



It's all about... OUTCOMES !

Safety Care Variation eMeasures Quality Service Medication Errors
Clinical Decision Support Antimicrobial Stewardship
Length of Stay Readmissions
Cost of Care Process Improvement
Consumer Engagement EHR Adoption
Data Warehousing Efficiency Mortality Value Realization Optimization
Informatics Excess Days Blood Utilization Analytics Patient Satisfaction

THE GOLDILOCKS PRINCIPLE



Applying the Goldilocks Principle to Clinical Decision Support

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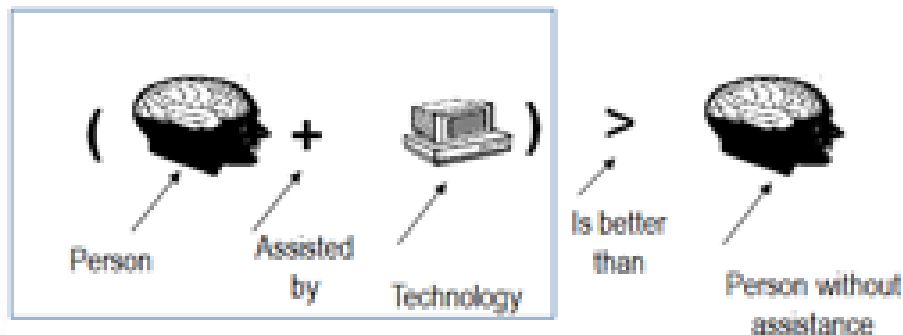
Conflict of Interest Disclosure

Carla J Maslakowski, M.S., M.Ed, RPh
has no real or apparent
conflicts of interest to report.



Session Objectives

- Discuss the process for enhancing health-related decisions and actions by use of the CDS Five Rights.
- Review the recent literature regarding override rates for key clinical decision support alerts.
- Review alert rates and override rates of inpatient drug-allergy, drug-drug interaction, and dose range checking alerts before and after local customization efforts.



Friedman CP, Wyll JC, Evaluation Methods in Biomedical Informatics, 2nd ed



Clinical Decision Support (CDS)



- Defined as *a process for **enhancing health-related decisions*** and actions with pertinent, organized clinical knowledge and patient information to improve health and healthcare delivery. Achieving these outcomes requires addressing the
- CDS Five Rights :
 - The right information (evidence-based guidance)
 - To the right people
 - Through the right channels
 - In the right format
 - At the right point in the workflow for key decision or action
- https://www.cms.gov/regulations-and-guidance/legislation/EHRincentiveprograms/downloads/clinicaldecisionsupport_tipsheet.pdf



Alert Issues

- Drug-Drug Interaction and Drug-Allergy Alerts are required for Meaningful Use Stage 1.
- These Alerts require the use of a commercially available database (in this case-Multum) embedded in the electronic health record system and cannot be easily customized.
- Clinicians see *Interruptive Pop-Up Alerts* at point of sign order (Discern Alerts).
- Database not specific enough to drill down below therapeutic category to class level for drug allergy interactions.
- Expectation of a computerized system is that the system will “save you” from making dose, allergy, medication treatment errors but not cause alert fatigue.



Do you remember this medication error?



It wasn't a stray bullet that killed her...

... it was a stray decimal point.

Cerner Bridge medical. www.mederrors.com
Digoxin ten fold overdose in a child





Ten Rules for Effective Clinical Decision Support


1. Speed is everything
2. Anticipate needs and deliver in real time
3. Fit into the user's workflow
4. Little things can make a big difference.
5. Physicians resist stopping
6. Changing direction is fine
7. Simple interventions work best
8. Asking for information is OK--but be sure you really need it
9. Monitor impact, get feedback, and respond
10. Knowledge-based systems must be managed and maintained

Bates DW Kuperman GJ et al J Am Med Inform Assoc 2003; 10:523



► Our View of Clinical Decision Support

Discern: (1 of 1)

 **Pardon the Interruption!**

We're so sorry to bother you while you are in the middle of thought. However, it appears that one of your orders might do harm to this patient. (You were probably too busy dealing with important matters, so please don't take offense.)

Please be so kind as to tell us what you want to do.
Thanks!

Alert Action

☒ 1) Remove the order. Thanks for the help!

☐ 2) Leave the order alone, I know what I'm doing


OK





Physician's View: Clinical Decision Support

Discern: (1 of 1)

 **You Idiot!**

Are you trying to kill someone?

Select one of the options below to make up for your horrendous lack of judgment

Alert Action

☒ 1) Remove the offending order and zap me with 1000 volts

☐ 2) Remove the offending order and zap me with 2000 volts

OK



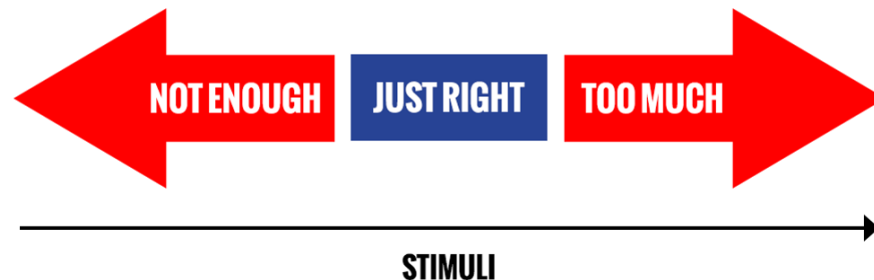
▶ The Goldilocks Principle and CDS

- How much is enough ?



- How to **balance safety** by using the Goldilocks principle while combating Alert Fatigue with Clinical Decision Support.

THE GOLDILOCKS PRINCIPLE





Provider Override Rates for Standard Alerts

Alert	Lit 2010	Lit 2016
Drug Allergy	91	96.9
Drug-Drug Interaction	95	96.9
Drug-Dose	90	98.5

Appl Clin Inform. 2010; 1(3): 346–362.

PMCID: PMC3631901

Published online 2010 Sep 29. doi: [10.4338/ACI-2009-11-RA-0014](https://doi.org/10.4338/ACI-2009-11-RA-0014)

Decision Support Alerts for Medication Ordering in a Computerized Provider Order Entry (CPOE) System

A systematic approach to decrease alerts

[M. A. Del Beccaro](#),^{1,2} [R. Villanueva](#),¹ [K. M. Knudson](#),¹ [E. M. Harvey](#),¹ [J. M. Langle](#),¹ and [W. Paul](#)¹

[Ochowski M](#), [Boll P](#). **Alert fatigue: improving alert impact by reducing noise.**
HIMSS Conference Mar 2016.



Recent Literature Reports

- Bright TJ, Wong A, Dhurjati R, et al. **Effect of clinical decision-support systems: a systematic review.** Ann Intern Med. 2012; 157:29–43

“This review found evidence of the efficacy of CDSs on health care process outcomes across diverse settings but data showing an effect on clinical and economic outcomes were sparse.”

- Horn JR, Hansten PD, Osborn JD, et al. **Customizing clinical decision support to prevent excessive drug-drug interaction alerts.** Am J Health-Syst Pharm. 2011; 68:662–4.
- Brodowy B, Nguyen D. **Optimization of clinical decision support through minimization of excessive drug allergy alerts.** Am J Health-Syst Pharm. 2016; 73: 526-528
- Bryan AD, Fletcher GS, Payne TH. **Drug Interaction alert override rates in the Meaningful Use era: No evidence of progress.** Appl Clin Inform. 2014 Sep 3; 5 (3) 802-13.
- Ochowski M, Boll P. **Alert fatigue: improving alert impact by reducing noise.** HIMSS Conference Mar 2016.

Customizing Clinical Decision Support



Methodology Used to Optimize Alerts

- Adopted the use of the new Medication Clinical Decision Support (**mCDS**) **window** in the EHR 2012 code to view drug-allergy, drug-drug interaction and duplicate therapy alerts.
- Reviewed **Multum drug interaction pairs** to determine appropriateness and updated as approved.
- Used the **MultumCustom tool** to address specific **drug-allergy** changes as approved.
- Added custom CCL* within mCDS to limit CPOE **duplicate alerts** to six key classes of medications only.
- Added custom CCL* within mCDS to allow the provider to suppress the same drug-allergy, drug-drug interaction or duplicate alert for the rest of the encounter for this provider only
- **Drug Dose** Range Checking-Enterprise Project with Pharmacists. Added Lexicomp database for pediatrics and Multum drug database for adults. Incorporated renal rules, age, weight to determine drug dose.

*With new mCDS code, use Bedrock Filters to configure alerts and duplicates



The Foundation for Customization-mCDS window

Anderson, Aaron - 00-021-143

Medication Clinical Decision Support (mCDS)

The order was created with the following alerts:

- ceftioxone** 50 mg/kg, Intravenous, Once

Allergy (1)

Severity	Allergy	Medication	Details	Reaction Type	Allergy Comments	Reason
Mild	ceFAZolin	ceftioxone	50 mg/kg, Intravenous, Once	Allergy	11/4/2016 9:25 AM CDT - Patient states rash was isolated to his arms.	Select Override Reason

Reaction Symptoms: Rash Source: Patient

Drug/Drug (1)

DC	Severity	Medication	Details	Status	Interaction Information	Reason
<input type="checkbox"/>	Major-Contraindicated	leucovorin	15 mg, Oral, every 6 hours	Order	ceftRIAXone-leucovorin	Select Override Reason

Duplicate Therapy (1)

DC	Severity	Medication	Details	Status	Interaction Information	Reason
<input type="checkbox"/>	Duplicate	ampicillin-sulbactam (Unasyn)	3 g, Intravenous, every 6 hours	Ordered 11/04/2016 09:53	ceftRIAXone-ampicillin	Select Override Reason

Discern Alerts (2)

Alert Information

Estimated Creatinine Clearance = 97.57 mL/min

Serum Creatinine = 0.95 mg/dL

Provider Filtered Alerts

☒ Apply to all interactions
☐ Apply only to required interactions
☐ Apply only to selected

Override Reason
Select Override Reason

Anderson, Aaron - 00-021-143 [Continue](#) [Remove New Order](#)

Callouts:

- You can now easily see the medication that is being ordered and its order details.
- Allergen vs. medication; reaction info is also listed for evaluation.
- Same link available for drug/drug interaction information.
- If you are seeing Duplicate Alerts, you can now easily see the Duplication order, its details, status, and the interaction information in available with a link.

Drug-Allergy Alert Challenges

- Alert does not drill down to chemical class, only therapeutic category for medications.
- Nuisance alerts are generated
 - **Example:** Fentanyl order with a codeine allergy alerts providers
- Pharmacist Committee reviewed drugs causing the most alerts and provided a conservative response with changes
- The Multum Custom Interactions tool (MultumCustom.exe) was used to alter Multum, which provided data for drug-allergy interactions



Allergy Filtration by Class Changes Completed

1	Action	Allergy	Allergy Vocabulary	Medication	Medication Class
2	loop diuretics (category) / sulfonamides (category) loop diuretics (category) / Sulfa drugs (allergy category) loop diuretics (category) / sulfonamides (allergy category)	sulfa drugs	Multum Allergy Category	furosemide	cardiovascular agents -> diuretics -> loop diuretics, diuretics -> loop diuretics
3	penicillins (allergy category) / aztreonam (drug) penicillins (category) / aztreonam (drug)	penicillins	Multum Allergy Category	aztreonam	anti-infectives -> miscellaneous antibiotics
4	codeine (drug) / meperidine (drug)	codeine	Multum Drug	meperidine	analgesics -> narcotic analgesics, central nervous system agents -> analgesics -> narcotic analgesics
5	morphine (drug) / meperidine (drug)	morphine	Multum Drug	meperidine	analgesics -> narcotic analgesics, central nervous system agents -> analgesics -> narcotic analgesics
6	oxyCODONE (drug) / meperidine (drug)	oxyCODONE	Multum Drug	meperidine	analgesics -> narcotic analgesics, central nervous system agents -> analgesics -> narcotic analgesics
7	codeine (drug) / fentanyl (drug)	codeine	Multum Drug	fentanyl	analgesics -> narcotic analgesics, central nervous system agents -> analgesics -> narcotic analgesics
8	oxyCODONE (drug) / fentanyl (drug)	oxyCODONE	Multum Drug	fentanyl	analgesics -> narcotic analgesics, central nervous system agents -> analgesics -> narcotic analgesics
9	fentaNYL (drug) / hydromorphone (drug)	fentaNYL	Multum Drug	hydromorphone	analgesics -> narcotic analgesics, central nervous system agents -> analgesics -> narcotic analgesics
10	meperidine (drug) / acetaminophen-oxycodone (drug)	meperidine	Multum Drug	acetaminophen-oxycodone	analgesics -> narcotic analgesic combinations, central nervous system agents -> analgesics -> narcotic analgesic combinations
11	loop diuretics (category) / cox-2 inhibitors (category)	CeleBREX	Multum Drug	furosemide	cardiovascular agents -> diuretics -> loop diuretics, diuretics -> loop diuretics
12	meperidine (drug) / HYDROmorphone (drug)	HYDROmorphone	Multum Drug	meperidine	analgesics -> narcotic analgesics, central nervous system agents -> analgesics -> narcotic analgesics
13	acetaminophen-propoxyphene (drug) / hydromorphone (drug)	acetaminophen-propoxyphene	Multum Drug	hydromorphone	analgesics -> narcotic analgesics, central nervous system agents -> analgesics -> narcotic analgesics
14	acetaminophen-propoxyphene (drug) / acetaminophen-oxycodone (drug)	acetaminophen-propoxyphene	Multum Drug	acetaminophen-oxycodone	analgesics -> narcotic analgesic combinations, central nervous system agents -> analgesics -> narcotic analgesic combinations
15	nalbuphine (drug) / meperidine (drug)	nalbuphine	Multum Drug	meperidine	analgesics -> narcotic analgesics, central nervous system agents -> analgesics -> narcotic analgesics
16	acetaminophen-hydrocodone (drug) / meperidine (drug)	acetaminophen-hydrocodone	Multum Drug	meperidine	analgesics -> narcotic analgesics, central nervous system agents -> analgesics -> narcotic analgesics
17	carbapenems (category) / third generation cephalosporins (category)	ceftriaxone	Multum Drug	imipenem-cilastatin	anti-infectives -> carbapenems



▶ Suppress This Alert for Visit Reason Added

Suppress Alert Override Reason is an option for Drug Allergy Alerts, Drug-drug interaction alerts, drug duplicate alerts. This suppression would apply to this provider only. All others would still be alerted.

CHNTESTING, RITA - J59901243

Medication Clinical Decision Support (mCDS) (Collapse All)

CHNTESTING, RITA - J59901243

The order was created with the following alerts:

warfarin 2.5 mg, PO (oral), qDay

Allergy

Drug/Drug (1)

Severity	Medication	Details	Status	Interaction Information	Reason
Major-Contraindicated	amiodarone (amiodarone) 200 mg tablet UD)	200 mg, 1 tab(s), PO (oral), bid	Ordered 08/09/2017 13:10	warfarin- amiodarone	Select Override Reason

☒ Apply to all interactions
☐ Apply only to required interactions
☐ Apply only to selected

Override Reason: Select Override Reason

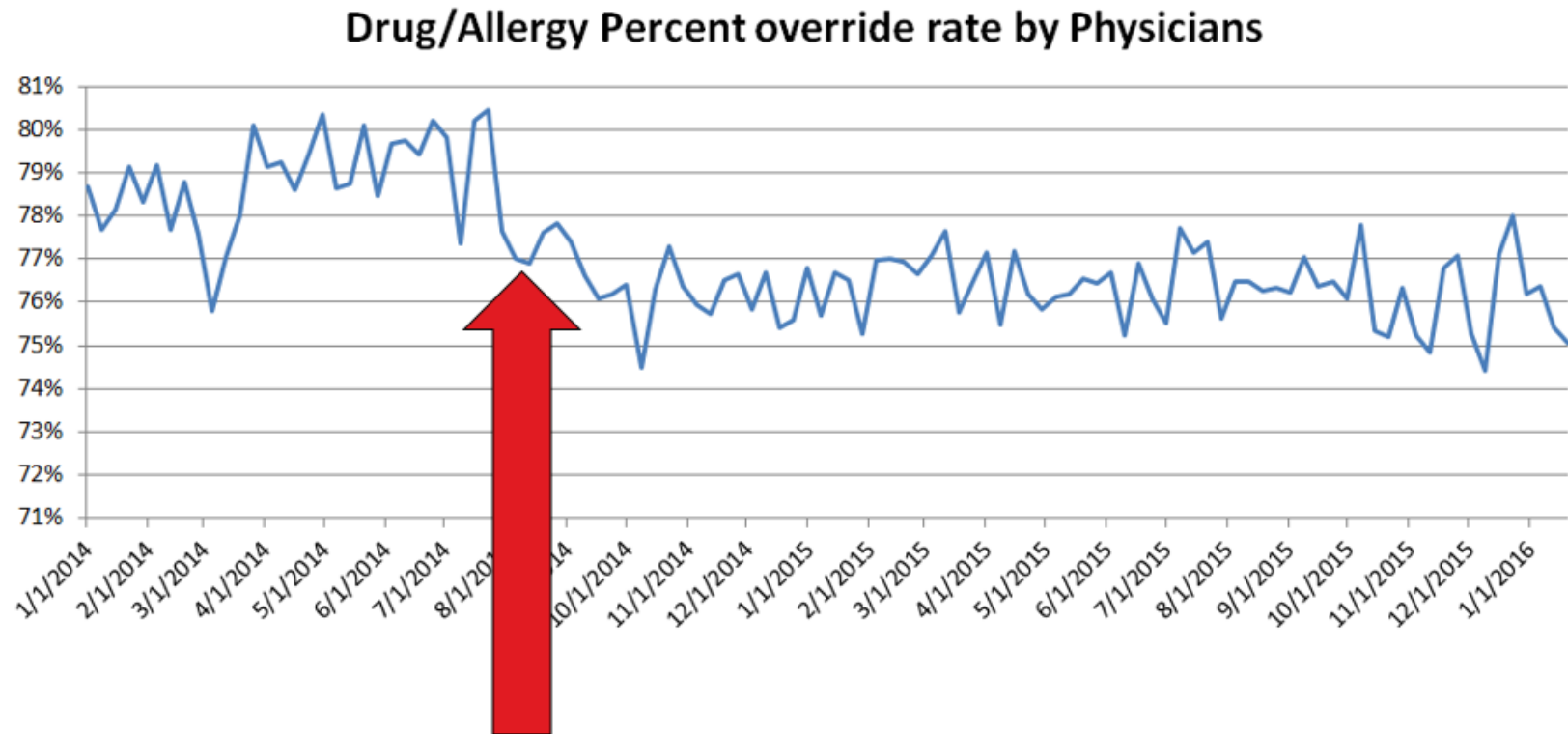
CHNTESTING, RITA - J59901243

Select Override Reason

- Physician Aware
- Pharmacist Reviewed
- Disagree with recommendation
- Suppress Alert, Provider Aware
- Treatment plan requirement
- No True Allergy
- Not applicable
- Order already exists
- See Clinical Note
- Free Text



Provider Drug/Allergy Override Percent Rates

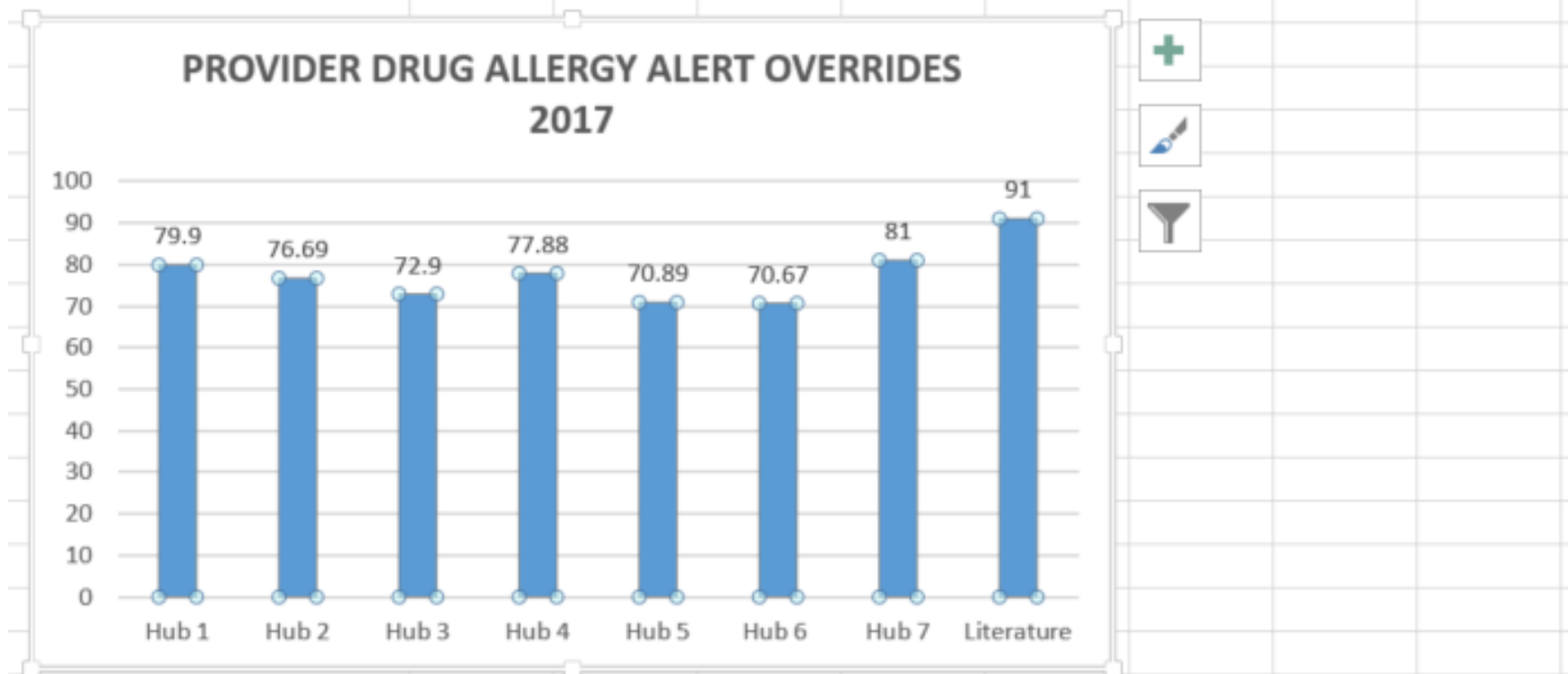


Effect of Adding Suppression for Rest of Encounter for Provider
Decreased Overrides from 80% to 77% average



Provider Drug/Allergy Override Percent Rates

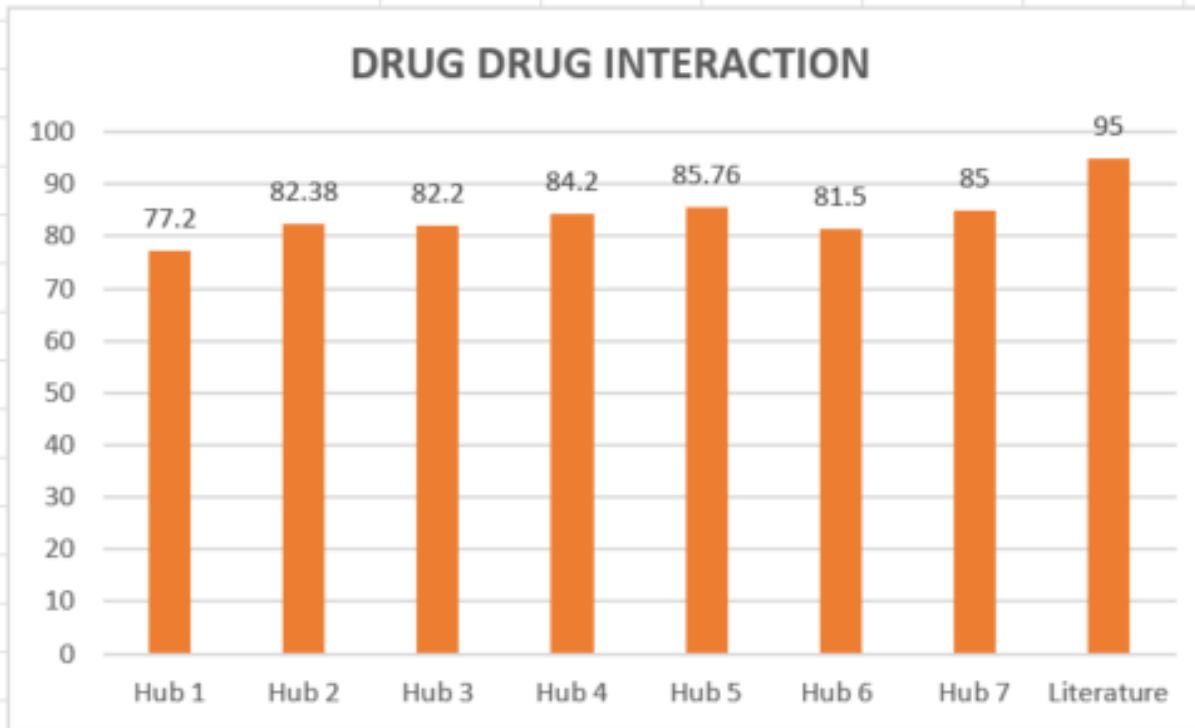
	Hub 1	Hub 2	Hub 3	Hub 4	Hub 5	Hub 6	Hub 7	Literature
DRUG ALLERGY ALERT	79.9	76.69	72.9	77.88	70.89	70.67	81	91





Provider Overrides for Drug-Drug Interaction Alerts

	Hub 1	Hub 2	Hub 3	Hub 4	Hub 5	Hub 6	Hub 7	Literature
DRUG DRUG INTERACTION	77.2	82.38	82.2	84.2	85.76	81.5	85	95



Dose Range Checking (Drug Dose Alerts)

- Tenet uses Multum drug database for Adult drug dose alerts in conjunction with Lexicomp drug database for pediatrics and neonates.
- There are over 660 “groupers” that have been reviewed and setup for Cerner facilities in hubs 1 thru 7 at this time.
- ACI Pharmacy in conjunction with Clinical Pharmacists at the facilities continue to add/revise drug dose alerts.
- Tenet providers only override Drug Dose alerts an average of 68% of the time compared to 90% literature standards.





Provider Overrides for Alerts

Hub 1	2015	2016	2017	Literature
DRUG ALLERGY ALERT	76.4	77.9	79.9	91
DRUG DRUG INTERACTION	85.6	81.72	77.2	95
DOSE RANGE CHECKING	59.87	60.43	63.6	90
Hub 2	2015	2016	2017	Literature
DRUG ALLERGY ALERT	77.08	76.81	76.69	91
DRUG DRUG INTERACTION	82.38	82.13	82.38	95
DOSE RANGE CHECKING	65.89	64.48	66.3	90
Hub 3	2015	2016	2017	Literature
DRUG ALLERGY ALERT	76.42	76.05	72.9	91
DRUG DRUG INTERACTION	84.22	83.7	82.2	95
DOSE RANGE CHECKING	66.4	66.52	65.7	90
Hub 4	2015	2016	2017	Literature
DRUG ALLERGY ALERT	79.8	78.6	77.88	91
DRUG DRUG INTERACTION	87.1	84.88	84.2	95
DOSE RANGE CHECKING	73.7	70.44	70.4	90
Hub 5	2015	2016	2017	Literature
DRUG ALLERGY ALERT	73.84	73.24	70.89	91
DRUG DRUG INTERACTION	85.79	87.06	85.76	95
DOSE RANGE CHECKING	70.65	69.75	69.19	90
Hub 6	2015	2016	2017	Literature
DRUG ALLERGY ALERT	70.28	68.7	70.67	91
DRUG DRUG INTERACTION	81.78	83.37	81.5	95
DOSE RANGE CHECKING	61.32	60.85	63	90
Hub 7			2017	
DRUG ALLERGY ALERT			81	
DRUG DRUG INTERACTION			85	
DOSE RANGE CHECKING			60	





2017 Provider Alert Overrides

	Hub 1	Hub 2	Hub 3	Hub 4	Hub 5	Hub 6	Hub 7	Literature
DRUG ALLERGY ALERT	79.9	76.69	72.9	77.88	70.89	70.67	81	91
DRUG DRUG INTERACTION	77.2	82.38	82.2	84.2	85.76	81.5	85	95
DOSE RANGE CHECKING	63.6	66.3	65.7	70.4	69.19	63	60	90

- Jan-Jul 2017 data for all hubs except Hub 7
- Hub 7 contains Ambulatory clinics, just one month of data





Finding the “just right amount” of CDS...

- Efforts to combat medication errors via clinical decision support alerts has unfortunately induced sensory and cognitive overload that we now know as “alert fatigue”.
- Exposure to a certain volume or frequency of alerts makes users stop paying attention to alerts and therefore can disregard important safety alerts.
- Determining at what volume this disregard happens has yet to be identified however we all know this fatigue is real and should try to be avoided.
- Efforts continue to filter alerts and only show “actionable alerts” at a volume that is “just right” to decrease alert fatigue.

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Questions





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