INTRODUCTION

- **Problem:** Despite an increase in exam volumes, there was not an increase in utilization of our critical result alert system

- **Hypothesis:** Important critical results are not being communicated

- **Purpose:** Increase the number of critical finding alerts and improve documentation in our system

Exams 3 Years Prior to Study

Slope = 89.8
95% CI: (35.9 – 143.8) p = 0.002
Interpretation:
Average increase of 90/month
15% increase from 10/16 to 10/19

Alerts 3 Years Prior to Study

Slope = -1.39
95% CI: (-5.14 – 2.36) p = 0.456
Interpretation:
Average decrease of 1.4/month
27% decrease from 10/16 to 10/19

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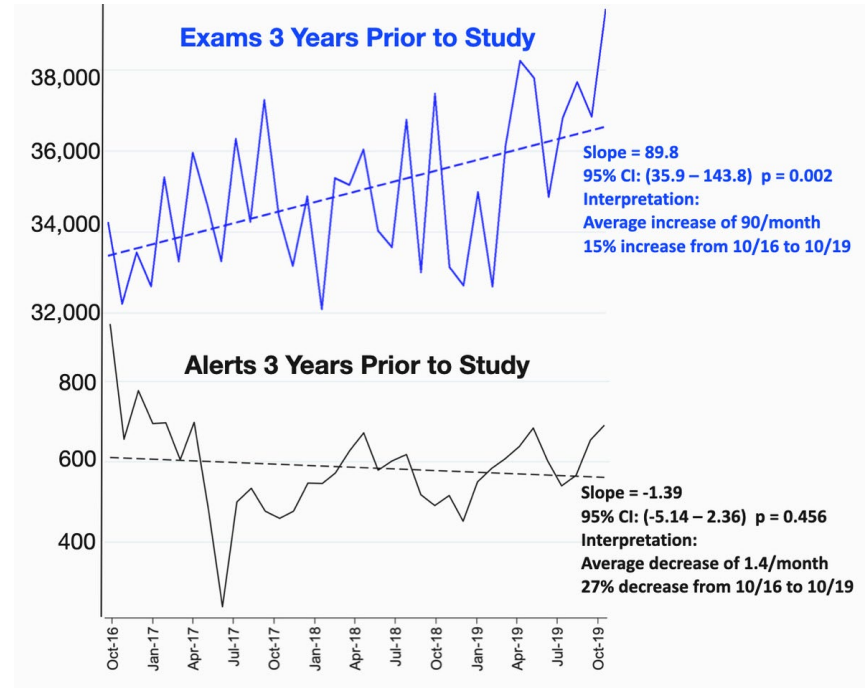
BACKGROUND

- 720-bed, quaternary-referral academic medical center
- Three Critical Result alert levels:
    - Red – Emergency (e.g., tension pneumothorax)
        - Closed-loop communication time goal <1 hour
    - Orange - Requires attention (e.g., malpositioned tube)
        - Closed-loop communication time goal <12 hours
    - Yellow - Non-urgent follow-up needed (e.g., lung nodule)
        - Closed-loop communication time goal <24 hours
- In the 15 months prior to intervention, an average of 662 critical alerts were submitted per month
    - Overall closed-loop communication time compliance rate of 99%

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BACKGROUND

- Prior to intervention, 89.8% of alerts went to providers with up-to-date contact information in our critical result alert system
    - 10.2% of alerts were for providers with missing or incorrect info, potentially delaying notification
- Red alert time compliance was also not entirely reliable
    - Prior to intervention, the time from report finalization to Red alert closed-loop communication was tracked
    - Need to know time from identification of the critical finding to closed-loop communication
    - Time stamp statement (Macro critical) added to all users' Powerscribe macro list to document time of Red level finding identification

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INTERVENTIONS

- Critical Results reporting protocol was streamlined and posted in a prominent position on our departmental webpage

- Protocol was distributed to radiology faculty and residents, with periodic reminders (emails, meetings)

- Event reports (iCare) were generated for instances of inadequate Red alert documentation

- To address the referring provider contact database, we actively engaged providers and leadership to increase submission of current contact info

| UMMC Imaging Services Critical Results Protocol		Revised: 01/13/2021
The following list is **not all-inclusive** and represents select examples of UMMC's Radiology Critical Imaging Findings. Ultimately, it will be the interpreting radiologist's own professional judgment how to classify a critical imaging finding in light of all circumstances presented.		
RED CRITICAL FINDINGS COULD BE LIFE-TREATENING – ALL CONTACT ATTEMPTS SHOULD BE DOCUMENTED IN THE REPORT (WHO you attempt to contact and at what TIME via what ROUTE and the OUTCOME of each attempt – send RED Alert if no reply within 20 minutes)		
RED RESULTS (CRITICAL FINDINGS)	**ORANGE RESULTS & LUNG NODULE SUSPICIOUS**	**YELLOW RESULTS & LUNG NODULE NEEDS FOLLOW-UP**
Compliance Goal = 60 minutes from identification. **Note time of identification in report using Macro Critical	*Compliance Goal = 12 hours*	*Compliance Goal = 24 hours*
Tension pneumothorax or pneumomediastinum	Unexpected/Acute pneumomediastinum	Incidental findings requiring follow-up (i.e. liver/kidney/pancreatic mass)
New/Acute/Massive pulmonary embolism	Unexpected/Acute pneumothorax	Unexpected/Acute pneumonia
Ruptured/Leaking/Dissected aortic aneurysm	Unexpected/Massive pleural effusion	Incidental/Enlarged AAA
Unexpected/Acute pneumoperitoneum	Unexpected/Acute infection, any location	Lung nodule requiring follow-up (Lung Nodule Alert)
Unexpected/Acute pneumatosis intestinalis	Line/Tube inadequate placement	Incidental intracranial aneurysm
Pediatric small bowel obstruction	New suspected malignancy (Lung Nodule Alert)	Unexpected/Acute diverticulitis
Gastrointestinal volvulus	Unexpected/Acute pancreatitis	Unexpected/Acute bowel obstruction, adult
Intussusception with bowel obstruction	Unexpected/Acute biliary obstruction	Any findings where specific imaging follow-up is recommended
Pediatric Intussusception	Unexpected/Acute cholecystitis	
Unintended retained foreign object or surgical item	Unexpected/Acute appendicitis	
New intracranial hemorrhage	Unexpected/Acute pseudoaneurysm	
Unexpected/Acute hemorrhage, any location	Pediatric pyloric stenosis	
Acute cerebral thrombosis	New or acute venous thrombosis	
Acute arterial thrombosis (non-cerebral)	Unexpected new fracture	
Pediatric non-accidental injury	Impending pathological fracture	
New or acute cervical spine fracture with suspected spinal cord injury	New, unexpected spinal cord edema	
Any acute life or limb threatening finding requiring immediate clinical attention	Unexpected/Acute hydrocephalus or pneumocephalus	
	Acute occluded bypass graft	
	Unexpected stent graft leak	
	Ovarian or testicular torsion	
	Ectopic pregnancy	
	Any acute or unexpected finding requiring urgent clinical attention	

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METRICS

- Critical Results Coordinators (WCH, KNM) tracked data over 15 months utilizing our critical results software (PowerConnect):
  - Numbers of critical alerts
  - Alerts to providers without contact information
  - Red alert documentation compliance
  - Compliance with communication times
- All changes were attributed to our interventions
  - No other concurrent interventions involving critical alert utilization
  - No statistically significant change in the rate of increase in monthly exams post-intervention (132/month, 95% CI: –378.4—383.5) vs. pre-intervention (2.5/month, 95% CI: –262.5—525.8) (p=0.705)

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ANALYSIS

- Collected data was plotted versus time, and trendlines were generated for each variable, along with 95% confidence intervals
- Trendline slope was interpreted as the average monthly change in each parameter
- Change-point analysis versus pre-intervention data was performed by statistician (STL) to determine statistical significance

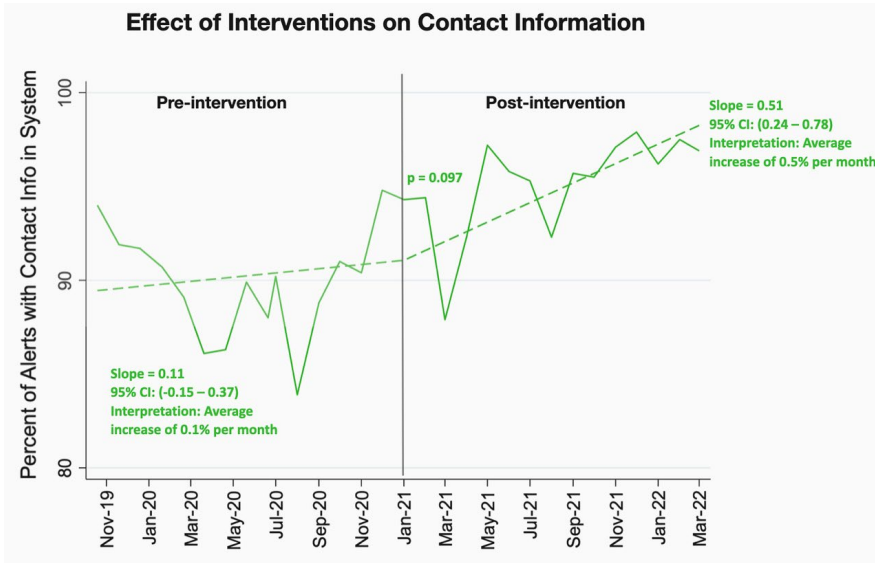THE UNIVERSITY OF MISSISSIPPI
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RESULTS

Effect of Interventions on Critical Alert Numbers
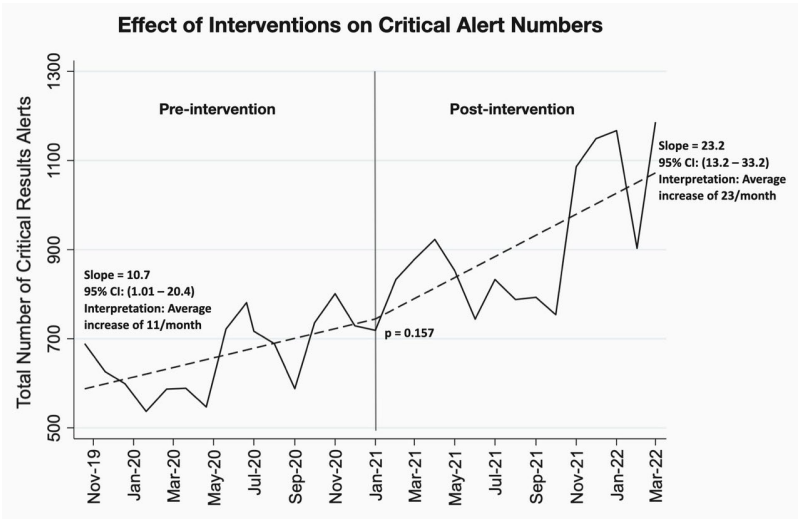
- Average increase of 23 total alerts per month, increased from 11 per month prior to intervention (p=0.157)

Effect of Interventions on Critical Alert Numbers
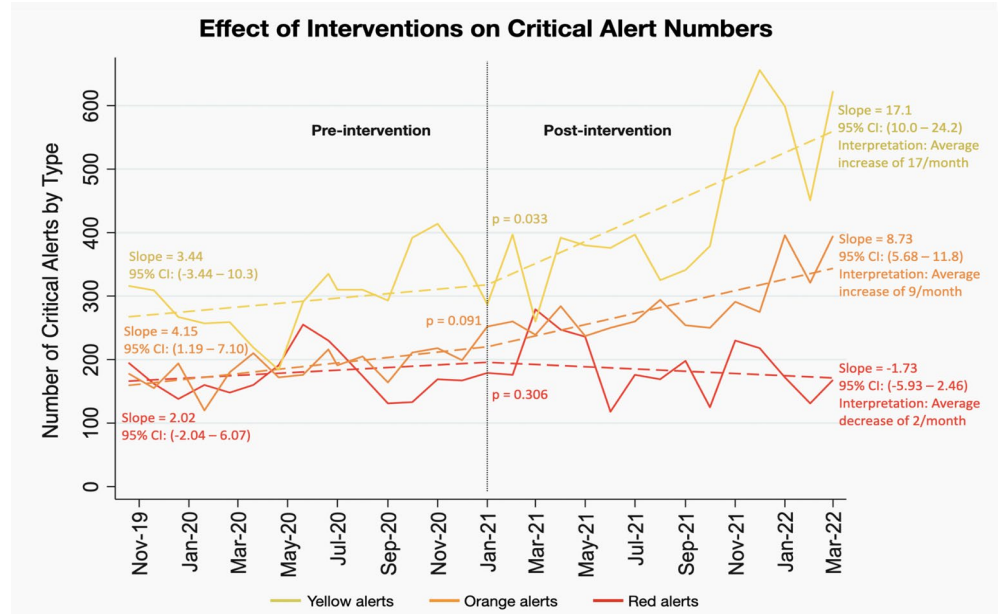
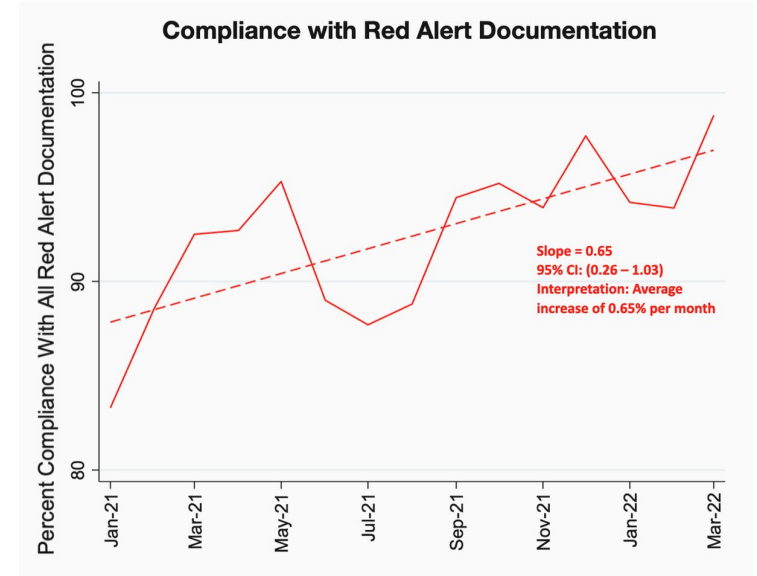- Yellow alerts (non-urgent follow-up) increased 17 per month on average, up from 3 per month (p=0.033*)
- Orange alerts increased 9 per month, up from 4 per month (p=0.091)
- Red alerts remained essentially unchanged

RESULTS

Effect of Interventions on Contact Information

Pre-intervention | Post-intervention

p = 0.097

Slope = 0.51
95% CI: (0.24 – 0.78)
Interpretation: Average increase of 0.5% per month

Slope = 0.11
95% CI: (-0.15 – 0.37)
Interpretation: Average increase of 0.1% per month

Compliance with Red Alert Documentation

Slope = 0.65
95% CI: (0.26 – 1.03)
Interpretation: Average increase of 0.65% per month

- Average 0.5% monthly increase in alerts to providers with current contact info, up from 0.1% pre-intervention (p=0.097)

- Compliance with Red alert documentation increased 0.65% per month

Closed-loop communication time compliance remained ≥99% post-intervention

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CONCLUSION

- Implementation of a quality improvement project to increase usage of the critical alert system increased the number of alerts generated per month
- In particular, there was a statistically significant increase in Yellow alerts, improving communication of follow-up recommendations for important incidental findings
- Our interventions also resulted in improved documentation for emergency Red alerts and in an improved provider contact information database
- The major limitation of our project was that it did not look at findings that should have generated an alert per our protocol, but did not
- Compliance with closed-loop communication time goals was not sacrificed to achieve these results

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