Document Management – An Electronic Tool to Optimize Documentation and Orders Related to Children Undergoing CT and MRI

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Introduction / Problem

- During the radiology leadership rounds in CT and MRI, a concern was raised regarding excessive paperwork requirements
  - ♦Documentation of contrast orders
  - ♦Flushing lines orders
  - ♦IV documentation
- Inefficiencies associated with excessive documentation were far-reaching
  - ♦Adverse effect on patient flow
  - ♦Adverse effect on employee and patient satisfaction
  - ♦Increased time requirements for technologists
    - ■ Time required to complete the paper order forms
    - ■ Time spent tracking down a radiologist for a signature
  - ♦Lost forms
  - ♦Transfer to medical records
- Excessive documentation had a potential impact on patient safety
  - ♦Technologists often had to leave the scanner to find a physician to sign an order
    - ■ Patient left on scanner while orders were signed
  - ♦Manual calculation of contrast dosages

Resolution: Develop Electronic Document Management System

- An electronic, web-based Document Management system was created using
  - ♦Microsoft 2003 Server (Microsoft, Redmond, WA)
  - ♦Microsoft IIS web services (Microsoft, Redmond, WA)
  - ♦Microsoft SQL 2003 (Microsoft, Redmond, WA)
  - ♦Microsoft Visual Studio 2005 (Microsoft, Redmond, WA)
  - ♦HL7 interfaces developed for orders and results
- Requirements of document management system
  - ♦Manage all orders, documentation and signatures for radiology contrast administration as well as other paperwork
  - ♦Replace multiple paper forms (Fig. 1)
    - ■ Radiology transfer orders for patients receiving anesthesia
    - ■ Radiology (CT/MR/Radiograph) contrast media order form
    - ■ Radiology IV request
    - ■ Radiology orders for flushing central venous/peripheral lines
    - ■ Procedure verification checklist
    - ■ Radiology Sweet Ease orders (used to comfort/calm infants)
  - ♦Technologists, nurses and radiologists electronically complete the appropriate orders (Fig. 2)
  - ♦Radiologist receives alerts through the hospital paging system when an order is ready to be signed (Fig. 3)
  - ♦System documents
    - ■ Order data
    - ■ User completing the task
    - ■ Date and time stamp each action

Methods

- A retrospective study was performed to evaluate the impact of the document management system
- Evaluated multiple variables
  - ♦Technologist efficiency
    - ■ Time motion studies were performed before and after implementation of the system
    - ■ Time spent completing forms both before and after implementation
  - ♦Use of the system
    - ■ The total number of orders signed in document management system
  - ♦Effectiveness and compliance with hospital medical record regulations
    - ■ Electronic medical record was sampled before and after implementation
      - ❖ Percentage of orders present
      - ❖ Percentage of orders containing dosing errors
  - ♦Technologist survey to evaluate perception of gains in
    - ■ Workflow efficiency
    - ■ Patient safety

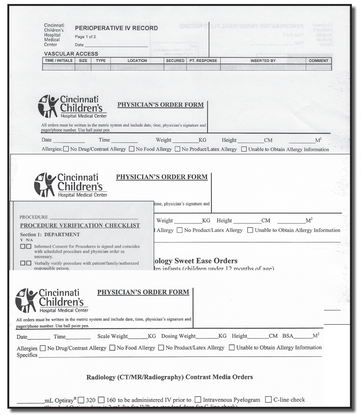

Figure 1. *Manual paper process involved completing paper forms. Six forms the Document Management system automates include: 1) Radiology Transfer Orders for Patients Receiving Anesthesia; 2) Radiology (CT/MR/Radiograph) Contrast Media Form; 3) Radiology IV Request; 4) Radiology Orders for Flushing Central Venous/Peripheral Lines; 5) Procedure Verification Checklist; 6) Radiology Sweet Ease Orders (used to comfort/calm infants)*

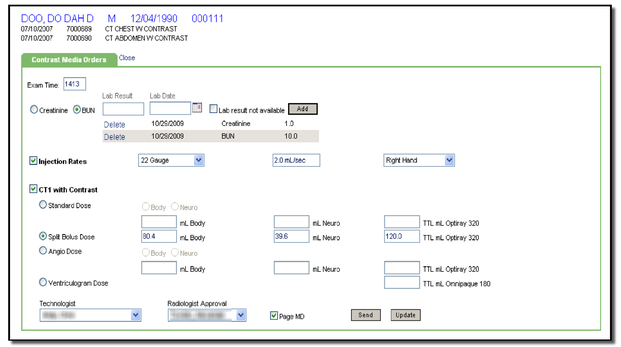

Figure 2. *Electronic Contrast Order Form. Technologist enters patient weight, BUN and creatinine and other pertinent information. The system automatically calculates the amount contrast to be administered. There is an option to page the radiologist Lines; 5) Procedure Verification Checklist; 6) Radiology Sweet Ease Orders (used to comfort/calm infants).*

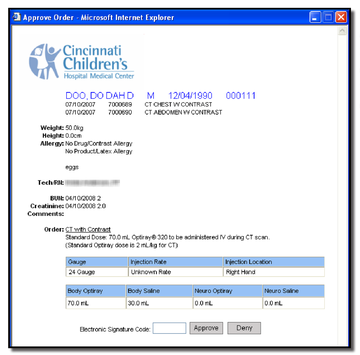

Figure 3. *Electronic Physician Approval Form. The radiologist is alerted via pager that there is a contrast order to be approved. The radiologist is able to access the system from any hospital computer to approve or deny the order.*

Results / Impact on Safety

- System implemented in July, 2007
  - ♦81,370 orders signed electronically between July, 2007 and June, 2009
- Improvement in efficiency seen on time-motion study
  - ♦67% gain in efficiency
  - ♦Time to complete orders dropped from 15 minutes to 5 minutes
- Improved compliance with hospital medical record submission
  - ♦Submission of the order to medical records increased from 94.3% prior to implementation to 100% after implementation
- Improved accuracy of orders
  - ♦2% of the manual forms contained an error in the calculation of the contrast dose
  - ♦0 errors in electronic forms
- Improved safety and efficiency (figure 4)
  - ♦Survey of technologists (23 of 30 technologists responded)
    - ❖ 87% responded that it has improved patient safety
    - ❖ 78% responded it has improved employee satisfaction

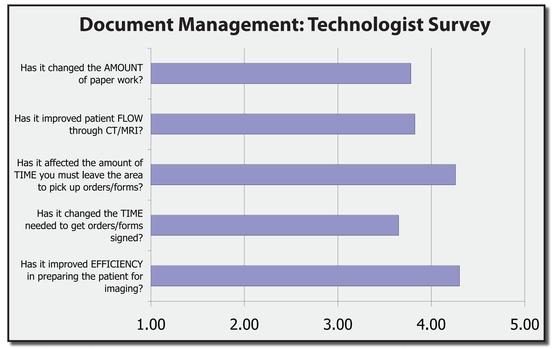

Figure 4. *Results from technologist survey shows the positive impact the Document Management system had on their perception about patient flow, safety and efficiency. The bar graph represents the average score using a 5-point Likert scale where 1 = no improvement to 5 = high improvement.*

Discussion

Lessons Learned

- Benefits gained from the document management system
  - ♦Significant time reduction
    - ■ Computerized system to complete orders and hospital documentation
    - ■ No need to track down radiologist for signature
      - ❖ Radiologist automatically paged when a new order is present
      - ❖ Electronic signature of orders
  - ♦Fewer errors
    - ■ Automatic calculations based on patient weight and age
  - ♦Improved patient safety within the department
    - ■ Technologists no longer need to leave patients unattended
  - ♦Improved patient throughput
    - ■ More timely approval of forms
    - ■ Particularly important with sedation patients
  - ♦Improved compliance with hospital medical records
    - ■ Output from document management system produces hospital approved form
    - ■ System directly faxes contrast orders to the hospital pharmacy
      - ❖ Reduces the time it takes to complete order approval
    - ■ Improved accessibility of completed forms
      - ❖ Able to view old orders through document management system
  - ♦Increased technologist efficiency
    - ■ Less paperwork
    - ■ Less back-and-forth to have orders signed
    - ■ Increased patient throughput
    - ■ Fewer angry families
- Deficiencies of the system
  - ♦Standalone not integrated to other hospital systems [1,3]
  - ♦Only accessible within Radiology
  - ♦Requires manual entry of BUN, creatinine and weight
  - ♦Home grown system – correcting problems requires internal support [3]
- Numerous studies investigating the effects of electronic order entry systems [1,2,3,4]
  - ♦ Consistent findings with this study
    - ■ Error reduction
    - ■ Automated dosage calculations
    - ■ Historical access to information
      - ❖ Forms filed automatically to medical records
    - ■ Efficiency gains
      - ❖ Remote accessibility of the system
      - ❖ Automatic notification
      - ❖ Variable depending on study
  - ♦ Efficiency gains reported in this study are higher than others

Study Limitations

- Survey was limited to radiology technologists
  - ♦Nurses, radiologists, and patients were not surveyed

Conclusions

- Electronic Document Management system was successfully implemented to automate the documentation and order signing process in radiology
- This system has increased technologist efficiency and improved patient safety
- The number of medication errors has decreased due to an automated dosing calculator
- Order documentation has improved due to automatic electronic submission of the orders directly to the hospital's medical records department

References

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