Improving Patient Follow-Up Imaging Using Artificial Intelligence

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Financial Disclosures

None.
Background

Why recommend follow-up imaging?
- Monitor interval change versus stability
- Characterize abnormalities
- Ensure resolution of disease
- Improve outcomes with earlier diagnosis

Adverse risks of failing to comply:
- Delayed treatment
- Poor patient outcomes
- Additional unnecessary testing
- Lost revenue
- Legal liability

Previously existing compliance analysis of *Einstein* radiology reports with *pulmonary nodule* follow-up recommendations

24% adherence rate 😞

...and beyond *Einstein?*

12% of potential malignancies not followed up appropriately

> 35% non-adherence rate of follow-up imaging recommendations

Currently at Einstein…

• “ACT 112” command during dictation to document that a letter has been sent
• Patients receive letter within 20 days...beyond that?
• Radiologist receives no confirmation that the patient has received the letter
• No system to determine adherence of follow-up recommendations
• No reminder system for follow-up
Objective

To improve patient compliance rates for follow-up imaging recommendations by implementing a natural language processing (NLP) algorithm and a tracking and reminder system that:

- identifies patients who require follow-up imaging based on radiology reports
- organizes follow-up recommendations by due date
- reminds patients of due or overdue recommendations

OUR GOAL

is to incorporate as much automation as possible, particularly due to the lack of a nurse navigator.
Methods

• All outpatient diagnostic radiology reports at our institution from January 1, 2020 through April 30, 2021 that generated an Act 112 notification

• Reports processed through a NLP algorithm (Within Health, Brooklyn, NY) to determine the following:
  • Recommended radiologic examination (modality & anatomy)
  • Recommendation due date
    • Specified in the report
    • Assumed to be 3 months from the date of the examination if no time interval was provided

• Compliance Range: defined in accordance with the American College of Radiology (ACR) as the period that begins 30 days before and ends 60 days after the due date

• Expiration Date: defined as 60 days after the due date

• Deemed compliant if recommendations with completed follow-up examinations fell within the compliance range

• Automated tracking and reminder system (Within Health, Brooklyn, NY) to determine if follow-up imaging was scheduled or completed
<table>
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<th>Term</th>
<th>Definition</th>
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| Baseline Compliance Rate                  | Patients that already had follow-up at the beginning of the designated time period  
*Helps to determine patients at risk of falling out of compliance for follow-up*                                                        |
| At-Risk Population                        | Patients approaching the end of the adherence range, excluding those already at compliance  
*Intervention group received a short message service (SMS) communication and then up to 3 additional notifications unless/until the follow-up examination was completed or scheduled*                               |
| Compliance at End of Adherence Range      | % of recommendations with completed or scheduled follow-ups at the end of the compliance period                                                                                                             |

**Outcome measures:**
- Baseline compliance rate
- At-risk population
- Compliance rate in the at-risk population
- Differences in the compliance rates and percentages of compliance rate change

- Fisher’s exact test and chi-squared test
- Statistical significance was set at $P<0.05$

### Table

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<thead>
<tr>
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<th>Control Group</th>
<th>Intervention Group</th>
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<tbody>
<tr>
<td>Received initial Act 112 letter?</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Received reminder messages?</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Intervention Time Frame</td>
<td>January 1-February 28, 2021</td>
<td>March 1-April 30, 2021</td>
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Control Group
Received initial Act 112 letter
But did not receive reminder messages

Intervention Group
Received initial Act 112 letter
Additional communication providing reminders about follow-up imaging

• 364 reports with recommendations
• 100 recommendations in the control group were compliant at baseline (27.5%)
• At-risk population:
  n = 264 recommendations
• 145 recommendations (39.8%) were compliant at the end of adherence range
• The compliance rate change from baseline was 12.4% → 45% improvement

• 438 reports with recommendations
• 137 recommendations in the intervention group were compliant at baseline (31.3%)
• At-risk population:
  n = 301 recommendations
• 214 recommendations (48.9%) were compliant at the end of adherence range
• The compliance rate change from baseline was 17.6% → 56.2% improvement

The compliance rate in the at-risk population was 17.1% for the control and 25.6% for the intervention (P=0.003)
Limitations

• Only outpatients (PA Act 112)
• Heterogenous application of Act 112 amongst radiologists
  \[i.e., \text{some recommended follow-up} > 3 \text{ months}\]
• Not all patients can receive SMS reminders
  • Phone number provided does not belong mobile phone
  • Phone number listed belongs to a family member or friend
• Follow-up data
  • No visibility on follow-up performed at another institution
  • No visibility on compliance if follow-up is not clinically needed per referring provider
• Prior compliance data analysis performed on lung nodule follow-up and pre-COVID using different methodology with mPower analytics
• COVID increased quarantine restrictions and decreased hospital visits
Conclusion

• Implementation of a NLP algorithm and tracking and reminder system provides automation in identifying patients with follow-up imaging recommendations and distributing reminder notifications to patients regarding due or overdue follow-up recommendations.

• Compared to patients who were only informed of follow-up recommendations by a letter at the time of the initial examination, patients receiving additional reminder notifications had significant improvement in compliance with recommended follow-up imaging.
References


