EMR Integration and Genomic Medicine Implementation – Big Data, Clinical Disseminations, Clinical Validities & Utilities

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EMR Integration

• Integration involves primarily PGx representation and clinical decision support
<table>
<thead>
<tr>
<th>Site</th>
<th>Drug</th>
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</thead>
<tbody>
<tr>
<td>Mount Sinai, Northwestern, Vanderbilt</td>
<td>CYP2C19 - clopidogrel; CYP2C9 / VKORC1 - warfarin; SLCO1B1 - Simvastatin</td>
</tr>
<tr>
<td>Mayo Clinic</td>
<td>CYP2C19 - clopidogrel; CYP2C9 / VKORC1 - warfarin; SLCO1B1 - Simvastatin; CYP2D6 - Codeine, Tramadol, Tamoxifen</td>
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<tr>
<td>Marshfield/Essentia</td>
<td>CYP2C19 - clopidogrel; CYP2C9, VKORC1, and CYP4F2 - warfarin; SLCO1B1 - Simvastatin</td>
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<tr>
<td>Group Health</td>
<td>HLA B* 1502 - Carbamazepine</td>
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<tr>
<td>Geisinger</td>
<td>CYP2C19 - clopidogrel; CYP2C9 / VKORC1 - warfarin; SLCO1B1 - Simvastatin; IL28B - Interferon response</td>
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<tr>
<td>Cincinnati Children’s</td>
<td>CYP2D6 - Codeine</td>
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<tr>
<td>Boston Children’s</td>
<td>CYP2C9/VKORC1 - Warfarin</td>
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<tr>
<td>CHOP</td>
<td>CYP2D6 - Codeine. SLC02B1 - montelukast; ABCB1 / CYP2C19 - ranitidine + omeprazole; CYP2D6 / ABCB1 / OPRM1 / COMT / UGT2B7 - Morphine</td>
</tr>
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<td>Site</td>
<td>Drug</td>
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<tr>
<td>Northwestern</td>
<td>HFE, Evaluate the use and impact of physician support documents and best practice alerts in the EHR for genomic results</td>
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<tr>
<td>Mayo Clinic</td>
<td>HFE, RCT of communicating genomic risk of a heart attack</td>
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<tr>
<td>Marshfield/Essentia</td>
<td>HFE, Complement Factor H and Macular Degeneration</td>
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<tr>
<td>Vanderbilt</td>
<td>HFE, Reduction of Adverse Drug Events</td>
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<tr>
<td>Group Health</td>
<td>HFE, nonpharmacogenomic results from the PGRN-Seq testing platform (e.g. $RYR1$, $RYR2$, $SCN5A$, etc.)</td>
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<tr>
<td>Mount Sinai</td>
<td>HFE, $APOL1$ and risk of CKD in AA patients with diabetes and hypertension</td>
</tr>
<tr>
<td>Geisinger</td>
<td>HFE, Risk algorithm Abdominal Aortic Aneurysm, Whole Genome Sequencing</td>
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</tbody>
</table>
eMERGE Infobutton Project

Objective 1: To develop a new information resource based on eMERGE II & PGx scenarios

Objective 2: To implement infobuttons within EHRs at eMERGE sites
Objective 1: To develop a new information resource based on eMERGE II & PGx scenarios

- Collect scenarios from involved sites – completed
- Design eMERGE template – completed
- Content developers fill out eMERGE template – in progress
- Engage target end users (physicians and patients) – in progress
- Evaluate resource (survey target end users) – in preparation
Objective 2: Implement infobuttons within EHRs at eMERGE sites

- Fill out site survey – completed
- Engage institutional stakeholders – on going
- Collaborate with University of Utah on OpenInfobutton system and responder – in progress
- Migrate content from Objective 1 to content management system – in preparation
- Configure EHRs for infobuttons – in preparation
- Training & support for installation – in preparation
- Configure information resources (including eMERGE resource) – in preparation
- Evaluate usage over time – in preparation
Challenges

• Implementation of research informatics project into clinical EHR system is really hard
• 1 successful implementation = 1 successful implementation
• Tension and frustration given more rapid pace of eMERGE discovery activities
• eMERGE network outcomes are all process based (some individual site are looking at clinical outcomes)
Challenges

Clayton aphorism
• Each system is built 3 times
  1. To see if it can be built
  2. To determine how it should be built
  3. To actually build it

eMERGE status (Starren)
• eMERGE Phase 2 EHRI relates to Clayton 1\textsuperscript{st} stage with some hope of learning enough to proceed with Clayton 2\textsuperscript{nd} stage
Future direction and opportunities

• Research agenda around actionable clinical decision support (CDS)
  – Optimum way to centralize and distribute standardized evidence-based CDS
  – Determination of accuracy of CDS across genomic medicine use cases
  – Study the impact of CDS on relevant clinical outcomes for selected genomic medicine use cases
Future direction and opportunities

• Study the ability to extract real-time patient level data from transactional EHRs to fire CDS for selected genomic medicine use cases

• Study how EHRs, Personal Health Records (PHRs) and Patient Portals can be used to enhance education of patients and providers
  – Measure comparative effectiveness of different approaches