GO WITH THE FLOW: LEVERAGING THE ELECTRONIC MEDICAL RECORD TO ENHANCE CONTRAST SAFETY

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Disclosures

- Travis Browning, MD
  - Physician Advisory Council
    - Hewlett-Packard through VisionIT
  - Clinical Advisor
    - McKesson Enterprise Medical Imaging Group
- Julie Champine, MD
  - None
- Kristen Bishop, MD
  - None
- Jason Wachsmann, MD
  - None
Background

- Imaging contrast agents are the most commonly used medications in radiology departments
  - Enhance visualization of anatomic structures
  - Provide perfusion characteristics of tissue
- Iodinated contrast is one of the most common contrast agents used
  - Useful for CT, fluoroscopy, and invasive intravascular imaging
- Critical to be administered safely
  - Contrast induced nephrotoxicity (CIN)
  - Contrast allergies
  - Metformin
  - Administered only when indicated

Purpose

- Leverage the tools within the Electronic Medical Record (EMR) to facilitate identification of patients at risk for adverse events related to iodinated contrast and embed clinical decision support
  - At order entry
  - At order review and protocol
  - At exam preparation and performance
  - Using
    - Information displays and print groups
    - Order sets
    - Best Practice Alerts (BPA)
    - Workflow processes – protocling, technologist navigators
“Grouper” Build

- Our EMR (Epic Systems, Verona, WI) includes a “Grouper” functionality
  - Allows for custom grouping of orders, medications, other elements
    - Separate from other categories like modality, anatomy, location, class, etc.
  - Used to facilitate clinical decision support
- We developed 2 groupers for our use:
  - Contrast Grouper – included all types of iodinated contrast
  - Contrast Exam Grouper – included all exams that use iodinated contrast
Simply displaying needed information at the time of decision making aids in clinical decision support.

We utilized the two basic paradigms of clinical decision support workflow:

- **Passive** – no action required to have information display
  - Does not interrupt workflow
- **Interruptive** – based on an action taken
  - Display of information interrupts the user workflow
  - Forces action, acknowledgement

Renal labs display at order entry. Abnormal results highlighted automatically by the system.
Interruptive – Allergy Alert at Order Validation

Medication allergy alert firing at signing of order. Provides no further support, but requires acknowledgement to proceed.

Electronic Protocoling

- Electronic protocling allows protocol selection to be discretely captured in the EMR
- Can be made visible in other electronic workflows as information display
- Allows for auditable timestamp and provider identification
- Mimics those elements of Computerize Provider Order Entry
- Can be considered the radiologist’s “orders”
  - Initiate non-provider workflows and care protocols
    - Contrast administration
    - Lab draws
    - Renal prophylaxis regimes
Electronic Protocoling

- Common contrast alterations can be entered by radio button or free text. Will display for the scheduler and performing technologist.

Order Sets

- Preprogramed groups of orders utilized in specific clinical situations
- Reduce time and error in order entry
- Within our EMR, order set have a unique identifier allowing for track of usage
  - Who, when, where
  - Measure, evaluate, monitor
- Our order sets for contrast safety
  - Contrast allergy prophylaxis
  - Renal nephrotoxicity prophylaxis – hydration protocol
  - Inpatient
  - Outpatient
Order Sets – Hydration

- IV hydration prophylaxis protocol
  - Initiated by radiologist protocoling step
    - Nursing Cr/eGFR testing if patient meets specified criteria and no result within 30 days
      - Or otherwise specified in radiologist entered protocol
    - Initiation of IV hydration if eGFR 30-59
      - Performed by radiology for outpatients
      - Suggested to treatment teams for inpatients
    - Outpatient to return in 48 hours for repeat Cr check in radiology
    - If worsened, radiologist is notified for further instructions

Hydration Prophylaxis Order Set

![Graph showing hydration prophylaxis order set over time]

- **AMBULATORY RENAL INSUFFICIENCY BPA ALERT**
  - I will Remove the Order
    - 107 155 115 125 144 84 119 113 104 113 124 141
  - Not Done-Medical Reason
    - 1 4 5 1 1 3 1 1 4 3 2 5
  - Patient has Tolerated Therapy Previously
    - 15 14 26 21 23 17 17 16 18 24 22 20

- **INPATIENT RENAL INSUFFICIENCY BPA ALERT**
  - 294 348 327 316 281 320 325 303 393 342 330 358
  - Other
    - 44 53 58 49 37 53 30 42 72 48 58 48

- Grand Total
  - 452 558 503 492 489 461 488 467 582 526 525 578
Best Practice Alerts (BPA)

- BPAs are an interruptive form of clinical decision support
- Displays patient specific data
- Offers recommendations or guidelines on actions to take
- Can facilitate taking those actions
  - Embedded hyperlink to recommended orders or order sets
  - Track acknowledgement and justification responses
- System logic created to determine when BPAs “pop-up” to alert
- EMR “Groupers” facilitate this workflow
  - For example, if ordering an exam in the “Contrast Exam Grouper” and patient has an allergy to a medication in the “Contrast Grouper”, then trigger Contrast Allergy BPA
BPA – Renal Insufficiency

Renal insufficiency BPA triggers when ordering Contrast Exam Grouper test with last eGFR <60. The inpatient version includes hyperlink to inpatient hydration order set for consideration. Outpatient is only informative, as hydration is directed by the radiology department.

BPA – Contrast Allergy, BPA – Metformin

Contrast Allergy BPA displays the type of allergen and type of reaction. Also used to facilitate proper prophylaxis orders when appropriate.
BPA – Allergy Alerts, Prophylaxis Order Set Usage

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<td>92</td>
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<td>Not a true allergy</td>
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BPA – Metformin Alerts

- This BPA is primarily for information display
- Remind inpatient provider patient is on metformin and will need to hold for contrast imaging
- Remind inpatient provider ordering metformin patient has recently had contrast imaging and need to check renal status

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Workflow Navigators are used in the EMR to facilitate proper completion of certain tasks
- Organized as a sequential series of steps
  - Differing elements can display based on patient characteristics
    - Gender, age, other data elements
- Captures answers/acknowledgement entries
- Supports cascades of additional questions based on earlier answers
- Displays information
  - Reminders to perform IV assessment and review renal labs
- Auditable

Radiologist entered protocol details from electronic protocoling step.

Cascade question displays based on preceding answer become interruptive reminders to perform IV safety checks.
Technologist BPA fires if the ordered exam is a noncontrast exam, but the technologist answers “Yes” to the “Will IV contrast be used?” question.

- Possible near miss if tech preparing to give IV contrast when not ordered or protocoled for it
- Possible billing issue resolved when protocoled to give IV contrast but tech forgot to change the orderable to match

BPA Alert activated February 2015
- Fired 36 times between February 1st and July 31st, 2015
- 19 possible near miss IV contrast administration
  - 12 different technologists
- 9 reminder to change orderable to match protocol
  - Ordered as W/O IV contrast, protocoled with IV contrast
  - 7 different technologists
- 5 workflow issues
  - Noncontrast exam processed in Epic AFTER contrast exam
  - 4 different technologists
- 3 unclear how triggered
  - 2 exams ordered and protocoled with IV contrast, but changed to noncontrast due to day of exam eGFR
  - 1 exam ordered with IV contrast, protocoled without contrast, and technologist appropriately handled

Exam Begin Navigator BPA – Outcomes
Exam Begin Navigator – Outcomes

Possible Near-Miss IV Contrast Administration Prevented by BPA (19)
Average Days Between = 9.7; Median Days Between = 6.0

Possible Near-Miss IV Contrast Administration Prevented by BPA (19)
Technologist Specific

Circles indicate recurrence by the same tech, helping to identify when an intervention is needed.

Exam Type Changes for Proper Coding Aided by BPA (9)
Average Days Between = 20.3; Median Days Between = 17.9
Conclusions

- Leveraging tools and workflows within the EMR can facilitate identification and management of patients at risk from allergies or nephrotoxicity related to iodinated contrast.
- Embedding contrast related workflow tools at exam order entry, exam protocoling, and Exam Begin processes can produce a multilayer system of safety.