Abstract IHI ID 03 Table 1

<table>
<thead>
<tr>
<th>Cancer Trigger</th>
<th>Unique Patients with Trigger Positives</th>
<th>Unique Patients Seen</th>
<th>Timeframe</th>
<th>PPV % (95% CI)</th>
<th>NPV % (95% CI)</th>
<th>Extrapolated Sensitivity % (95% CI)</th>
<th>Extrapolated Specificity % (95% CI)</th>
<th>Estimated Number of Diagnoatic Delays Found per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bladder</td>
<td>495</td>
<td>310,331</td>
<td>Jan 2012–Dec 2014</td>
<td>58.0 (53.0-63.2)</td>
<td>97.0 (90.8-99.2)</td>
<td>64.1 (59.4-68.5)</td>
<td>96.2 (95.6-96.6)</td>
<td>95.7</td>
</tr>
<tr>
<td>Breast</td>
<td>552</td>
<td>365,686</td>
<td>Jan 2010–May 2015</td>
<td>70.8 (66.0-75.1)</td>
<td>93.0 (85.6-96.9)</td>
<td>76.8 (72.7-80.4)</td>
<td>90.8 (89.2-92.1)</td>
<td>72.2</td>
</tr>
<tr>
<td>Colorectal</td>
<td>1,073</td>
<td>245,158</td>
<td>Jan 2013–Dec 2013</td>
<td>56.0 (51.0-61.0)</td>
<td>88.0 (79.6-93.4)</td>
<td>86.4 (79.3-93.5)</td>
<td>81.7 (75.5-85.2)</td>
<td>600.9</td>
</tr>
<tr>
<td>Hepatocellular</td>
<td>130</td>
<td>333,828</td>
<td>Jan 2011–Dec 2014</td>
<td>82.3 (74.4-88.2)</td>
<td>98.0 (92.3-99.7)</td>
<td>89.1 (81.8-93.8)</td>
<td>96.5 (94.8-97.7)</td>
<td>26.7</td>
</tr>
<tr>
<td>Lung</td>
<td>655</td>
<td>208,633</td>
<td>Jan 2012–Dec 2012</td>
<td>60.5 (55.5-65.3)</td>
<td>97.0 (90.8-99.2)</td>
<td>91.7 (88.6-94.1)</td>
<td>81.7 (79.6-83.7)</td>
<td>396.3</td>
</tr>
</tbody>
</table>

*CI=Confidence Interval

Abstract IHI ID 04

**Application of Electronic Trigger Tool Methods to Identify Targets for Improving Diagnostic Safety**

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**Background**

Failure to follow-up abnormal test results can lead to patient harm.

**Objectives**

We created and validated electronic trigger algorithms that analyzed electronic health record (EHR) data from a large Veterans Affairs (VA) network to identify patients with potential delays in diagnostic evaluation for multiple cancers.

**Results**

The proposed methodology was tested on one of Kaiser’s target clinical areas of importance, interventional cardiology. Three potential improvement opportunities were identified:

1. network leakage;
2. avoidable hospital days; and
3. preventable 30 day hospital readmission.

Preliminary estimates suggested that our data could lead to approximately 1 million dollars in savings and up to 250 avoided hospital days while improving the quality and safety of care to our members.

**Conclusions**

Systematic use of a framework for data exploration may create operational and strategic business value by increasing the speed at which data are transformed into actionable knowledge.
Methods We developed five trigger algorithms to detect delays in diagnostic evaluation of possible bladder, breast, colorectal, hepatocellular, and lung cancer. Each used structured clinical data to identify patient records with red-flags (abnormal test results warranting further diagnostic evaluation). Red-flags included high-grade hematuria (>50 red blood cells/high powered field; bladder cancer trigger), abnormal mammograms (breast cancer trigger), iron deficiency anemia or positive fecal immunochemical tests (colorectal cancer trigger), elevated alpha-fetoprotein (hepatocellular trigger), or chest imaging flagged as suspicious for malignancy (lung cancer trigger). Algorithms excluded records where follow-up was unnecessary (e.g., hospice patient) and records where follow-up was documented within 30 (lung cancer trigger) or 60 days (all others). We validated triggers by applying them retrospectively to EHR data (see table 1 for timeframes and sample sizes).

Results The five triggers yielded PPVs ranging from 56.0–82.3%, NPVs ranging from 88.0–98.0%, sensitivity from 64.1–91.7%, and specificity from 81.1–96.5% (see table 1). We estimated that these triggers have the potential to identify 1192 diagnostic errors in the VA network studied per year.

Conclusions Our triggers have potential to identify large numbers of patients experiencing delays in diagnostic evaluation. Implementing prospective electronic trigger-based measurement systems using these algorithms could support health systems in reducing delays in cancer diagnosis.

Background Rapid growth in patient volumes led to operating above 85% capacity with increased frequency. This growth strained antiquated patient flow processes that had not matured as patient demand increased. With limited options to increase physical capacity, a centralized effort to optimize patient throughput was prioritized at both the macro and the microsystem level.

Objectives Getting the patient to the right place, at the right time, meant instituting a measurement system and standardizing bed management practices across the organization. Targeting delays in patient progression led to defining hospital boarding time as the time when a patient meets medical criteria to transfer to another level of care to the time the patient is transferred.

Methods Multiple plan-do-study-act cycles were completed during a pilot. An Xbar-S statistical process control chart assessed the impact of key interventions over time with a primary goal to reduce process variation to improve flow. Key interventions focused on process re-design, standardization of operational definitions, mistake proofing, and education for sustainability.

Tests performed with unequal sample sizes

Intervention #1: Pilot

Mann-Whitney Test and CI: Pre, Post

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>85.000</td>
<td>80.000</td>
</tr>
<tr>
<td>N</td>
<td>2066</td>
<td>678</td>
</tr>
</tbody>
</table>

Point estimate for n1 - n2 is 5.000
95.0 Percent CI for n1 - n2 is (2.002, 7.001)
W = 2099645.5
Test of n1 ≠ n2 vs n1 = n2 is significant at 0.0003
The test is significant at 0.0003 (adjusted for ties)