



Precision Medicine at Intermountain Healthcare

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Executive Director, Precision Genomics
Intermountain Healthcare*

Precision Medicine at Intermountain Healthcare: An Overview

- Clinically implementing precision oncology
- The survival and cost outcomes associated with precision oncology
- Precision Medicine in other medical disciplines outside of oncology

Intermountain Healthcare: An Integrated System

22

Hospitals

180

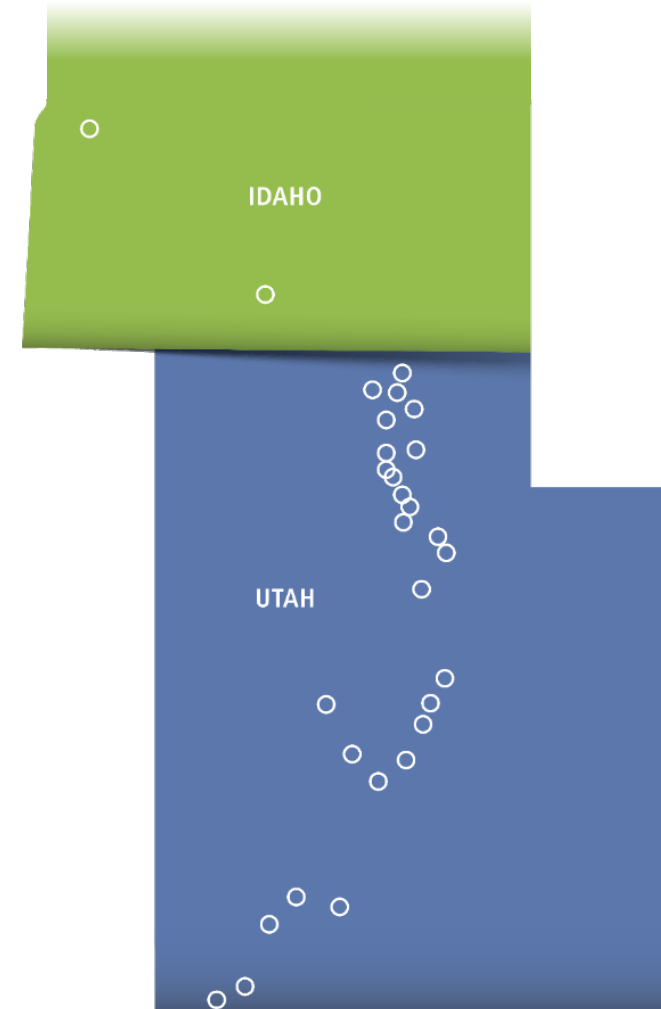
Medical Group
Clinics

2,800

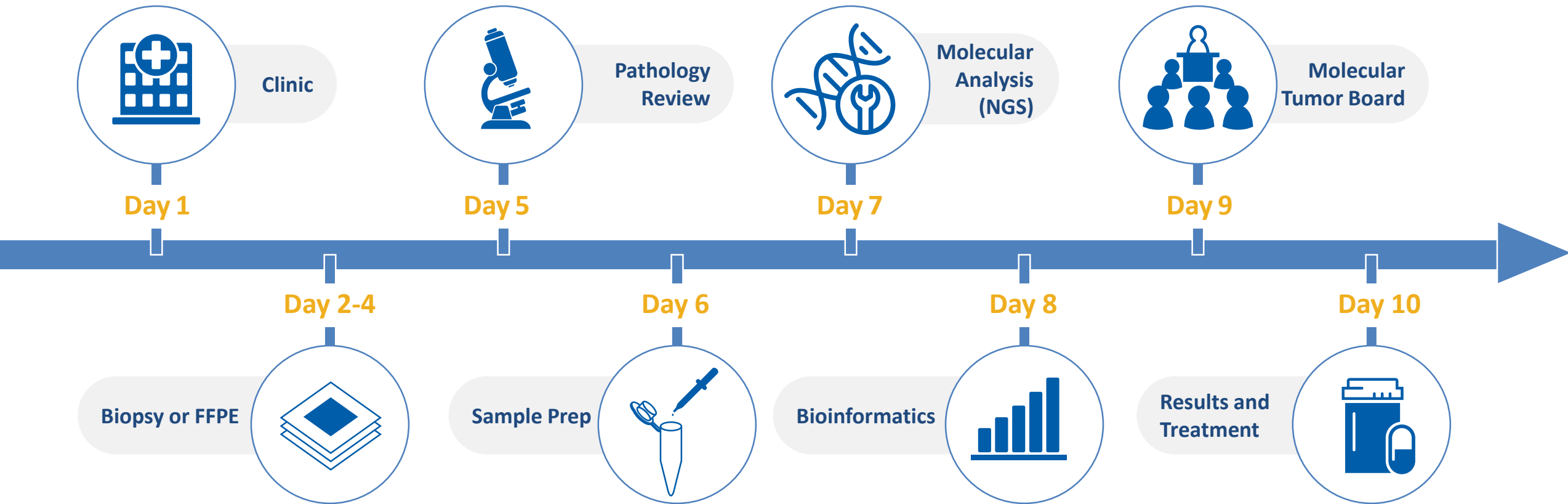
Licensed Beds

875,000

SelectHealth
Members



Precision Oncology Workflow



MTB Interpretation included on the report

TUMOR BOARD REVIEW FOR IMH-244 Hold and Save Complete

Last Action: 2014-11-14 10:56:55 / Workflow: ICG Tumor Panel for TRF-171 / Step record: IMH-244 / Edit note

☒ Preview Report ☐ View & Edit Details

PATIENT
Name
John M. Doe
Patient DOB
1965-01-01
Gender
Male

SPECIMEN INFORMATION
Surgical Procedure Date
11/03/2014
Date Received
11/14/2014
Specimen Source
bladder
Clinical Diagnosis
Bladder Cancer

PHYSICIAN INFORMATION
Ordering Physician
John Dolittle
Ordering Physician Phone
(555)555-5555
Pathology Lab
Path Lab Inc.
Pathology Phone
(555)555-5555

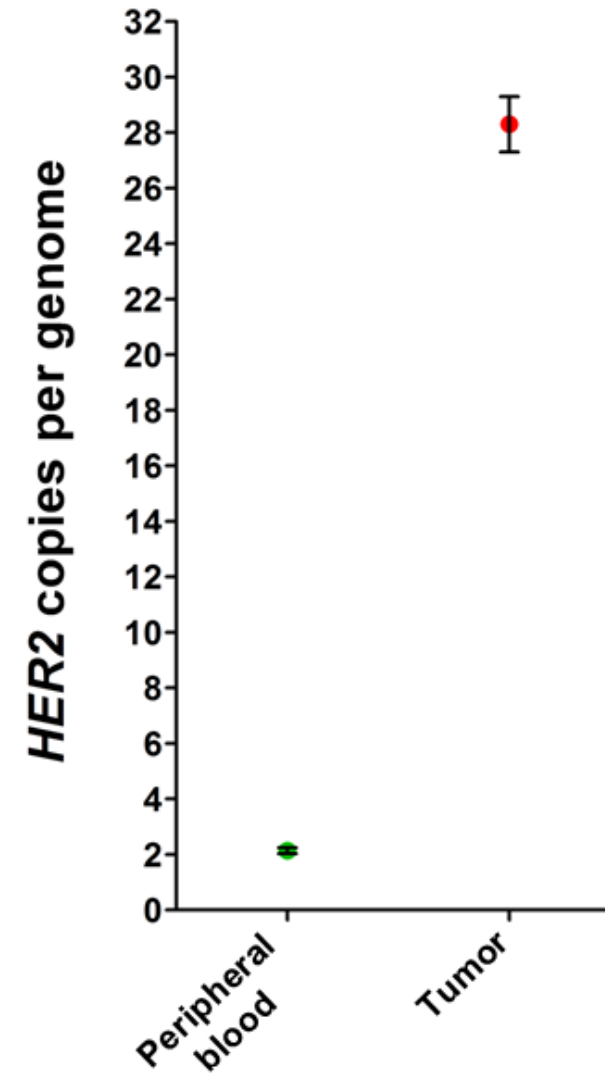
MOLECULAR TUMOR BOARD INTERPRETATION
Edit
Based on the genomic profile of your patient's tumor, the Molecular Tumor Board's interpretation suggests the following potential therapeutic interventions in the ranked list below*

GENE	RANKED LIST OF AGENTS	
EGFR	Afatinib	Order
	Erlotinib	Order

Interp. in the
report

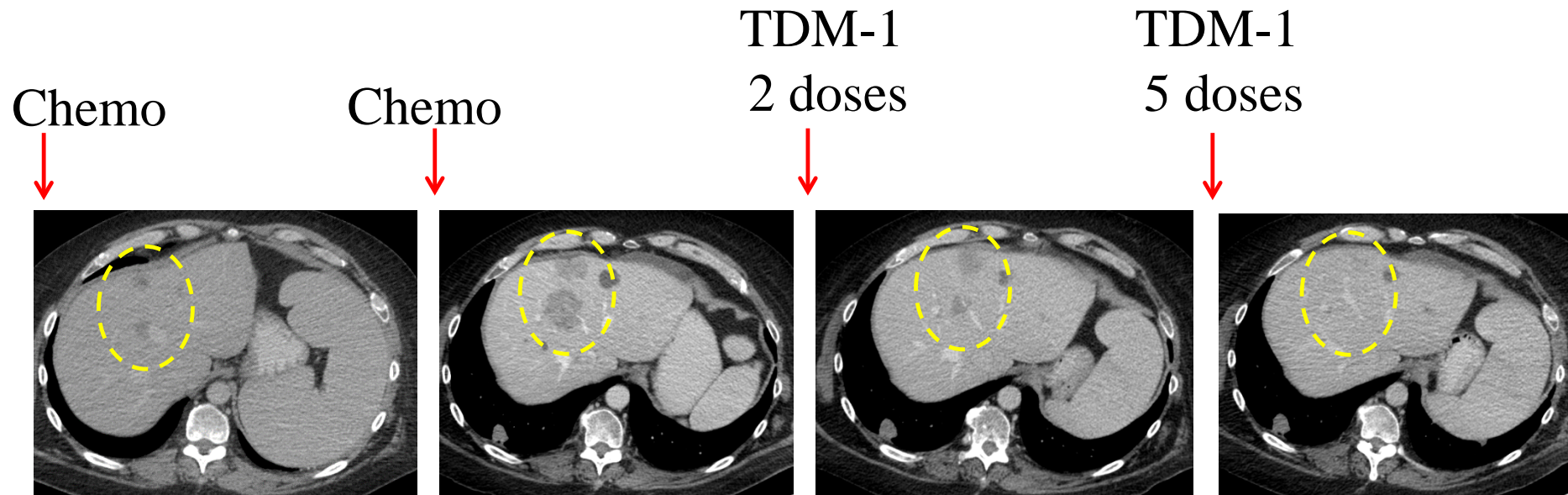
Patient Case: HER2+ Colon Cancer

- 47 yo man with metastatic colon cancer
- Genomic analysis: HER2 amplification



Nadauld et al, JCO-PO, 2017

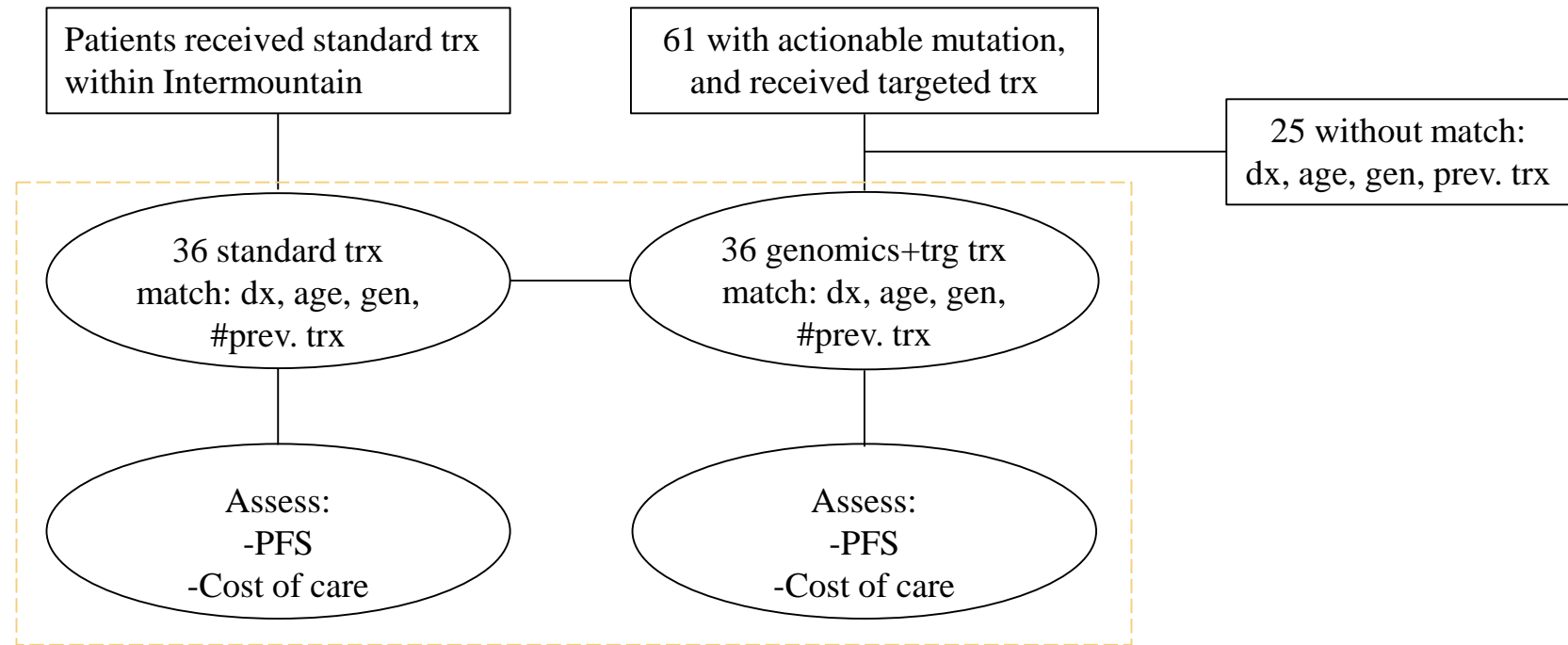
Patient Case: HER2+ Colon Cancer



- Time to response: 2 months
- Total time on drug: 18 months

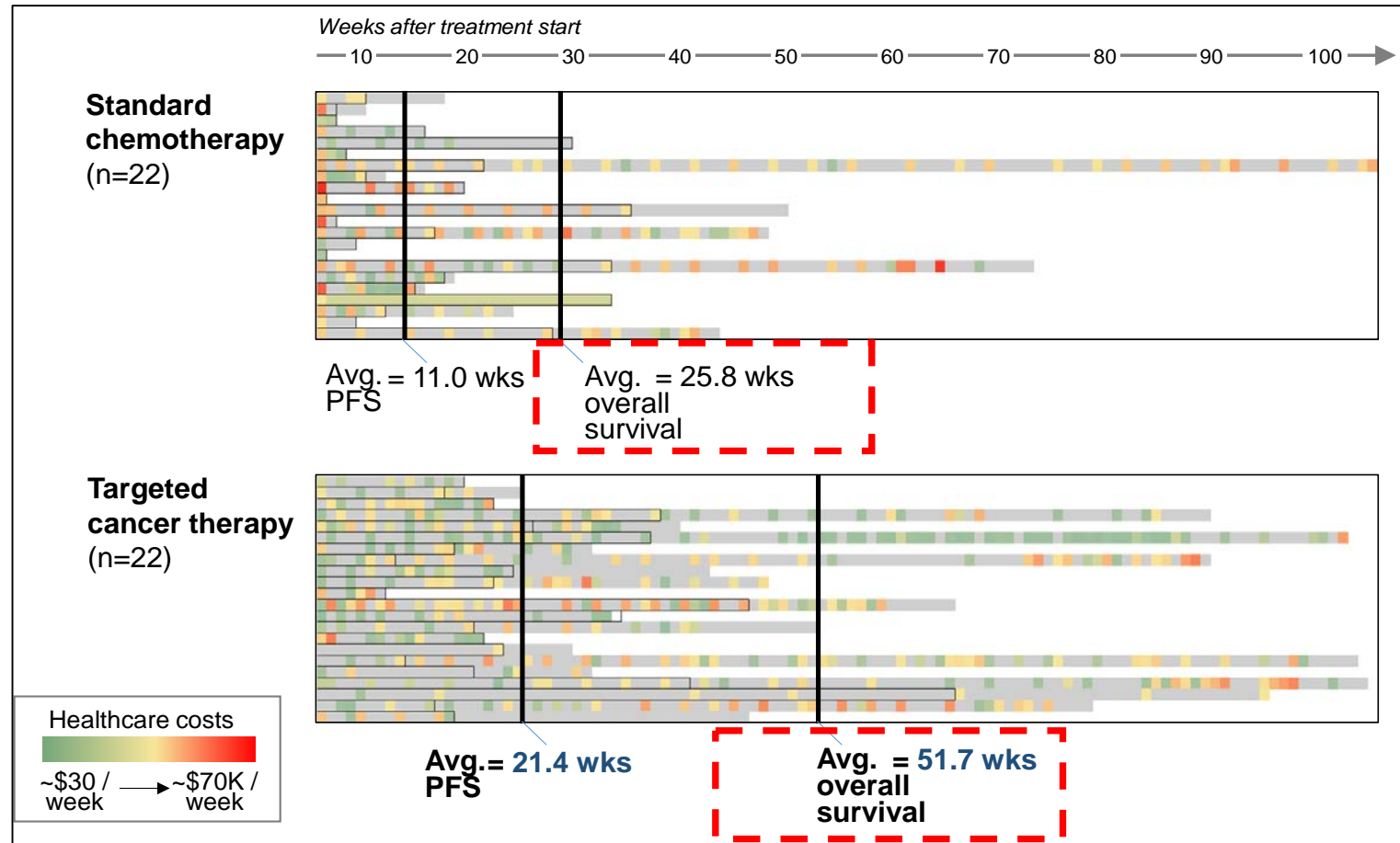
Nadault. JCO-PO. 2017

Intermountain Precision Medicine Cohort Study



Haslem and Nadauld. JOP. 2016

Precision Oncology: Overall Survival

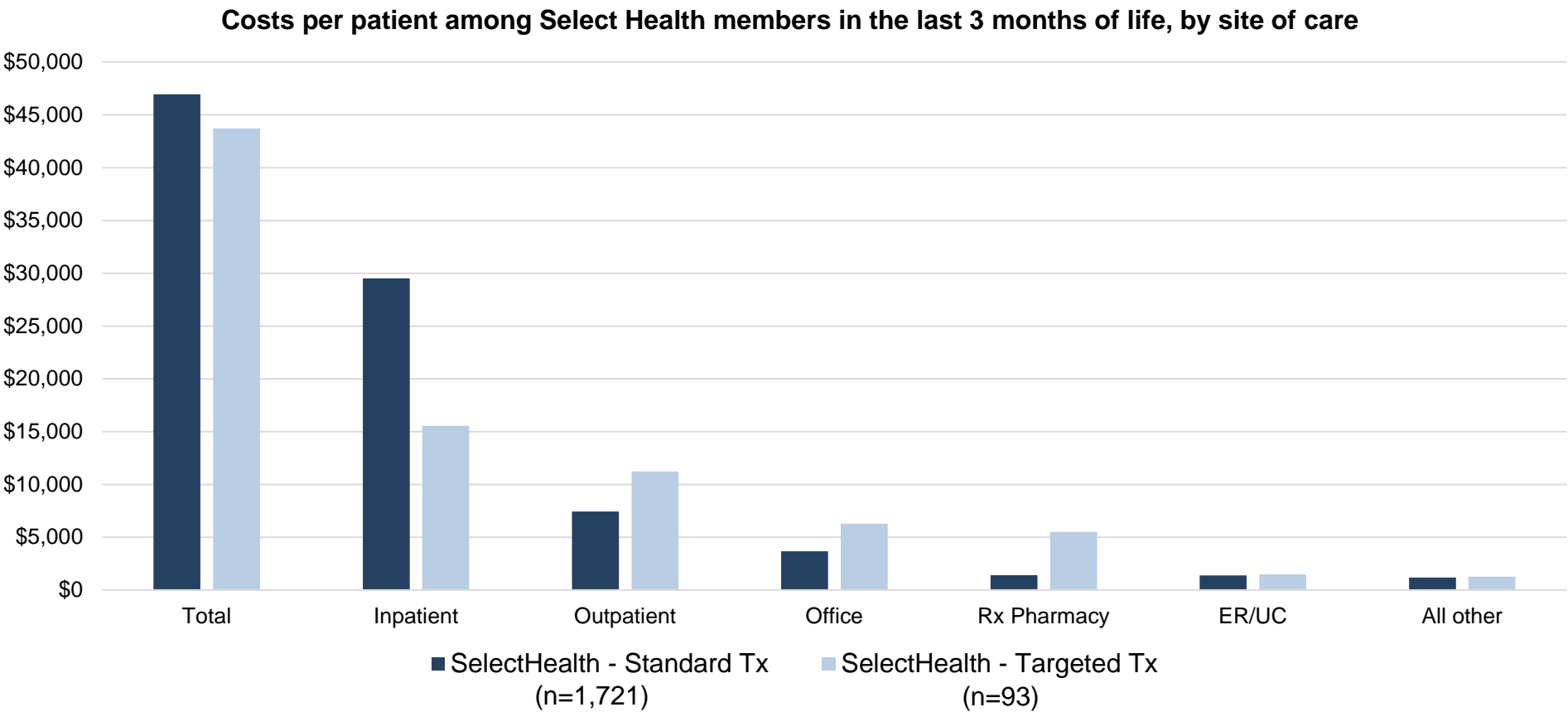


Precision Oncology Costs

	Control (N=22)	Targeted (N=22)	Difference
Inpatient	\$552	\$448	(\$104)
Outpatient	\$2,376	\$1,167	(\$1,209)
ER	\$34	\$45	\$11
Rx drugs	\$346	\$940	\$594
Hospice	\$146	\$9	(\$137)
Sequencing	\$0	\$112	\$112
Total/week	\$3,453	\$2,720	(\$734)

Haslem et al., Oncotarget. 2018

Precision Oncology Costs



	Total	Inpatient	Outpatient	Office	Rx Pharmacy	ER/UC	All other	
SelectHealth - Standard Tx	\$46,940	\$29,523	\$7,425	\$3,663	\$1,415	\$1,385	\$1,177	
SelectHealth - Targeted Tx	\$43,711	\$15,535	\$11,216	\$6,265	\$5,500	\$1,469	\$1,242	
	-6.9%	-47.4%	51.1%	71.1%	288.7%	6.1%	5.5%	

Genomic Testing now covered by local health plan



MEDICAL POLICY

GENETIC TESTING: MOLECULAR PROFILING FOR DETERMINING THERAPY OF MALIGNANT TUMORS

Commercial Plan Policy

SelectHealth covers multi-marker tumor panels using next generation sequencing in the diagnosis and treatment of cancer as a method to guide the selection of therapeutic agents for malignant tumors in *limited circumstances*.

Patients must meet ALL of the following to be eligible for next-generation sequencing:

1. The member has one of the following clinic circumstances:
 - a. Any advanced stage IV solid tumors;
 - b. All lymphomas;
 - c. Multiple myeloma.
2. Patient has demonstrated progression of disease despite at least 1 lines of FDA approved and NCCN approved standard cancer therapy,
3. Member has performance level as evidence by documentation of ECOG performance status 0-2 or Karnofsky score $\geq 70^*$
4. Advance care planning (ACP) has been completed, and documented, with a trained facilitator (i.e. nurse navigator, licensed clinical social worker) or a palliative care provider, or the treating provider.

Precision Medicine Menu

ICG100™

Cancer Panel

RxMatch™

Pharmacogenomics in Mental Health

HerediGene™

Hereditary Cancer Panel

All orderable and reportable within the EMR (Cerner)

ICG100™ Precision Cancer Test: *Product + Impact*

Overall Survival:

- Precision Med: 51.7 weeks
- Control: 25.8 weeks
- HR: 0.53, $p < 0.002$

Cost of Care:

- Precision Med: \$3,453/week
- Control: \$2,720/week
- $p = 0.22$

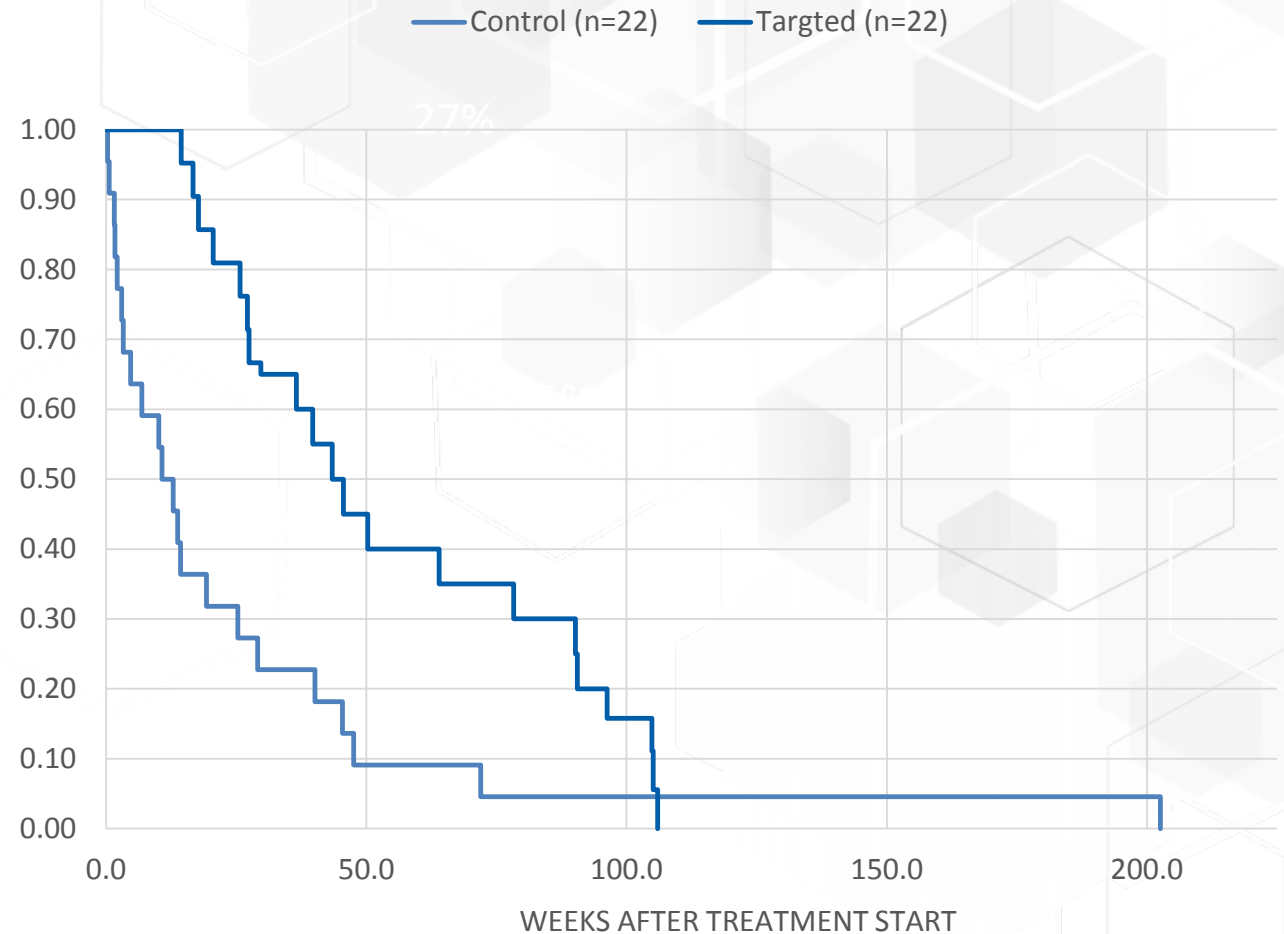


Figure 1. Overall survival, $p = 0.002$

RxMatch™: Mental Health Product + Impact

Behavioral Health Clinical Program recommendation

Consider ordering RX Match for depression and anxiety in:

1. New diagnosis of depression and/or anxiety to be treated with an antidepressant
2. Existing diagnosis of depression and/or anxiety not responding



HerediGene™: *Hereditary Cancer Test Product + Impact*

10% of all cancers are
due to a gene mutation
that can be passed
through a family.

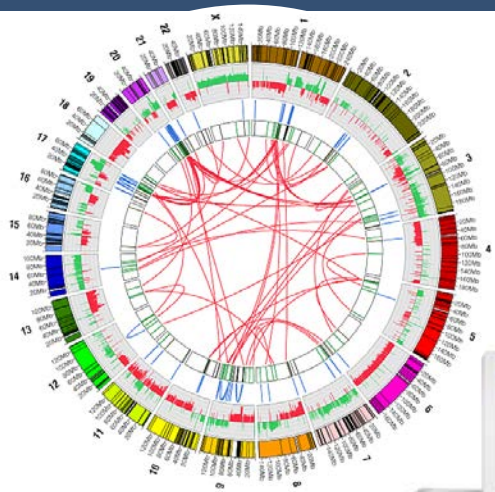


System Wide Genetic Counseling: *Product + Impact*

Reduced time to genetic
counseling appointment

12 days → 6 days





Translational Science Center Hight Throughput Genomics Facility

Illumina NovaSeq 6000

- 15,000 whole genomes at 30X per year

WGS, WES and Transcriptome

Chromium 10X Genomics Instrument

- Haplotyping and single cell sequencing

Fluidigm Helios/Hyperion Mass Cytometer

Lab Automation – Hamilton Stars

Full LIMS integration (LabVantage)

CLIA/CAP certification 2H 2018



NGSOne: *Whole Genome Product + Impact*

- Whole Genome, Whole Exome Sequencing, Whole Transcriptome
- New external collaborations
- NICU sequencing
- Precision Nephrology
- Biorepository (4.3M archival samples)



Precision Genomics across all Clinical Programs and Services



Biorepository



Pain Management



Respiratory and Sleep Services



Nutrition Services



Laboratory Services



Digestive Health



Women & Newborns



Behavioral Health



Cardiovascular



Surgical Specialties



Neurosciences



Pediatric



Oncology



Musculoskeletal



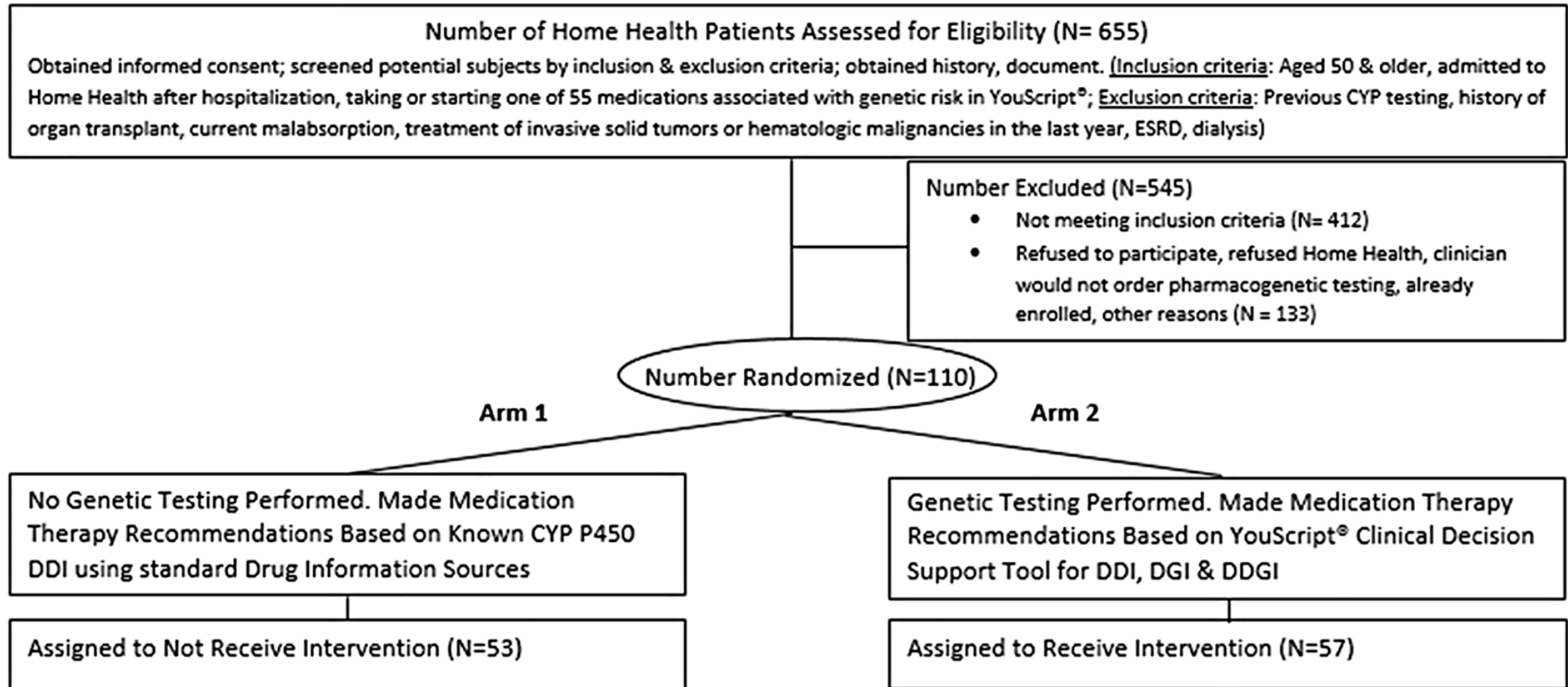
Medical Specialties

Acknowledgements

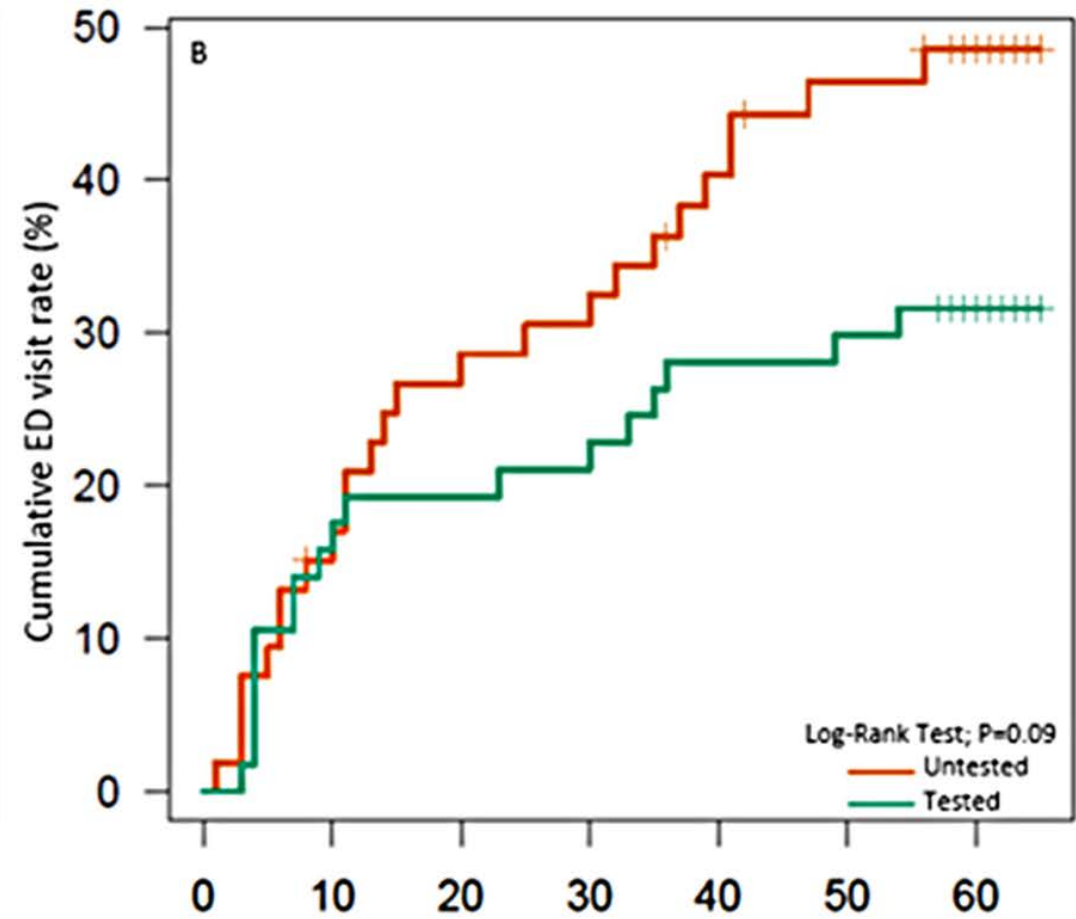
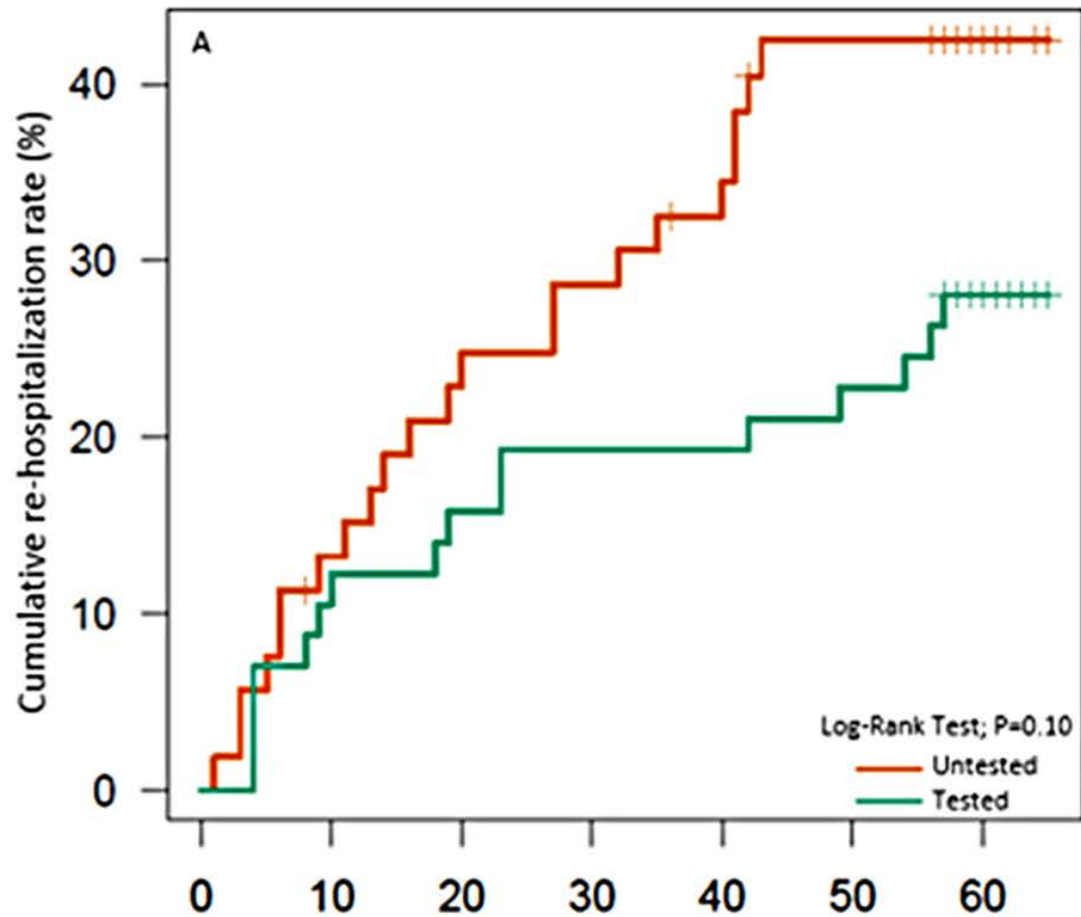
- Intermountain Precision Genomics:
 - Derrick Haslem
 - Gary Stone
 - Pravin Mishra
 - David Loughmiller
 - Genomics Core Lab
 - Cancer Clinical Program
 - Sharanya Raghunath
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 - Brent James
- Stanford University
 - Jim Ford
 - Hanlee Ji
- NCI
- AACR
- ASCO











Pharmacogenetics and Hospital Readmissions



Decreased re-hospitalization and ED visit rates



Pharmacogenetics: Opioids as an example

RxMatch™ Comprehensive Report				
Therapeutic Class	 Standard Precautions	 Caution / Info	 Change recommended	
Opioids	Buprenorphine Fentanyl Hydrocodone	Codeine Fentanyl (OPRM1) Oxycodone Oxycodone (CYP3A5)	Tramadol	
Hydrocodone	 CYP2D6: *4 *35	Typical response is expected; no additional therapeutic recommendations.		
Oxycodone (Oxycontin)	 CYP2D6: Intermediate metabolizer. One allele showing normal activity and one showing little or no activity.	Individuals with intermediate metabolizer status are at risk of potentially reduced efficacy; consider alternative therapy. Insufficient evidence to allow calculation of dose adjustment. Select alternative drug (not tramadol or codeine) or be alert to symptoms of insufficient pain relief.		Efficacy 

RxMatch™

- Identifies how a patient metabolizes medication.
- The RxMatch report guides medication selection and dosing for prescribing providers.

RxMatch™ Comprehensive Report

Drug	Finding	Recommendation	Concern	Evidence
Selective Serotonin Reuptake Inhibitors (SSRIs)				
Citalopram (Celexa)	⚠️ CYP2C19: Rapid metabolizer status. One allele showing normal activity and one showing increased activity.	The therapeutic outcome of this combination of alleles is uncertain. However, individuals with rapid metabolizer status may show increased enzyme activity compared to normal metabolizers but less than ultrarapid metabolizers. Consider monitoring plasma concentration and titrate dose to a maximum of 150% in response to efficacy and adverse drug reaction or select alternative drug (e.g. fluoxetine, paroxetine).	ADR & Efficacy	●
Escitalopram (Lexapro)	⚠️ CYP2C19: Rapid metabolizer status. One allele showing normal activity and one showing increased activity.	The therapeutic outcome of this combination of alleles is uncertain. However, individuals with rapid metabolizer status may show increased enzyme activity compared to normal metabolizers but less than ultrarapid metabolizers. Consider monitoring plasma concentration and titrate dose to a maximum of 150% in response to efficacy and adverse drug reaction or select alternative drug (e.g. fluoxetine, paroxetine).	ADR & Efficacy	●
Fluvoxamine (Luvox)	⚠️ CYP2D6: *4/*35	Individuals with intermediate metabolizer status may be at an increased risk of adverse drug reactions due to reduced metabolic clearance. Insufficient evidence to allow calculation of dose adjustment. Be alert to adverse reactions.	ADR	●
Paroxetine (Paxil)	ℹ️ CYP2D6: Intermediate metabolizer. One allele showing normal activity and one showing little or no activity.	Individuals with intermediate metabolizer status may have increased plasma concentrations/ decreased clearance of paroxetine. However, an association with treatment response or severity of side effects is not conclusive.	ADR	●
Sertraline (Zoloft)	ℹ️ CYP2C19: Rapid metabolizer status. One allele showing normal activity and one showing increased activity.	The therapeutic outcome of this combination of alleles is uncertain. However, individuals with rapid metabolizer status may show increased enzyme activity compared to normal metabolizers but less than ultrarapid metabolizers. No additional therapeutic recommendations.		●

Donor 14 - - Reported Apr 27, 2018

The information contained in this report is intended to be interpreted by a licensed physician or other licensed healthcare professional. This report is not intended to take the place of professional medical advice. Decisions regarding use of prescribed medications must be made only after consulting with a licensed physician or other licensed healthcare professional, and should consider each patient's medical history and current treatment regimen.