused -	% of total
██████████ multiple alerts Physician - Urgent Care	22	37%
██████████ multiple alerts Nurse Practitioner - Nurse Practitioner	3	5%

Choosing Wisely:

“Avoid nonsteroidal anti-inflammatory drugs (NSAIDs) in individuals with CKD.”

American Society of Nephrology

CDS Intervention #697 INPT

Based on prevalence data:

742
follows*/year

2

**Upper GI
bleed or
perforation⁵**



21

**Atrial
fib
episodes²**



32

**Acute
kidney
injuries³**



33

**C. diff
infections¹**



References:

1. *Can J Gastroenterol Hepatol.* 2016;2016:7431838. doi: 10.1155/2016/7431838. Epub 2016 Mar 8.
2. *Am J Cardiol.* 2014 Nov 15;114(10):1523-9. doi: 10.1016/j.amjcard.2014.08.015. Epub 2014 Aug 27.
3. *BMC Nephrol.* 2017 Aug 1;18(1):256. doi:10.1186/s12882-017-0673-8.
4. *J Hosp Med.* 2017 Feb;12(2):70-76. doi: 10.12788/jhm.2683.
5. *Arthritis Rheum.* 2010 Jun;62(6):1592-601. doi: 10.1002/art.27412.
6. <http://www.beckershospitalreview.com/finance/average-cost-per-inpatient-day-across-50-states-2016.html>

*Cancellation of inappropriate NSAID order



Thank You



BEFORE Ordering

Remove low performing CDS

Optimize order sets & preference lists

Analytics

DURING Ordering

Choosing wisely - cost-reducing & quality improving alerts

PAMA imaging CDSM

Prior authorizations

Content

AFTER Ordering

Peer-comparison feedback

Outlier analysis

Analytics

RESULTS

Quality improvement
Cost savings
Harm avoided
Learning effect

Analytics