
IMPROVING EQUITY IN THE U.S. HEALTHCARE SYSTEM

FRAMING, IDENTIFYING & ADDRESSING HEALTH
DISPARITIES AT INTERMOUNTAIN HEALTHCARE

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NOTE TO READERS

This report was developed principally for the author's three clients at Intermountain Healthcare and Castell, but it is written to be relevant to others as well: stakeholders at Intermountain, Castell, other health systems, and beyond the healthcare system. Different audiences may find certain parts more relevant than others.

The report's four sections vary in specificity and content:

The [Introduction](#) provides background on key dynamics in the U.S. healthcare system, offers a definition of health equity, and introduces Intermountain, its history, and its current challenge.

[Part 1](#) provides high-level framing for how health systems may approach health equity initiatives, drawing from interviews with health systems other than Intermountain and Castell. This section is applicable to any health system undertaking health equity initiatives. The [appendix](#) includes six case studies taken from these interviews.

[Part 2](#) includes data analysis specific to Intermountain. It is written to be understood by a general audience, but it is more relevant to those at Intermountain interested in a detailed analysis of preventive health services rates. For a brief overview of the results of this section, view [Table 1](#) at the end of the [Executive Summary](#).

[Part 3](#) includes high-level and Intermountain-specific suggestions on steps to address disparities in preventive screening rates by improving healthcare access and quality. While the suggestions are tailored to Intermountain, this section is meant to offer approaches to health equity that can be applied elsewhere.

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EXECUTIVE SUMMARY

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This report includes insights from health systems exploring health equity, an assessment of health equity at Intermountain Healthcare through analyses of preventive health services, and recommendations for interventions to reduce health disparities within Intermountain.
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Introduction to Health Equity

Health equity means that everyone has a fair and just opportunity to be as healthy as possible. Health disparities – avoidable differences in health outcomes for disadvantaged groups – must be reduced to make progress towards health equity.¹ The United States and its healthcare system contain individual, organizational, and system-level dynamics that perpetuate social and health disparities for marginalized groups. Americans have worse infant and maternal mortality than any other OECD nation,² and the child of an African American mother is more than twice as likely as the child of a white mother to die before reaching its first birthday.³ Many factors drive these outcomes, including differences in economic opportunity, structural racism, and unequal distribution of access to care. Improving health equity requires a range of actions to ensure that individuals, communities, and populations have access to the resources and opportunities needed to improve health.⁴

Organized health systems – entities that combine hospitals, physician groups and other medical service providers⁵ – are key players pushing for health equity. Their activities range from interventions targeting high-risk patients⁶ to advocacy for policies that reduce poverty and increase access to health care as a fundamental human right⁷. Intermountain Healthcare, a national health leader, is an integrated, not-for-profit health system based in Salt Lake City that serves almost two million patients across Utah, Nevada, and Idaho. It is undertaking a multi-year effort to affirmatively pursue health equity and to identify and address health disparities. Intermountain’s largely integrated system and its introduction of value-based care models make it well-positioned to address health equity. Moving forward, Intermountain can improve

¹ Braveman P, Arkin E, Orleans T, Proctor D, and Plough A. “What Is Health Equity? And What Difference Does a Definition Make?” Princeton, NJ: Robert Wood Johnson Foundation, 2017
² Abrams M, Tikkanen R. “U.S. Healthcare from a Global Perspective, 2019: Higher Spending, Worse Outcomes?” *The Commonwealth Fund*. Issue Brief 30 January 2020. <https://www.commonwealthfund.org/publications/issue-briefs/2020/jan/us-health-care-global-perspective-2019>
³ “Table 1. Infant mortality rates, live births, and infant deaths by selected characteristics and Hispanic origin of mother and by race of mother for mothers of non-Hispanic origin: United States, 2016.” *User Guide to the 2016 Period Linked Birth/ Infant Death Public Use File*. Hyattsville, MD: Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics, Division of Vital Statistics.
⁴ Braveman P, Gottlieb L, Francis D, Arkin E, Acker J. *What Can the Health Care Sector Do to Advance Health Equity?* Princeton, NJ: Robert Wood Johnson Foundation. 2019.
⁵ Compendium of U.S. Health Systems. Content last reviewed February 2021. Agency for Healthcare Research and Quality, Rockville, MD. <https://www.ahrq.gov/chsp/data-resources/compendium.html>
⁶ Tucker A, Edmondson A. “Cincinnati Children’s Hospital Medical Center.” *Harvard Business School*. 9-609-109. 25 April 2011.
⁷ Quinlan, Joan. Massachusetts General Hospital. Interview 8 January 2021.

health equity by leveraging insights from other health systems and by setting new standards of excellence for the healthcare industry.

This report begins with an overview of health equity and ends with equity interventions tied to Intermountain-specific needs. **Part 1** offers a general framework for implementing health equity strategies. **Parts 2 and 3** delve into one element of this framework – “Intervening to Reduce Inequities” – in **Part 2**, by assessing patients’ use of preventive health services at Intermountain, and, in **Part 3**, by offering intervention opportunities for Intermountain to use to improve health equity.

How can Intermountain and other health systems operationalize health equity?

Part 1 uses insights from interviews with nine health systems around the country, as well as reports from leading organizations like the Robert Wood Johnson Foundation, to explore guiding frameworks, best practices, and challenges that health systems face in the pursuit of health equity. **Part 1** also references [six health system case studies](#) detailed in the appendix.

Frameworks from **Part 1** are presented in [Figures 3 and 4](#), and key takeaways include:

Dynamics that Support Health Equity Efforts

- *Changing system and provider incentives to align behavior with outcomes*
- *Relying on the “army of the willing” to get started*
- *Using diversity and cultural competency training as a starting point, not the end goal*
- *Working directly with community members*

Dynamics that Hinder Health Equity Efforts:

- *Allowing efforts to occur in organizational siloes*
- *Being unwilling to acknowledge racism and institutional oppression*
- *Dismissing health equity efforts due to lack of financial return-on-investment (ROI) data*
- *Thinking narrowly about acute health needs and not root causes*

What drives differences in preventive health services rates in Intermountain patients?

Preventive health services, such as cancer screenings and immunizations, help patients and medical providers preemptively identify or prevent health issues and enable early medical intervention.⁸ Patient utilization of preventive health services can be understood as a proxy for patient access to and use of the health system – two components of health equity. Applying the concept that “You can’t change what you can’t measure,” **Part 2** examines Intermountain

⁸ Healthcare.gov ‘Preventive Services.’ U.S. Centers for Medicare & Medicaid Services. <https://www.healthcare.gov/glossary/preventive-services/>

patients' healthcare access through analyses of four Intermountain preventive health datasets: breast cancer screening, colon cancer screening, MMR vaccinations, and HPV vaccinations.

Findings are summarized in **Table 1** and include the following:

- **Health system factors** – physician and insurance type – strongly influence rates of use of preventive health services.
- Access to and uptake of preventive health services vary by **Utah geography**; in general, central Utah's Salt Lake City metropolitan area has higher rates of care, and Utah's more rural southern and northern regions have lower rates.
- For cancer screenings and HPV vaccinations, **socioeconomic indicators** at the census block level predict rates of screening. People who live in areas of higher poverty are less likely to receive cancer screening, and (perhaps counterintuitively) children who live in areas with higher high school education rates are less likely to receive HPV vaccines.
- Intermountain preventive health rates differ by **demographics**. Medicare members who identify as White, married, and English-speaking all have higher rates of cancer screenings, and non-White children have higher rates of HPV vaccinations.

How should Intermountain intervene to increase use of preventive services in lagging groups?

Based on insights from Intermountain and other health systems, **Part 3** presents options to address differences in cancer screening and vaccination rates within Intermountain populations; these proposals can be adapted to other health measures and outcomes. While financial return-on-investment (ROI) has not been calculated for these initiatives, the author proposes a way to prioritize interventions and expects that, even in the absence of predictable financial outcomes, health systems will invest in initiatives for the goal of improving equity.





- **Intervention Category #1: Replicating Best Practices**
 - Adapting Intermountain's Medicare Accountable Care Organization (ACO) practices (such as patient mailings) to its Medicare Advantage populations to increase cancer screenings.
 - Leveraging clinical pathways for pediatricians and piloting "family vaccination visits" to improve vaccine rates for children seeing family medicine providers.
- **Intervention Category #2: Novel Approaches to Access**
 - Using the existing Castell patient data platform and dashboard to proactively coordinate care for patients less likely to receive preventive health services.
 - Providing free or reduced-cost transportation services for colonoscopy visits.
 - Building on successes from Mayo Clinic and Kaiser Permanente pilot programs, increasing colon cancer screening rates by sending at-home kits to patients.

- **Intervention Category #3: High-Touch Community Interventions**

- Working with Utah government officials, faith-based organizations, and schools to bring cancer screening education workshops and vaccine distribution to communities facing the greatest need.

This report was developed against the backdrop of Intermountain’s integrated, capitated healthcare model and novel population health offerings. Still, findings from Intermountain data are corroborated by national research, and many health systems face similar challenges as their leadership seeks to address the effects of poverty and racism in healthcare. While the findings and recommendations presented in this report are tailored to Intermountain’s unique context, the discussion applies to all health systems on their journeys toward implementing health equity interventions and achieving health equity.

Table 1: Results of Quantitative Analysis on Breast & Colon Cancer Screening, MMR & HPV Vaccinations

	MEDICARE CANCER SCREENINGS	PEDIATRIC VACCINATIONS
 HEALTH DELIVERY FACTORS	<ul style="list-style-type: none"> • Enrollment in the ACO is associated with higher rates than Medicare Advantage. • Attribution to employed or affiliated providers was associated with higher rates. 	<ul style="list-style-type: none"> • Medicaid enrollment is associated with lower vaccination rates than commercial insurance. • Attribution to pediatricians was associated with higher rates than family medicine.
 GEOGRAPHY	<ul style="list-style-type: none"> • Patients in the Utah South regions (Rural, Southwest, and Utah Valley) typically trail behind other parts of Utah on breast and colon cancer screenings. 	<ul style="list-style-type: none"> • Patients in the Utah South regions (Rural, Southwest, and Utah Valley) trail behind other parts of Utah on MMR and HPV vaccinations.
 SOCIOECONOMIC INDICATORS	<ul style="list-style-type: none"> • Higher census block poverty was associated with lower rates of cancer screening. 	<ul style="list-style-type: none"> • Census block level poverty was not associated with differences in vaccination rates. • Higher census block high school education was associated with lower HPV rates.
 PATIENT DEMOGRAPHICS	<ul style="list-style-type: none"> • Identifying as white, speaking English, and being married were associated with higher rates of cancer screening. 	<ul style="list-style-type: none"> • Few patient demographics were statistically associated with MMR rates. • Identifying as white, non-Hispanic, or male was associated with lower HPV rates.

Source: Author’s analysis: results from a multivariate logistic regression, controlling for a number of factors; significant at the $p < .05$ level.

INTRODUCTION AND BACKGROUND

This report was developed to answer a central question:

- **How can Intermountain improve health equity in its organization?**

To answer this question, I considered the following:

- **How should Intermountain and other leading health systems in the U.S. think about and implement health equity efforts?**
- **Using a set of patient populations and preventive health services as proxies for equity in health access at Intermountain, what disparities exist in access to and receipt of preventive medical care? What drives these disparities?**
- **Leveraging insights from other health systems and Intermountain's data, how can Intermountain (and population health company Castell) close gaps in patients' use of preventive health services?**

This introduction offers context for the author's interest in health equity, basic information on the American healthcare system and Intermountain, and an overview of what health equity means within the health system today.

Healthcare in the United States – Existing Disparities in Health Outcomes

In 2014 and 2015, I served as a patient advocate at Massachusetts General Hospital, responsible for connecting patients who had been screened for social needs to relevant state and local services. These patients revealed the myriad structural flaws in the U.S. health system: a woman lost her job, and as a result, her health insurance, for taking time off work to care for her sick father; a young man, disabled after a debilitating car accident, could not get a credit card or rent an apartment because of crushing medical debt; a patient struggled to find transportation to and from the hospital to obtain behavioral health services for her substance abuse disorder. Like everyone in the United States, these patients' interactions with the healthcare system were buoyed, constrained, or mediated by non-medical factors.

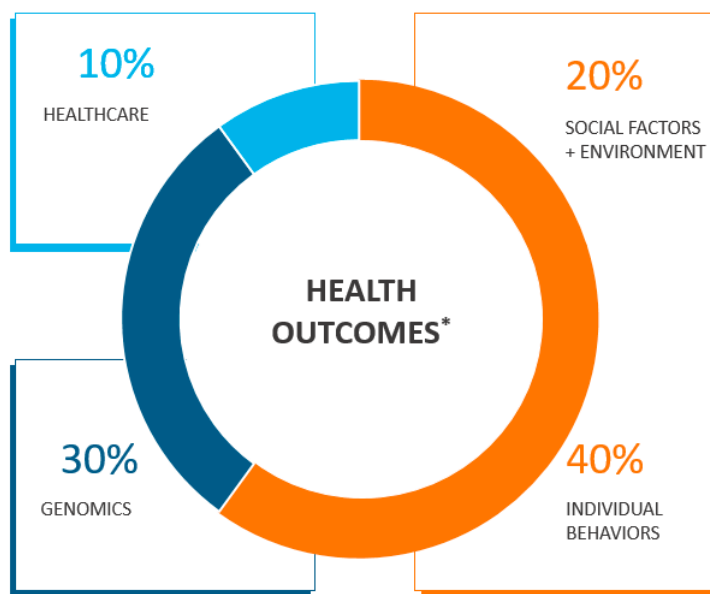
The stories of the patients I worked with reflect broader patterns in the United States, where a person's zip code is a better predictor of health outcomes than genetics,⁹ and, in certain cities, children born within five miles of each other can have twenty-year differences in life expectancy.¹⁰ Access to housing, education, transportation, employment, health services, open space, and environments free from discrimination all shape the context in which individuals live. One model of health outcomes, derived from an analysis of premature American deaths

⁹ Graham GN. "Why Your ZIP Code Matters More Than Your Genetic Code: Promoting Healthy Outcomes from Mother to Child." *Breastfeed Med.* 2016 Oct;11:396-7. doi: 10.1089/bfm.2016.0113. <https://pubmed.ncbi.nlm.nih.gov/27513279/>

¹⁰ "Mapping Life Expectancy." Virginia Commonwealth University Center for Society and Health, RWJF. 26 September 2016. <https://societyhealth.vcu.edu/work/the-projects/mapping-life-expectancy.html>

between 1977 and 1993, argues that only about 10% of such deaths are driven by poor quality in healthcare delivery; the remaining drivers, the paper argues, are attributable to genetics, individual behavior patterns (such as tobacco use), and social and environmental factors (such as access to housing free of toxic agents).^{11,12} While the exact relative importance of each factor is unknown, this model collectively offers a more holistic understanding of the drivers of a patient’s health and wellbeing. **Figure 1** shows one visualization of this model.

Figure 1: Majority of Health Outcomes Driven by Non-Medical Factors



Source: Adapted from “We Can Do Better — Improving the Health of the American People,”¹² courtesy of Phat Doan. Social Factors + Environment include, for example, toxic agents present in living space. Individual Behaviors include, for example, tobacco use. Genomics includes, for example, genetically inherited diseases.

In practice, the healthcare system often fails to address social and environmental determinants of health. This means that disparities in health may reflect the accumulated effects of inequitable social, environmental, and medical factors facing individuals and communities.

Structural or systemic racism affects health outcomes. The term refers to embedded, pervasive societal factors that perpetuate discrimination and disadvantage racial groups through “mutually reinforcing systems of housing, education, employment, earnings, benefits, credit,

¹¹ McGinnis, Williams-Russo, Knickman. “The Case For More Active Policy Attention To Health Promotion.” *Health Affairs* 2002; 21(2). <https://doi.org/10.1377/hlthaff.21.2.78>

¹² Schroeder, S. “We Can Do better – Improving the Health of the American People.” *N Engl J Med* 2007; 357:1221-1228 DOI: 10.1056/NEJMs073350 <https://www.nejm.org/doi/full/10.1056/nejms073350>

media, healthcare, and criminal justice.”¹³ Structural racism and systemic disadvantage baked into American communities lead to pervasive, well-documented disparities in health outcomes by race, ethnicity, socioeconomic status, sexual orientation, and geography.

Repeated studies, for example, find that doctors are more likely to prescribe pain medication to white patients than to black patients, even when controlling for identical physical conditions.¹⁴ A California-focused study on older adults found that individuals who did not speak English have worse access to healthcare and lower health status.¹⁵ Health outcomes often follow socioeconomic lines – individuals with lower income and lower educational levels consistently have lower health outcomes than wealthier, more educated individuals.¹⁶ These patterns of health disparities suggest that policies redistributing resources to specific groups will generate improved health outcomes.

While health systems cannot, on their own, eradicate poverty and racism, leaders in healthcare should orient efforts towards combatting structural disadvantage, so as not to perpetuate the effects of broader societal poverty and racism within the healthcare system.

Fee-For-Service Models and Health Equity

The United States spends more per capita on healthcare than any other country, with healthcare spending representing almost 18% of domestic GDP.¹⁷ Yet, the nation trails behind other OECD nations on life expectancy, chronic disease burden, and infant mortality.¹⁸ In the past decade, studies on healthcare costs have estimated that 25-30% of healthcare spending in the U.S. is unnecessary or wasteful.^{19,20}

The incentives embedded in America’s healthcare system directly contribute to wasteful spending and inappropriate or unjust care. Broadly, the healthcare system operates under a “fee-for-service” model, in which providers are paid based on volume of care delivered. Within this model, health systems are responsible for the process of providing care but are often not financially accountable for patient outcomes. Electronic medical records (EMR) software is

¹³ Bailey ZD, Krieger N, Agénor M, Graves J, Linos N, Bassett MT. “Structural racism and health inequities in the USA: evidence and interventions.” *Lancet*. 2017 Apr 8;389(10077):1453-1463. doi: 10.1016/S0140-6736(17)30569-X. PMID: 28402827. <https://pubmed.ncbi.nlm.nih.gov/28402827/>

¹⁴ Goyal MK, Kuppermann N, Cleary SD, Teach SJ, Chamberlain JM. “Racial disparities in pain management of children with appendicitis in emergency departments.” *JAMA Pediatr*. 2015; 169(11):996-1002. <https://jamanetwork.com/journals/jamapediatrics/fullarticle/2441797>

¹⁵ Ponce N, Hays R, Cunningham W. “Linguistic Disparities in Healthcare Access and Health Status Among Older Adults.” *J Gen Intern Med*. 2006 Jul; 21(7): 786–791. doi: 10.1111/j.1525-1497.2006.00491. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1924691/>

¹⁶ Braveman P, Cubbin C, Egerter S, Williams D, Pamuk E. “Socioeconomic Disparities in Health in the United States: What the Patterns Tell Us.” *Am J Public Health*. 2010 April; 100(Suppl 1): S186–S196. doi: 10.2105/AJPH.2009.166082 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2837459/>

¹⁷ “National Health Expenditure Data – Historical.” *Centers for Medicare and Medicaid Services*. Modified 12/16/2020

<https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsHistorical#:~:text=The%20data%20are%20presented%20by,spending%20accounted%20for%2017.7%20percent>

¹⁸ Abrams M, Tikkanen R, “U.S. Healthcare from a Global Perspective, 2019: Higher Spending, Worse Outcomes?” *The Commonwealth Fund*. Issue Brief 30 January 2020. <https://www.commonwealthfund.org/publications/issue-briefs/2020/jan/us-health-care-global-perspective-2019>

¹⁹ Berwick DM, Hackbarth AD. “Eliminating Waste in US Healthcare.” *JAMA*. 2012;307(14):1513–1516. doi:10.1001/jama.2012.362 <https://jamanetwork.com/journals/jama/article-abstract/1148376>

²⁰ Shrank WH, Rogstad TL, Parekh N. “Waste in the US Healthcare System: Estimated Costs and Potential for Savings.” *JAMA*. 2019;322(15):1501–1509. doi:10.1001/jama.2019.13978 <https://jamanetwork.com/journals/jama/article-abstract/2752664>

designed to allow providers to better bill for health services and not, in general, to enhance the quality of patient care. Under the fee-for-service model, specialty providers – a surgeon or a cardiologist – are paid more than primary care providers. Thus, health systems operating under the fee-for-service model may actually disfavor investments in upstream primary care, because these investments may reduce the need for downstream, revenue-generating specialty care.

The dynamics of the fee-for-service model are incompatible with health equity. Medical care in the U.S. is more expensive than in other countries, driven by higher administrative costs, higher salaries to care providers, and more expensive services.²¹ Research on Medicare patients shows that physicians are more likely to recommend health services when the services are more profitable to the physicians.²² America has fairly high rates of use of expensive technology (like MRIs) when compared to other OECD countries.²³ In 2020, physicians Amol Navathe and Harald Schmidt outlined how cost-control measures may drive hospitals to avoid caring for disadvantaged populations – particularly Black patients with historically worse health – as health systems are motivated to cherry-pick patients that are healthier and more able to afford expensive care when it is needed.²⁴

Interviewees in this project reiterated these views. One executive remarked that the fee-for-service model is “an impediment” to achieving health equity because its incentives are “almost perverse”: a hospital does better when its beds are full, ideally with high-paying patients. The Mayo Clinic’s Dr. Chyke Doubeni, Director of the Center for Health Equity and Community Engagement, discussed “lemon-dropping,” the practice of deliberately referring socioeconomically disadvantaged patients out of a hospital system due to lower reimbursement potential.²⁵ He notes that this term, inherently devaluing a patient’s humanity, is premised on innate oppressive structures.

To achieve health equity, health systems will have to fight these dynamics. Most doctors are deeply committed to the well-being of their patients, and many fee-for-service health systems have released well-meaning public statements about improving population health. But moving from commitment to outcome, from platitude to system change, will be complex and costly. Further, achieving health equity will require involvement from a range of stakeholders – politicians, policy makers, hospital executives, community leaders, patients – to reckon with the pervasiveness of institutional inequity in the health system and beyond.

²¹ Papanicolas I, Woskie LR, Jha AK. “Healthcare Spending in the United States and Other High-Income Countries.” *JAMA*. 2018;319(10):1024–1039. doi:10.1001/jama.2018.1150

²² Clemens J, Gottlieb J. “Do Physicians’ Financial Incentives Affect Medical Treatment and Patient Health?” *American Economic Review*. Apr 2014, Vol. 104, No. 4: Pages 1320-1349 <https://pubs.aeaweb.org/doi/pdfplus/10.1257/aer.104.4.1320>

²³ Abrams, Melinda and Tikkanen, Roosa. “U.S. Healthcare from a Global Perspective, 2019: Higher Spending, Worse Outcomes?” *The Commonwealth Fund*. Issue Brief 30 January 2020. <https://www.commonwealthfund.org/publications/issue-briefs/2020/jan/us-health-care-global-perspective-2019>

²⁴ Navathe Amol, Schmidt Harald. “Why a Hospital Might Shun a Black Patient.” *The New York Times*. 6 October 2020. <https://www.nytimes.com/2020/10/06/opinion/medical-racism-payment-models.html>

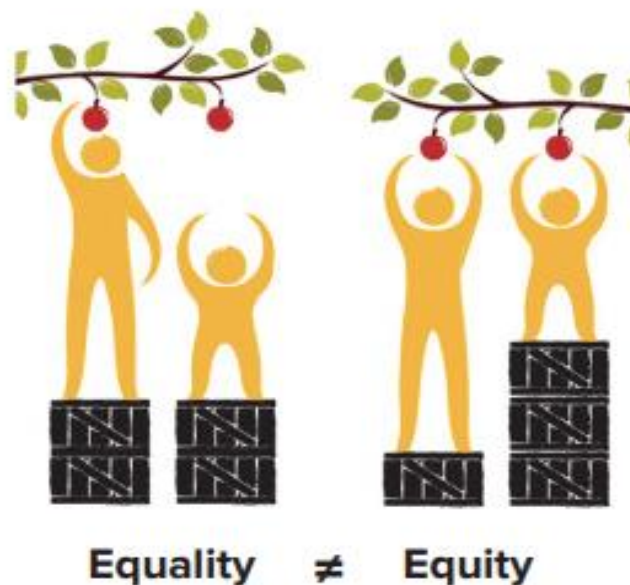
²⁵ Doubeni C, Selby K, Levin T. “Disparities in Preventable Mortality from Colorectal Cancer: Are They the Result of Structural Racism?” *Gastroenterology*. Mar 2021, Vol. 160, No. 4: Pages 1022-1025. [https://www.gastrojournal.org/article/S0016-5085\(21\)00011-1/fulltext?referrer=https%3A%2F%2Fpubmed.ncbi.nlm.nih.gov%2F](https://www.gastrojournal.org/article/S0016-5085(21)00011-1/fulltext?referrer=https%3A%2F%2Fpubmed.ncbi.nlm.nih.gov%2F)

The Evolution of Health Equity in Care Delivery

For the purposes of this report, health equity refers to a state in which everyone has a fair and just opportunity to be as healthy as possible.²⁶ This ethical and human rights principle should motivate governments, health systems, and communities to eliminate disparities in health and its determinants, ultimately improving outcomes.²⁷ In practice, achieving health equity requires improving patient access to conditions that support and maintain health, from more equitable distribution of economic resources to higher quality care.

Health equity involves a distinction between equality and equity, visualized in **Figure 2**. *Equality* means treating all patients the same, but *equity* means tailoring care to meet the needs of individual patients. The distinction matters, because how an organization thinks about health equity informs the actions that people will take to address it.

Figure 2: Visualization of Difference between Equality and Equity



Source: University of British Columbia's EQUIP Model.²⁸

In 2020, as COVID-19 claimed the lives of Americans of color at disproportionate rates, killings of African American men and women by American police officers prompted waves of outrage

²⁶ Braveman P, Arkin E, Orleans T, Proctor D, Plough A. "What is Health Equity?" *Robert Wood Johnson Foundation*. 1 May 2017. <https://www.rwjf.org/en/library/research/2017/05/what-is-health-equity-.html>

²⁷ Braveman P, Arkin E, Orleans T, Proctor D, and Plough A. "What Is Health Equity? And What Difference Does a Definition Make?" Princeton, NJ: *Robert Wood Johnson Foundation*.

²⁸ EQUIP Healthcare. "What is Health Equity? A Tool for Health & Social Service Organizations and Providers." <https://equiphealthcare.ca/files/2019/12/HEQ-Mar-26-2018.pdf>

and protests.²⁹ In response, leaders from around the country issued statements condemning racism and discrimination, many for the first time. Leaders of health systems were no exception. Massachusetts General Hospital released some of its boldest health equity initiatives in the summer of 2020, including a commitment that “[a]ll at MGH will be knowledgeable about the impact of racism on health and healthcare, and have practical, actionable tools to assure their behaviors are equitable, just, and anti-racist.”³⁰ In October of 2020, billionaire hedge fund manager Ray Dalio, through his philanthropic organization, gave \$50 million to NewYork-Presbyterian Hospital to launch the Dalio Center for Health Justice.³¹ In the summer of 2020, Intermountain released a public video in which CEO Marc Harrison shared employee-reported instances of race and language-based discrimination within Intermountain, and he vowed to change it.³² A number of states declared racism a public health crisis.³³

These statements suggest that the United States is at a critical juncture in accepting, discussing, and taking action on systemic racism and health equity. **Part 1** of this report explores actions that health systems have taken, with recommendations for what hinders and supports health equity efforts. As noted there, some health systems have designed interventions to improve health outcomes for underserved or disadvantaged patients without explicitly linking these efforts to health equity. Moving forward, the health system must go beyond “window-dressing,” symbolically checking the box of advancing health equity, to actions that will move the needle on improved patient health, well-being, and livelihood.

Introduction to Intermountain – An Integrated, Capitated Model

Intermountain Healthcare was founded in 1975 when members of The Church of Jesus Christ of Latter-Day Saints (LDS) donated its 15 hospitals to the organization.³⁴ Since then, Intermountain has grown and experimented with novel models of care delivery, including launching its own insurance company, called SelectHealth, in 1983, and incorporating its physicians as an employed medical group in 1994. While SelectHealth initially endured several years of financial losses, the insurance plan became profitable in the 1990s.³⁵ Today, Intermountain’s 26 hospitals and numerous health facilities serve nearly two million patients per year, including nearly one million SelectHealth members, and the Intermountain Medical Group employs 2,500 physicians across Utah, Nevada, and Idaho. Intermountain facilities see patients with commercial insurance, Medicare (public health insurance for the elderly), Medicaid (public health insurance for the poor and disabled), and no insurance. In addition to providing care through a traditional fee-for-service model, some one million Intermountain patients are

²⁹ Reuters. “U.S. Saw Summer of Black Lives Matter Protests Demanding Change.” *U.S. News and World Report*. 7 December 2020. <https://www.usnews.com/news/top-news/articles/2020-12-07/us-saw-summer-of-black-lives-matter-protests-demanding-change>

³⁰ “MGH Structural Equity Plan.” 15 June 2020. Courtesy of Joe Betancourt, Chief Equity Inclusion and Diversity Officer at Massachusetts General Hospital.

³¹ NewYork-Presbyterian. “NewYork-Presbyterian Launches Dalio Center for Health Justice.” *PR Newswire*. 13 October 2020. <https://www.prnewswire.com/news-releases/newyork-presbyterian-launches-dalio-center-for-health-justice-301150719.html>

³² Intermountain Healthcare. 2 September 2020. “Intermountain Equity and Inclusion Message.” Video. https://www.youtube.com/watch?v=gyRUBNpd0_0&feature=youtu.be

³³ Vestal, Christine. “Racism Is a Public Health Crisis, Say Cities and Counties.” *PEW Trusts*. 15 June 2020. <https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2020/06/15/racism-is-a-public-health-crisis-say-cities-and-counties>

³⁴ Intermountain Healthcare. “Fast Facts.” <https://intermountainhealthcare.org/about/who-we-are/fast-facts/>

³⁵ Interview with Dr. Charles Sorenson, former CEO of Intermountain Healthcare

served through a capitated model, in which Intermountain’s provider system receives an upfront, pre-determined payment to care for the patient’s health needs on a per member per month basis. If patient costs go over the capitated rate, Intermountain is responsible for the losses, leading capitated plans to be described as “at-risk” models.

In 2019, Intermountain launched a spin-off organization called Castell, a population health and analytics company that manages health delivery and health outcomes for Intermountain’s capitated health insurance patients, as well as patients enrolled in other health insurance plans. Castell’s model includes a central data platform used to track and manage patient care, as well as a non-clinical workforce of “Care Traffic Controllers,” who provide care coordination and administrative support to patients. Dave Henriksen, Castell’s VP of Operations, describes Care Traffic Controllers as similar to “grandchildren” who might support an elderly relative experiencing acute or chronic health needs by “caring a lot and knowing what the resources are.” Care Traffic Controller responsibilities include coordinating home-based care and post-acute care management, ensuring accurate patient documentation and coding, connecting patients to telemedicine services, and facilitating high-value provider referrals.

Intermountain’s Challenge

Intermountain’s strategic priorities include increasing quality, affordability, accessibility, value, and equity. In recent years, Intermountain initiated an ongoing, multi-year effort to develop the strategy, initiatives, and resource commitments to advance health equity. At this writing, Intermountain is recruiting a Chief Health Equity officer, and several departments are pursuing their own health equity efforts, including a Health Equity Dashboard for Pediatric Vaccinations, and a multi-year, multi-sector research pilot in Utah’s Weber County called “The Alliance” that brings together non-profit organizations, community health workers, and state officials to manage patients.

This report seeks to assist Intermountain on its path to health equity. In **Part 1**, I share high-level learnings and guiding frameworks from other health systems. In **Part 2**, I assess preventive health service rates among Intermountain’s patients. In **Part 3**, I propose a range of possible interventions by which Intermountain (and Castell) can address health equity challenges. I do not provide cost estimates for interventions. Even so, I work from the assumption that Intermountain’s and Castell’s leadership teams are committed, at a minimum, in piloting or testing interventions to determine which are most cost-effective and highest value.

PART 1: LESSONS FROM U.S. HEALTH SYSTEMS

This section presents findings from interviews with more than fifteen leaders and operators across nine U.S. health systems. The findings address how those health systems frame and implement health equity strategies, with an eye towards identifying practices that might advance or hinder health equity efforts.

While major health systems are not the only stakeholders responsible for achieving health equity, they are, collectively, responsible for facilitating the flow of trillions of dollars of annual health spending; they exert political influence through groups like the American Medical Association (AMA); and they are attuned to their communities' needs. As a result, health systems, and particularly integrated health systems like Kaiser and Intermountain, are well-positioned to frame discussions around health equity and create meaningful change. And, while health systems need to assess the financial results of investments in health equity, they should also understand that failing to invest in equity perpetuates an existing, inequitable system.

Guiding Framework for Approaching Health Equity

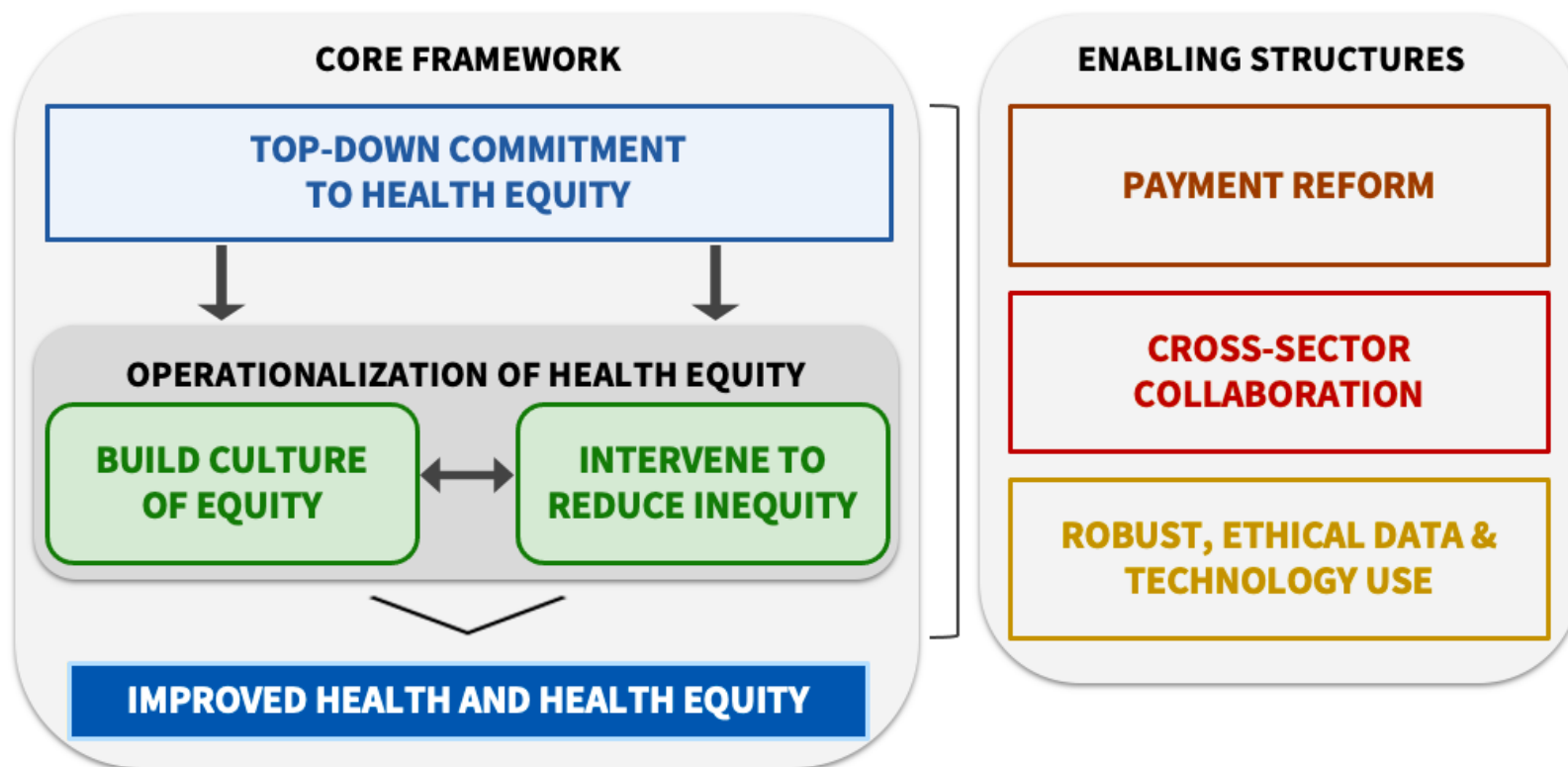
Dr. Marshall Chin, Health Disparities researcher and physician at the University of Chicago, presents a framework for health systems to advance health equity (**Figure 3**). His framework includes core operational activities and enabling structures. Based on interviews, the author developed a supplemental framework to expand upon the “operationalization of health equity” section of Dr. Chin’s framework. **Figure 4** presents this supplemental framework, which provides guideposts for how to “Build a Culture of Equity” and “Intervene to Reduce Inequity.”

Core Operational Activities

In Dr. Chin’s model, core operational activities start with an organization-wide, top-down commitment to maximizing the health of individuals and populations, with clear language in support of marginalized or disadvantaged communities (such as communities of color and patients with lower socioeconomic status). Without top-down support, health equity efforts will likely not obtain enough organizational buy-in to generate meaningful, sustainable change. Health equity requires both time and money, and health systems must integrate health equity investments into the budgeting process in light of financial and other resource constraints.

Operationalizing health equity takes place through two intertwined efforts: creating a culture of equity within the organization and designing interventions that reduce health disparities. To further the development of Dr. Chin’s model, I offer detailed framing for how health systems can create a culture of health equity and implement health equity efforts.

Figure 3: Health Equity Requires Operational Activities and Enabling Structures



Source: Adapted from "Advancing health equity in patient safety: a reckoning, challenge and opportunity"³⁶

³⁶ Chin, Marshall. "Advancing health equity in patient safety: a reckoning, challenge and opportunity" *BMJ Quality and Safety*. 2020 December. <http://dx.doi.org/10.1136/bmjqs-2020-012599>

Figure 4: Expansion of Health Equity Operationalization

BUILD CULTURE OF EQUITY

Assess how explicit or implicit discrimination may influence the organization and its activities.

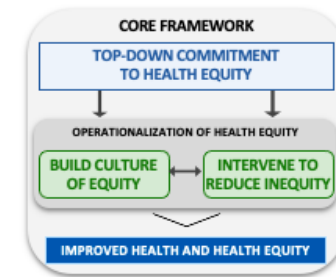
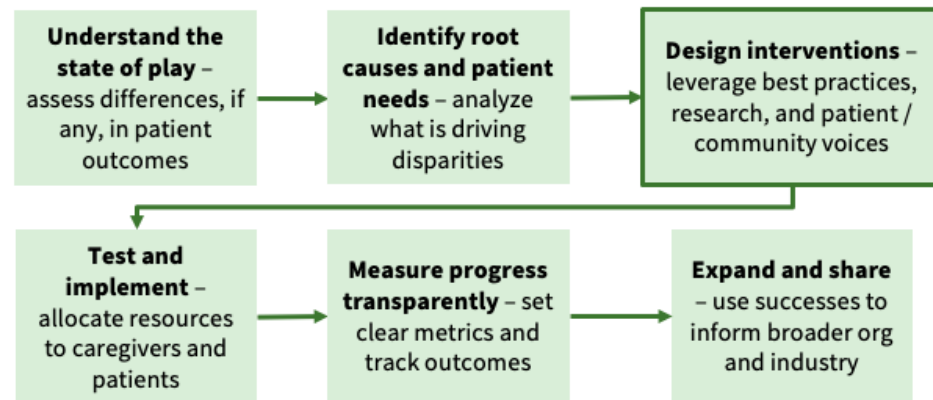
THE HOW: Ongoing organizational improvement

PEOPLE	Provide ongoing training to establish a shared culture of equity and elevate traditionally marginalized voices.
PROCESSES	Deploy internal evaluations to surface how processes like hiring and patient recruitment may be subject to bias.
TOOLS	Understand how technologies and infrastructure in place may affect outcomes for employees and patients.

INTERVENE TO REDUCE INEQUITY

Identify disparities, design interventions according to patient needs, and track outcomes.

THE HOW: Resource allocation to patients most in need



Source: Developed by author, derived from interviews with health systems

Building a Culture of Equity

Creating a culture of equity within a health system involves ongoing improvement to the organization's internal activities. I organize these interventions around people, processes, and tools – with the assumption that equipping and educating the right people, designing and managing the right processes, and developing and deploying the right tools will sustain equity.

- **People:** Creating a culture of equity starts with ensuring that the people who carry out the organization's activities are aligned with the health equity strategy and empowered to achieve health equity goals. Initiatives in this category may include:
 - Training employees on cultural humility, cultural competency, storytelling, and the history of systemic racism in the health system. See the [University of Chicago Hospital](#) and [Bernard J. Tyson School of Medicine](#) case studies for examples.
 - Elevating the voices of non-physician and non-executive employees who may traditionally be deprioritized in understanding patient needs.
 - Assessing how the make-up of care providers, from physicians to clinic staff to leadership, represent the patient populations that are served.

- **Processes:** Sustaining a culture of equity requires processes that minimize or eliminate inequitable results. Often, employees rely on policies and procedures to guide activities, so processes that promote health equity will reverberate throughout the organization. Initiatives in this category may include:
 - Ongoing evaluations of hiring decisions, performance evaluations, promotions, and contracting to identify how bias and discrimination may influence outcomes or marginalize groups. For example, the organization may assess whether hiring practices effectively promote diverse applicants, or whether performance evaluations may incorporate compensation based on achieving goals such as diversity within a team.
 - Assessing how a health system's reimbursement models may promote health inequities (e.g., if the health system is purely fee-for-service, or if the hospital charges high prices without offering discounts to lower-income patients).
 - Analyzing what messages or cultural norms are promoted through marketing materials and adjusting materials to be more inclusive.

- **Tools:** Tools enable employees and patients to better use processes and resources to promote health equity. Tools range from technology like remote monitoring apps and software to checklists and forms. Initiatives in this category may include:
 - Assessing and modifying how the organization uses technologies to manage patients. At one hospital system, an internal audit found that a bed-assignment

formula was less likely to place emergency department patients (disproportionately lower income) into beds in the hospital than patients with scheduled visits. In many hospitals, intake forms and electronic medical records (EMR) do not allow for gender identifications for non-binary patients.

- Ensuring there is an anonymous tool (e.g., an app or a hotline) for employees and patients to report incidents of discrimination.

Intervening to Reduce Inequity

Achieving health equity also requires interventions to reduce existing inequities. This likely entails changes to pre-existing processes and procedures, as well as allocating resources to specific groups of patients to meet their needs. (Returning to [Figure 2](#), this is adding the extra “box” to stand on, so that a relatively disadvantaged patient can reach the “apple”.) The **Figure 4** framework organizes interventions around designing and implementing programs to improve patient outcomes. This process has six high-level elements.

- (1) **Gathering and analyzing data to assess the current state of disparities among patients.** How do patients of different races report satisfaction with care? Are certain patients more likely to return to the emergency department after discharge? Dashboards and data heighten leaders’ awareness of issues in care delivery and health outcomes. Further, transparent, publicly shared data can be a strong motivating force for change.
- (2) **Using qualitative and quantitative data to understand why differences in health outcomes happen and linking those causes to patient needs.** Root-cause analysis does not necessarily require only “hard” data – speaking with patients, providers, and community members can also help health systems understand patient needs. The result of this step should be a “need statement,” which identifies the target population, states a clear goal, and defines how to measure the outcome. For example, a need statement might be: “A way for low-income pre-diabetic patients [population] to engage in exercise [goal] to improve their HA1C and glucose control [outcome measurement].”
- (3) **Designing interventions.** Interventions can come from best practices elsewhere in the organization, from academic research (which can often be useful for estimating intervention effects), and from patients and communities. This essential step identifies both a specific health outcome to change and the resources to enable that change. See the [Massachusetts General Hospital](#), [Kaiser Permanente of Northern California](#), [Cambridge Health Alliance](#), and [Cincinnati Children’s Hospital Medical Center](#) case studies for examples.
- (4) **Implementing interventions through pilots and broader implementations.** At this step, interventions are properly supported with financial and human resources, and the specific components of the interventions are executed.

- (5) **Measuring progress.** The organization will need to track its intervention and how it affects patient outcomes. Thus far, many health equity efforts lack information on financial return on investment (ROI) metrics, which makes it difficult for health system leadership to assess the opportunity cost of such efforts.
- (6) **Expanding interventions and sharing lessons.** A critical component of advancing health equity is showcasing what good results look like for other providers and health systems. Major health systems, in particular, should take responsibility for disseminating what they learn to other stakeholders (politicians, academics, health systems).

Enabling Structures

Enabling structures refer to the organizational scaffolding that facilitates key operational activities. The main components from Dr. Chin’s adapted framework include:

- **Payment reform:** Modify payment models and incentive structures (such as performance evaluations) to motivate care transformation in pursuit of health equity. Examples include Medicare Advantage-focused payors and providers that benefit financially by keeping patients out of the hospital; compensation plans that reward providers for improving patient health outcomes; and benefit packages for employees that encourage attending health equity trainings.
- **Cross-sector collaboration:** Cultivate relationships with communities, patients, governments, and experts to better address medical and social drivers of health. An example is Massachusetts General Hospital’s involvement with community organizations in Chelsea, Massachusetts to change local policies to promote health and wellbeing (discussed in further detail in the [appendix](#)). Similar to top-down commitment, cross-sector collaboration ensures patient and community buy-in and legitimizes health system efforts.
- **Robust, ethical data and technology use** (added by author): Invest in technology that allows for responsible care delivery, coordination, and outcome analysis. As Joe Betancourt, Chief Equity, Diversity and Inclusion officer for Massachusetts General Hospital notes, “You can’t change what you can’t measure.” Efforts to promote health equity require clear, measurable metrics for success, ongoing assessments of the organization’s progress, and technological coordination that allows for effective patient management. Further, as discussed in the “tools” section, health systems may inadvertently perpetuate bias through technology, as Stanford Hospital realized when its “black box” COVID-19 vaccine distribution algorithm left out nearly all medical residents and fellows, while board members and administrators were eligible.³⁷

³⁷ Wamsley, L. “Stanford Apologizes After Vaccine Allocation Leaves Out Nearly All Medical Residents.” *NPR KQED*. 18 December 2018. <https://www.npr.org/sections/coronavirus-live-updates/2020/12/18/948176807/stanford-apologizes-after-vaccine-allocation-leaves-out-nearly-all-medical-resid#:~:text=Stanford%20Medicine%20apologized%20on%20Friday,regularly%20treat%20COVID%2D19%20patients.>

Health systems can use these high-level frameworks to guide equity efforts and understand what aspects of their organizations may need to change to achieve health equity.

What Helps and Hinders Advancement of Health Equity Efforts?

Below is a synthesis of key points from interviews with health systems on factors that influence health equity efforts. Example interventions from leading health systems are discussed in the [appendix](#). Notably, for some health systems (like Kaiser Permanente), programs are not developed under the banner of health equity. For these organizations, existing business models or strategies already encourage the reallocation of resources to patients who are otherwise underserved or who have worse health outcomes.

Dynamics that Support Health Equity Efforts

- *Changing provider and system incentives to align behavior with outcomes:* Many health organizations do not have direct financial incentives to improve health outcomes or the social determinants of health. Changing incentives in health systems will better align employee behavior and patient needs. Examples include modifying compensation models for physicians, making performance outcomes transparent, and designing strategic initiatives to support cost containment and quality.
- *Relying on the army of the willing to get started:* Creating change in organizations often depends on internal champions with credibility and influence. As health systems move to enact health equity efforts, leaders can start by training, deploying resources to, and supporting individuals with a demonstrated appetite for pursuing change. Over time, recognizing and supporting these individuals may accelerate overall efforts. Because internal champions for health equity may themselves be members of traditionally underserved populations, such efforts should take pains to avoid replicating systems in which people of color, women, or LGBTQ+ individuals are expected to provide labor and expertise for improving equity without sufficient compensation.
- *Using diversity and cultural competency training as a starting point, not the end goal:* Dr. Chin's health equity framework offers insight into why diversity training is necessary but insufficient to advance health equity. Educating employees may help build a culture of equity, but it is insufficient in itself to reduce health disparities. Further, it takes time for people unfamiliar with health equity to internalize new concepts. As a result, health systems should think of diversity training as a jumping-off point to create shared language and understanding, rather than the purpose of health equity efforts.
- *Working directly with community members:* Health equity interventions should be tailored to the needs of communities; what works in one region or one patient population may need to be adapted elsewhere. A number of the case studies in the

[appendix](#) involve the active participation of patients, caregivers of patients, and community leaders.

Dynamics that Hinder Health Equity Efforts:

- *Having siloed efforts:* Health equity efforts require central, coordinated support – through specific strategic goals and top-down guidance. Shunting health equity efforts to specific parts of the organization diminishes the likelihood of developing a health equity culture or sustaining health equity interventions.
- *Being unwilling to acknowledge racism and institutional oppression:* Refusing to acknowledge racism and institutional oppression in healthcare can hinder health equity efforts. Health systems operate in a broader societal context that affects how systems provide, and patients experience, care. Tone and language used to discuss these challenges are critical to building legitimacy and credibility in the organization. The Disparities Solution Center at Massachusetts General Hospital produces a number of guides and toolkits for framing the effects of racism and discrimination in healthcare.³⁸
- *Dismissing health equity efforts due to lack of clear data on financial returns:* The Institute for Health Care Improvement’s Triple Aim framework seeks to improve the health of populations, provider better patient experience, and reduce costs.³⁹ While health equity efforts are often focused on improving clinical outcomes and patient experience, demonstrating positive financial return on health equity investments has been, at times, hard to come by. This occurs, in part, because health benefits may accrue to patients over time, because investments in upstream social needs may not always translate directly to downstream health outcomes, and because many health systems may not financially benefit from having healthier patients. Still, newer models of care delivery, like value-based primary care delivery organizations serving Medicare Advantage patients, reveal that upfront investments in primary care reduce hospital visits and costs. Health systems should be willing to pilot, test, and experiment to build the case for change across all goals of the Triple Aim framework.
- *Thinking narrowly about acute health needs and not root causes:* Achieving health equity requires investments to improve the social determinants of health, not just healthcare delivery. If a child repeatedly returns to the emergency department with asthma attacks, hospitals should ask what treatment the child really needs – do they have proper air conditioning and ventilation where they sleep? Are they living in a safe location? Achieving health equity requires holistic understanding of patients’ medical and non-medical needs. For health systems, appropriate interventions may move beyond the health system – taking the form of advocacy for social policy changes.

³⁸ The Disparities Solutions Center. “Guides and Tools.” <https://www.mghdisparitiessolutions.org/guides-tools>

³⁹ Feeley, Derek. “The Triple Aim or the Quadruple Aim? Four Points to Help Set Your Strategy.” *Institute for Healthcare Improvement*. 28 November 2017. <http://www.ihc.org/communities/blogs/the-triple-aim-or-the-quadruple-aim-four-points-to-help-set-your-strategy>

Each health system engaging in health equity efforts will require strategies adapted to its own resource constraints and organizational context. Still, these high-level frameworks provide a generally applicable guide for health systems on their health equity journeys.

PART 2: DIFFERENCES IN INTERMOUNTAIN PATIENTS’ USE OF PREVENTIVE HEALTH SERVICES

Part 2 explores my approach to and results of data analyses on four patient populations within Intermountain. Leveraging advice from **Part 1**, that “you can’t change what you can’t measure,” I assess the current status of health disparities in patients’ utilization of four preventive health services and seek to understand the drivers of those disparities.

Health Measures: Breast and Colon Cancer Screening, MMR and HPV Vaccines

My analysis centers on four preventive health services – breast cancer screening, colon cancer screening, MMR vaccinations, and HPV vaccinations. Intermountain follows national guidelines to determine who is eligible for these services. **Figure 5** provides an overview of the four measures, their adherence guidelines, and the size of the Intermountain patient dataset used. More detailed information is available in the [appendix](#).

While not comprehensive measures of health equity or health outcomes, rates of use of preventive health services offer a starting point to understand patient access to and receipt of care. The results may be understood as proxies for the broader state of health access within Intermountain.

Figure 5: Preventive Health Services Used in Analyses

MEASURE	CRITERIA	POPULATION	COHORT SIZE
Breast Cancer	Women between age 50 and 74 who should have received a mammogram in the last two years	Women in Utah enrolled in SelectHealth Medicare Advantage or IHC’s Medicare ACO in 2019	15K
Colon Cancer	Adults between age 50 and 74 who should have received appropriate screenings in appropriate timelines	Adults in Utah enrolled in SelectHealth Medicare Advantage or IHC’s Medicare ACO in 2019	36K
MMR Vaccine	Children between age 4 and 6 who should have received second dose of MMR vaccine	Children in Utah enrolled in SelectHealth Commercial or Medicaid in 2019	12K
HPV Vaccine	Children between age 9 and 15 who should have received a first and second dose of HPV vaccine	Children in Utah enrolled in SelectHealth Commercial or Medicaid in 2019	31K

Source: Developed by author

Patient Populations: Intermountain's At-Risk Medicare and Pediatric Populations

My analyses include two Utah-based Intermountain patient cohorts: Medicare-eligible populations between the ages of 50 and 74, and pediatric populations eligible for routine vaccinations between the ages of 4 and 15. Each patient group represents two health insurance types, including two “at-risk” Medicare insurance models, and two traditional pediatric insurance types – SelectHealth Commercial insurance and state-sponsored Medicaid.

Cancer Screening Population – Medicare ACO and Medicare Advantage

Intermountain offers multiple insurance types to Medicare-eligible patients. One is an Accountable Care Organization, or ACO, a model for insurance provision developed through the Affordable Care Act.⁴⁰ In an ACO, physicians, hospitals, and other providers are brought together to better coordinate care for a population of Medicare patients.⁴¹ The ACO shares medical and fiscal responsibility for the patients and is financially rewarded for avoiding unnecessary spending and keeping patients healthy. Intermountain has run its ACO since 2018, and in 2019, it served 51K Medicare patients.

A second “at-risk” model is Intermountain’s SelectHealth Medicare Advantage plan. Medicare Advantage is a capitated Medicare model, in which provider systems receive a pre-determined, fixed payment per member per month that must be used for the care of a cohort of patients. If patients need care beyond the predetermined rate, the system is responsible for covering the costs (although health systems typically reinsure against substantial unexpected expenses). Intermountain began offering a Medicare Advantage plan through SelectHealth in 2018, and it received a 4.5 out of 5 rating from the Centers for Medicare & Medicaid Services (CMS) in 2019, making it a high-performing Medicare Advantage plan.⁴² In 2019, SelectHealth’s Medicare Advantage plan covered about 26K patients.

Pediatric Vaccination Population – Commercial and Medicaid

Intermountain serves many children across Utah. About 70% are enrolled in Intermountain’s SelectHealth Commercial health plan, usually reflecting a child with a parent who applied for family coverage through an employer. Intermountain also serves about 18K children per year under Utah’s Medicaid offering, which provides public health coverage for children living under 200% of the Federal Poverty Line (FPL). In 2019, the FPL was ~\$26K for a family of four, so a child living in a four-person household earning less than ~\$52K would be eligible for Medicaid (the 2019 median Utah household income was ~\$72K).⁴³ In general, Medicaid reimbursement to health providers is lower than commercial rates.

⁴⁰ Gold, Kelly. “Accountable Care Organizations, Explained.” *Kaiser Health News*. 14 September 2015. <https://khn.org/news/aco-accountable-care-organization-faq/>

⁴¹ Gold, Kelly. “Accountable Care Organizations, Explained.” *Kaiser Health News*. 14 September 2015. <https://khn.org/news/aco-accountable-care-organization-faq/>

⁴² “SelectHealth Medicare Advantage Star Ratings.” Last Updated 7 October 2020. <https://selecthealth.org/medicare/star-ratings>

⁴³ “QuickFacts Utah, 2019.” *United States Census Bureau*. <https://www.census.gov/quickfacts/UT>

Tables 2 and 3 provide an overview of basic demographic and preventive health services information on the four patient cohorts.

Table 2: Dataset Breakdown of Cancer Screening Rates by Key Demographics

	BREAST CANCER SCREENING		COLON CANCER SCREENING	
	(% dataset)	(average rate)	(% dataset)	(average rate)
Sex				
Female	100%	78%	55%	75%
Male	-	-	45%	75%
Insurance				
Medicare ACO	55%	81%	79%	79%
Medicare Advantage	45%	73%	69%	69%
Race/Ethnicity				
White	96%	78%	96%	75%
Hispanic	3%	74%	3%	70%
Asian	1%	79%	1%	75%
Black	0%	80%	0%	77%
American Indian / Alaska Native	0%	77%	0%	71%
Native Hawaiian / Pacific Islander	0%	63%	0%	61%
Multiple	0%	63%	0%	75%
Declined	1%	80%	1%	71%
Not Available	1%	37%	1%	40%
Marital Status				
Married	67%	80%	72%	77%
Divorced	11%	71%	9%	69%
Single	9%	71%	9%	68%
Widowed	12%	77%	8%	75%
Primary Care Physician Attribution				
IHC Employed	72%	82%	67%	84%
IHC Affiliated	22%	69%	24%	58%
Not Attributed	6%	49%	9%	49%

Source: Intermountain data, author’s analysis; for screening rates with confidence intervals, see [appendix](#); non-White patients represent a very small percentage of the dataset (approximately 4%), which means there is insufficient data to statistically compare differences in rates between White and minority racial groups. Hispanic includes White and non-White individuals.

Table 3: Dataset Breakdown of Vaccination Rates by Key Demographics

	MMR VACCINE		HPV VACCINE	
	(% dataset)	(average rate)	(% dataset)	(average rate)
Sex				
Female	49%	85%	49%	41%
Male	51%	84%	51%	38%
Insurance				
SelectHealth Commercial	70%	86%	25%	40%
Medicaid	30%	81%	75%	39%
Race/Ethnicity				
White	91%	84%	91%	39%
Hispanic	14%	84%	13%	44%
Asian	2%	90%	2%	55%
Black	2%	86%	2%	43%
American Indian / Alaska Native	1%	82%	1%	42%
Native Hawaiian / Pacific Islander	2%	86%	2%	41%
Multiple	0%	71%	0%	46%
Declined	2%	86%	2%	48%
Not Available	0%	63%	1%	35%
Physician Type				
Pediatrician	79%	87%	66%	45%
Family Medicine	20%	72%	34%	28%

Source: Intermountain data, author’s analysis; for screening rates with confidence intervals, see [appendix](#); non-White patients represent a very small percentage of the dataset (approximately 9%), which means there is insufficient data to statistically compare differences in rates between White and minority racial groups. Hispanic includes White and non-White individuals.

Variables

My analyses assess the likelihood that a patient will get a cancer screening or vaccination according to national guidelines. Each model uses 10-15 predictor variables representing a range of categories. **Table 4** provides an overview of the key variables in my analysis.

Dependent Variable

My dependent variable measures whether a patient eligible for receipt of preventive care receives it. The variable is 0 if the patient has not received a cancer screening or vaccination, and 1 if the patient has received it.

Control / Predictor Variables

Health delivery variables refer to health system factors that affect a patient’s direct experience with care. These include the patient’s insurance (Medicare ACO or Medicare Advantage; Commercial or Medicaid) and provider type. For cancer screening patients, the attribution

Table 4: Key Variables in Analysis

VARIABLE	CATEGORY	CODED NAME	EXPLANATION	TYPE
Preventive Health Screening Statatus	Dependent Variable	SCREENED (cancer screening) or MET_FLG (vaccinations)	A measure of whether or not the patient has been appropriately screened or vaccinated according to guidelines. 1 if complete.	Binary (0 or 1)
Region	Geography / Region	REGION_i where i is each of eight regions	An indicator of the region where the patient lives, based on patient address.	Binary (0 or 1)
Health Insurance	Health Delivery Factor	MEDICARE_ADVANTAGE (cancer screening) or MEDICAID (vaccination)	For cancer screenings, an indicator of a patient on Medicare Advantage versus the ACO; for vaccinations, an indicator of a patient on Medicaid versus SelectHealth Commercial. 1 if MA or Medicaid.	Binary (0 or 1)
Attribution Type	Health Delivery Factor	IHC_EMPLOYED and IHC_AFFILIATED (cancer screenings only)	An indicator of whether a patient is attributed to a physician employed by Intermountain, to an affiliated provider, or, if neither, to no physician at all.	Binary (0 or 1)
Provider Type	Health Delivery Factor	PEDIATRICIAN (vaccinations only)	An indicator of whether a patient received care from a pediatrician versus a family medicine provider. 1 if pediatrician.	Binary (0 or 1)
Poverty Level	Socioeconomic Indicator	POP_BELOW_150_POV_LEVEL_PCNT	A measure of the percentage of individuals in the patient census block who live below 150% of the Federal Poverty Line.	Numerical (b/w 0 and 1)
Education Level	Socioeconomic Indicator	POP_GE25_W_HIGH_SCHOOL_ED_PCNT	A measure of the percentage of individuals over the age of 25 in the patient census block who have a high school diploma.	Numerical (b/w 0 and 1)
Race	Patient Demographics	WHITE	An indicator of whether the patient identifies as white or another of 8 racial categories (including declined and unavailable).	Binary (0 or 1)
Ethnicity	Patient Demographics	LATINO	An indicator of whether the patient identifies as hispanic or one of three other categories (not hispanic, not available, declined).	Binary (0 or 1)
Language	Patient Demographics	ENGLISH	An indicator of whether the patient identifies English as their major language versus numerous other language options.	Binary (0 or 1)
Sex	Patient Demographics	FEMALE	An indicator of whether the patient identifies as female or male.	Binary (0 or 1)
Marital Status	Patient Demographics	MARRIED (cancer screening only)	An indicator of whether the patient identifies as married or as one of Widowed, Divorced, Single, Partnered, Not Available.	Binary (0 or 1)

Source: Intermountain data columns; author’s analysis.

variable differentiates between an employed Intermountain primary care physician (PCP), an affiliated PCP (not employed by Intermountain), or a patient not attributed to a PCP. For vaccination patients, the provider type differentiates between a child who sees a pediatrician and a child who sees a family medicine provider.

Geography variables are the eight internal Intermountain groups used to allocate patients to regions. **Figure 6** shows eight Intermountain regions grouped by market (Utah North, Central, and South), and **Figure 7** shows markets superimposed on a map of Intermountain health centers. The majority of Utah’s population and Intermountain’s facilities are in Utah Central.

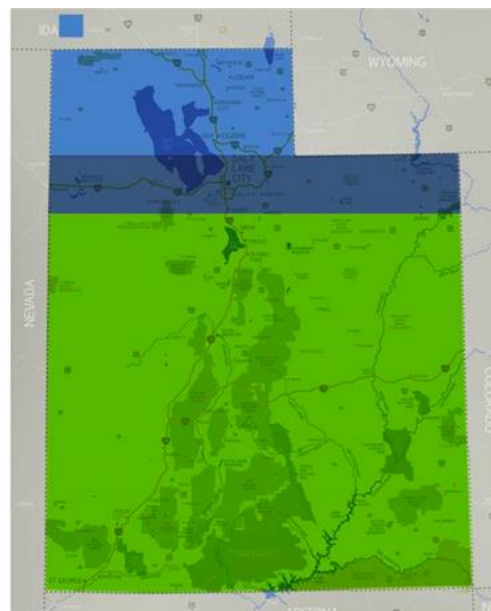
Socioeconomic indicator variables refer to a patient’s census block – geographical areas smaller than a 5-digit zip code (about the size of a city block). Intermountain has data on census-block poverty, education, unemployment, and vehicle ownership, among other indicators. In my analyses, I focus on poverty, which reflects the percentage of people in a census block living under 150% of the FPL. For a family of four, this poverty rate is ~\$39K, considerably lower than Utah’s median income of ~\$72K. I also use education, which measures the percentage of people in the census block greater than the age of 25 who have a high school diploma.

Patient demographic variables refer to individual patient factors like race, ethnicity, gender, language, and, for Medicare populations, marital status. The vast majority of Intermountain patients are white, non-Hispanic, and English-speaking. As a result, sample sizes were too small to run analyses comparing multiple specific groups (e.g., White, Black/African American, Asian); instead, I classify patients as White or Non-White, English-speaking or Non-English-speaking.

Figure 6: Mapping Intermountain Health Markets and Regions in Utah

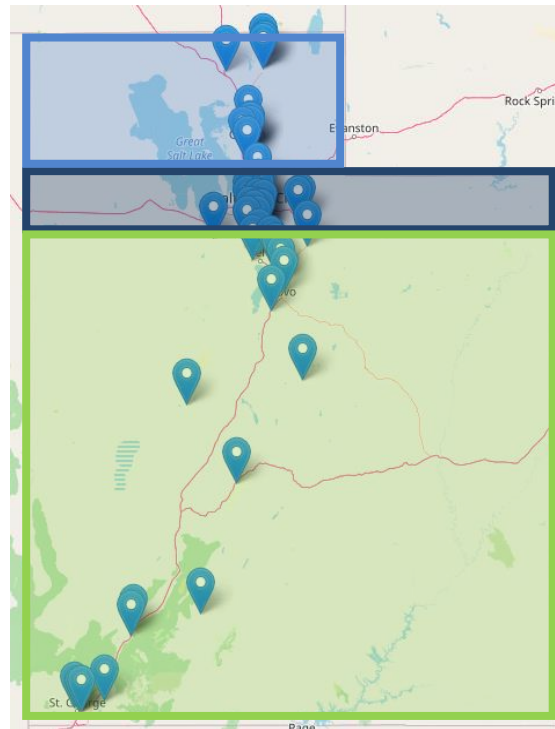
Geographies to markets

Utah North <ul style="list-style-type: none">• Cache Valley• Weber
Utah Central <ul style="list-style-type: none">• North Salt Lake• Central Salt Lake• South Salt Lake
Utah South <ul style="list-style-type: none">• Utah Valley• Central Rural• Southwest



Source: Intermountain Strategy Team, Courtesy of Shawn Brooks

Figure 7: Intermountain Hospitals and Health Clinics by Major Utah Market



Source: Intermountain data, courtesy of Phat Doan

Methodology: Logistic Regression, Random Forest, XGBoost

For each dataset, I used three models (logistic regression, random forest, and XGBoost) to assess the drivers of differences in preventive health rates. In the regression, I assess the Area Under the Curve (AUC) of the model (a measure of overall accuracy), the statistical significance of each variable at the $p < .05$ level, and the direction and magnitude of the log odds coefficients. For ease of interpretation, I convert the estimated log odds into a probability. In my random forest and XGBoost models, I assess the AUC and the relative importance of each variable in the construction of trees. See [appendix](#) for details.

Results

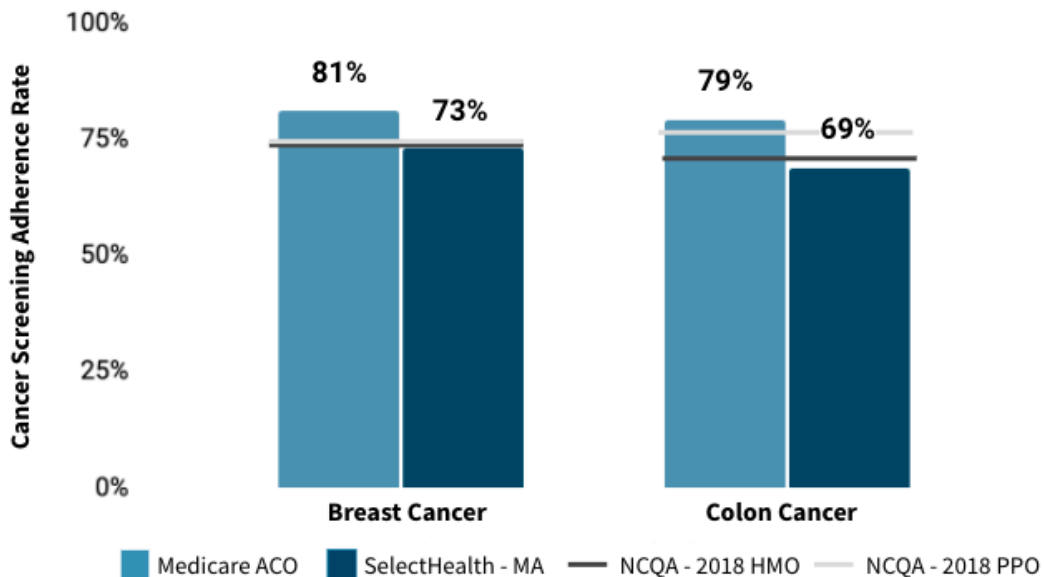
Results are summarized in **Table 1** in the [Executive Summary](#).

Cancer Screening

Findings below reveal what influences a patient’s likelihood of getting screened, resulting from a logistic regression that controls for region, provider and insurance type, census block poverty, and patient demographics. The results are directionally consistent across all three models.

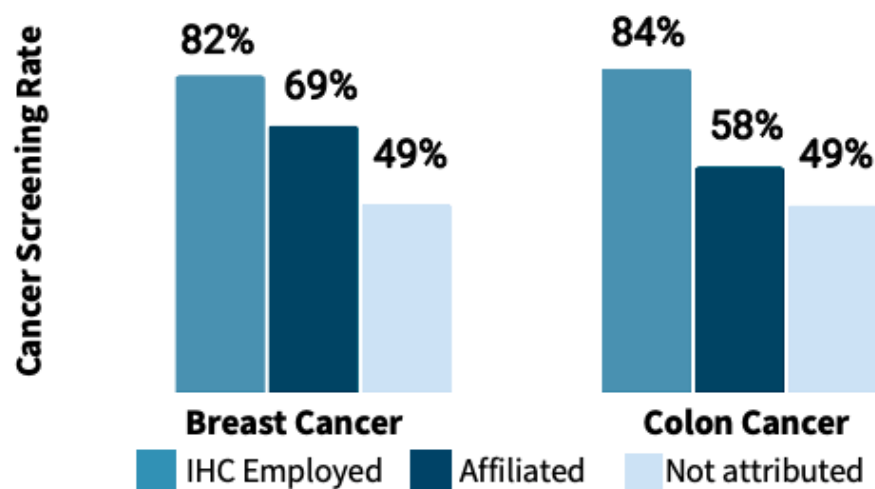
- **Health delivery variables:** Patients who were **attributed to an Intermountain primary care physician** or an **affiliated physician** as compared to a non-attributed patient, and patients who were **enrolled in the Medicare ACO** as compared to the Medicare Advantage plan had higher screening rates. **Figures 8** and **9** show simple correlations in differences in cancer screening rates by physician type and insurance type.
- **Geography variables:** In general, **patients who live in the Salt Lake City regions** (North Salt Lake, South Salt Lake, and Central Salt Lake) had higher screening rates. Not all differences in rates were statistically significant in the logistic regression. Patients who lived in the **Rural and Utah Valley** Regions had some of the lowest rates for cancer screenings. Further, there were particularly low mammogram rates in the Southwest region, and particularly low colon cancer screening rates in Cache Valley.
- **Socioeconomic indicator variables:** Patients who live in **census blocks with higher rates of poverty** were less likely to get cancer screenings.
- **Demographic variables:** Patients who identified as **White** (as compared to other races), **English-speaking** (as compared to any other language), and **married** (as compared to any other marital status) were more likely to get cancer screening. There was no statistical difference in colon cancer screening rates between men and women.

Figure 8: Medicare ACO Outperforms National Averages for Cancer Screenings



Source: Intermountain Data, National Committee for Quality Assurance (NCQA) HEDIS Measures, author’s analysis

Figure 9: Cancer Screening Rates by Physician Attribution Type



Source: Intermountain data, author's analysis

Model Insights

Table 5 shows the logistic regression output for cancer screening datasets. Findings significant at the $p < .05$ level are discussed below.

Holding all else equal, breast cancer screening patients attributed to an employed physician were 161% more likely to be screened than non-attributed patients, and patients attributed to affiliated physicians were 104% more likely. Speaking English was associated with a 63% increase in likelihood, being married was associated with a 48% increase, and being white was associated with a 31% increase. An increase in census block percentage poverty from 0% to 100% was associated with an 86% decrease in breast cancer screening and being on Medicare Advantage was associated with a 21% decrease.

Holding all else equal, the colon cancer screening regression found that a patient attributed to an employed Intermountain physician was 170% more likely to be screened than a non-attributed patient, and a patient attributed to an affiliated physician was 145% more likely. Speaking English was associated with a 43% increase in screening likelihood, being white associated with a 36% increase, and being married associated with a 34% increase. An increase in census block poverty from 0% to 100% was associated with a 32% decrease in breast cancer screening and being on Medicare Advantage was associated with a 48% decrease.

Table 5: Logistic Regression Output for Breast Cancer and Colon Cancer Screening

LOGISTIC REGRESSION - CANCER SCREENING OUTPUT				
Variable	Breast Cancer Screening		Colon Cancer Screening	
	Odds Ratio	P-value	Odds	P-value
Attributed - Employed	161%	.000**	170%	.000**
Attributed - Affiliated	104%	.000**	45%	.000**
Medicare Advantage	-21%	.000**	-48%	.000**
English	63%	.000**	43%	.000**
White	48%	.008**	36%	.000**
Married	31%	.000**	34%	.000**
Percent of census block in poverty	-86%	.000**	-32%	.007**
Region - North Salt Lake	8%	0.477	10%	0.157
Region - South Salt Lake	-14%	0.115	11%	.039*
Region - Weber	-16%	0.066	-24%	.000**
Region - Cache Valley	-36%	0.1	-56%	.000**
Region - Utah Valley	-36%	.000**	-21%	.000**
Region - Rural	-35%	.005**	-32%	.000**
Region - Southwest	-19%	.035*	-15%	.004**

Source: Intermountain patient data, author’s analysis; * significant at the p <.05 level; ** significant at the p <.01 level

Table 6 shows feature importance associated with the XGBoost models for cancer screening. For both screenings, attribution to a primary care provider and insurance type were the two most important variables, representing 57% and 51% of importance totals, respectively.

Table 6: XGBoost Model Feature Importance Output for Cancer Screenings

XGBOOST MODEL - CANCER SCREENING FEATURE IMPORTANCE			
Breast Cancer Screening		Colon Cancer Screening	
Variable	%	Variable	%
Attribution to PCP	45%	Attribution to PCP	35%
Insurance type – SH Med. Adv vs IHC ACO	12%	Insurance type – SH Med. Adv vs IHC ACO	16%
Marital status - married vs non-married	10%	Region – South Salt Lake	6%
Region – Utah Valley	6%	Region – Utah Valley	5%
Language – English vs non-English	4%	Census block poverty	5%
Race – White vs non-white	3%	Census block high school education	4%
Census block poverty	3%	Region – Cache Valley	4%
Region – Rural	3%	Marital status - married vs non-married	4%
Census block high school education	3%	Language – English vs non-English	4%
Region – Cache Valley	2%	Region – North Salt Lake	4%
Region – South Salt Lake	2%	Region – Rural	4%
Region – Central Salt Lake	2%	Race – White vs non-white	4%
Region – North Salt Lake	2%	Region – Southwest	3%
Region – Southwest	1%	Region – Central Salt Lake	3%

Source: Intermountain patient data, author’s analysis

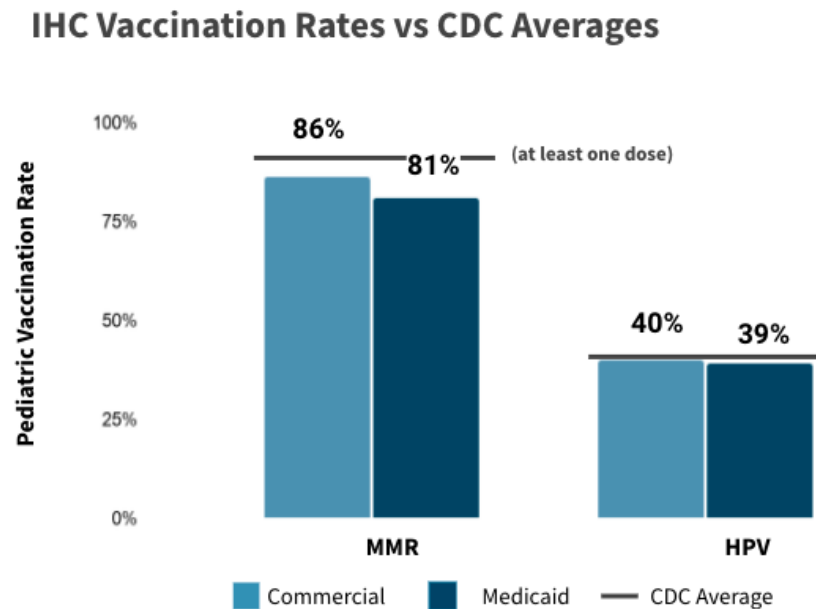
Additional model output can be found in the [appendix](#).

Pediatric Vaccinations

Findings below reveal what influences a patient’s likelihood of getting vaccinated, resulting from a logistic regression that controls for region, provider and insurance type, census block variables depending on the vaccination, and patient demographics. The results are directionally consistent across all three models.

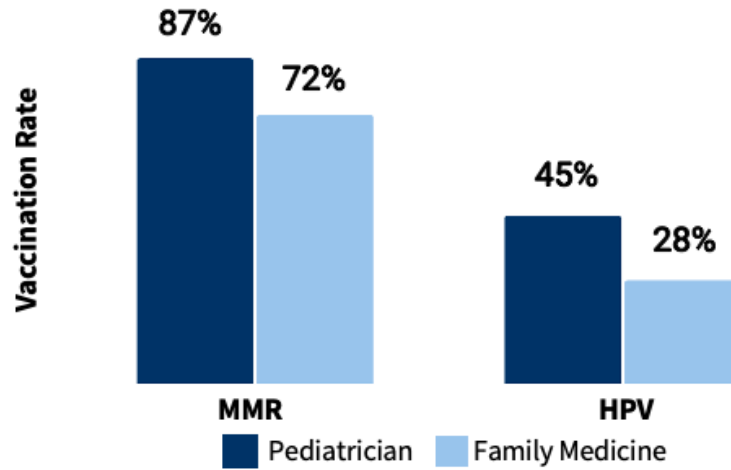
- *Health delivery variables:* Patients seeing **pediatricians** (as compared to family medicine providers) and patients **enrolled in Commercial Health Plans** (as compared to Medicaid) had higher MMR vaccination rates. **Figures 10** and **11** show differences in vaccination rates by physician and insurance type.
- *Geography variables:* In general, **patients who lived in the Salt Lake City regions** (North, South, and Central Salt Lake) had higher vaccination rates. Patients who lived in the **Rural and Utah Valley** Regions had lower MMR and HPV vaccination rates.
- *Socioeconomic indicator variables:* While census-block poverty was a statistically significant predictor of cancer screening rates, it was not significant for vaccinations. However, **census block level education rates** were inversely correlated with HPV vaccinations; more educated census blocks had lower HPV vaccination rates.
- *Demographic variables:* Patients who identified as **non-White** (as compared to White), were more likely get vaccinations (though the difference was only statistically significant for HPV vaccinations). **Girls were more likely to get HPV vaccines than boys**, but there was no statistically significant difference for MMR vaccines.

Figure 10: Commercial Insurance MMR Vaccination Rates Higher Than Medicaid



Source: Intermountain patient data, author’s analysis, Centers for Disease Control (CDC)

Figure 11: Patients of Pediatricians have Higher Vaccination Rates



Source: Intermountain patient data, author's analysis

Table 7 shows the logistic regression output for the vaccination datasets. Due to some variables not being statistically significant, each regression includes slightly different variables.

Holding all else equal, the MMR regression found that a patient seeing a pediatrician was 140% more likely to be vaccinated than a patient seeing a Family Medicine provider. Being from North Salt Lake was associated with a 60% increase in likelihood of MMR vaccination. Being on Medicaid was associated with a 23% decrease. Being from Utah Valley and Southwest regions were associated with 39% and 28% decreases in MMR vaccination rates, respectively. Being white, speaking English (not shown), being a girl (not shown), and being Latino (not shown) were not statistically significant.

Holding all else equal, the HPV regression found that a patient seeing a pediatrician was 91% more likely to be vaccinated. Being from North or South Salt Lake was associated with a 24% and 20% increase, respectively. Female and Hispanic patients had 17% and 24% higher likelihoods of HPV vaccination, respectively. While poverty was not statistically significant, an increase in high school education from 0% to 100% in the census block was associated with a 35% decrease in HPV vaccinations. Being white was associated with a 19% decrease in likelihood of vaccination. Being on Medicaid was associated with a 9% decrease.

Table 7: Logistic Regression Output for Vaccinations – MMR and HPV

LOGISTIC REGRESSION - VACCINATION OUTPUT				
Variable	MMR Vaccine		HPV Vaccine	
	Odds Ratio	P-value	Odds	P-value
Provider - Pediatrician	140%	.000**	91%	.000**
Insurance - Medicaid	-23%	.000**	-9%	.007**
White	-4%	0.355	-19%	.000**
Female	-	-	17%	.000**
Hispanic	-	-	24%	.000**
Percent of census block in poverty	-31%	0.610	-	-
Percent of census block with high school education	-	-	-35%	0.025
Region - North Salt Lake	60%	.004**	24%	.000**
Region - South Salt Lake	-13%	0.246	20%	.000**
Region - Weber	-3%	0.804	-5%	0.335
Region - Cache Valley	-6%	0.655	-20%	.000**
Region - Utah Valley	-39%	.001**	-14%	.030*
Region - Rural	29%	0.295	-24%	.020*
Region - Southwest	-28%	.011*	-42%	.000**

Source: Intermountain data, author’s analysis; * significant at the p <.05 level; ** significant at the p <.01 level

Table 8 shows the feature importance associated with the XGBoost model for MMR and HPV vaccines. For both vaccinations, provider type (pediatrician vs. family medicine) was the most important variable, representing 54% and 49% of importance totals, respectively. Beyond the provider type variable, regions were critical variables in predicting vaccination rates.

Table 8: XGBoost Model Feature Importance Output for Vaccinations

XGBOOST MODEL - CANCER SCREENING FEATURE IMPORTANCE			
MMR Vaccination		HPV Vaccination	
Variable	%	Variable	%
Provider Type – Pediatrics vs Family Med	54%	Provider Type – Pediatrics vs Family Med	49%
Region - Rural	7%	Region – Southwest	12%
Insurance – Medicaid vs Commercial	6%	Region – South Salt Lake	10%
Region – Southwest	4%	Region – North Salt Lake	10%
Region – Utah Valley	4%	Region – Central Salt Lake	3%
Region – North Salt Lake	4%	Region – Weber	3%
Region – Cache Valley	4%	Region – Rural	2%
Census block poverty	3%	Ethnicity – Latino vs non-Latino	2%
Census block high school education	3%	Gender – Female vs Male	1%
Region – South Salt Lake	3%	Census block education	1%
Gender – Female vs Male	3%	Census block poverty	1%
Race – White vs non-white	2%	Region – Utah Valley	1%
Language – English vs non-English	2%	Insurance: Medicaid vs Commercial	1%
Region – Weber	2%	Race – White vs non-white	1%
Region – Central Salt Lake	1%	Language – English vs non-English	1%

Source Intermountain data; author’s analysis

Additional model output can be found in the [appendix](#).

Discussion and Implications

Analyses of patient utilization of four preventive health services in the state of Utah reveal that structural health delivery factors (insurance and provider type), geography, socioeconomic indicators, and patient demographics are correlated with, and likely driving, differences in preventive health rates. Defining health disparities as plausibly avoidable health differences adversely affecting socially disadvantaged groups, certain cohorts of patients – from elderly populations living in areas of high poverty to children living in rural areas – experience healthcare differently, manifesting as different rates of preventive care critical to public health. My findings that provider type and insurance type are particularly important variables in building a predictive model imply that Intermountain can modulate patient access through interventions that target providers and insurance products.

Both academic literature and Utah-specific statistics corroborate many of the findings from my analyses; these external sources are discussed in detail in the [appendix](#). Findings from my analyses that were consistent with other recent studies include:

- Geographic variation in cancer screening rates in Utah,
- Association between poverty and lower cancer screening rates,
- Association between being married and higher cancer screening rates,
- Association between speaking English and higher cancer screening rates,
- Association between being white and higher colon cancer screening rates,
- Association between Medicaid insurance and lower MMR rates,
- Association between being a minority and higher HPV vaccination rates,
- Association between being a girl and higher HPV vaccinations.

Findings from my analyses that deviated from other studies include:

- National studies have found that children living in higher poverty had lower MMR rates and higher HPV rates. My analysis found that the relationship between poverty and vaccination rates was not significant at the $p < .05$ level.
- Some national studies have found higher rates of mammograms for patients in Medicare Advantage plans compared to fee-for-service enrollees; my analyses did not include a fee-for-service insurance, and I found that Medicare Advantage enrollees had lower rates of breast cancer screening than the Intermountain ACO.
- A national study found that maternal education was associated with higher HPV rates. In my analysis, however, increasing census block high school education rates was associated with lower HPV vaccination rates.

Collectively, these findings indicate that the U.S., Utah, and Intermountain experience many directionally similar differences in preventive health rates. Notably, Intermountain appears to be outperforming other health systems in Utah on breast and colon cancer screening and HPV vaccinations for boys; there may be opportunity for Intermountain to showcase best practices

within the state. At the same time, Intermountain has room for improvement, particularly among specific cohorts of Medicare-eligible patients and for children facing low HPV vaccination rates. My analyses suggest that Intermountain should, resources permitting, make efforts to increase overall use of preventive health services, and to increase access to care for groups of patients experiencing lower rates of cancer screenings and vaccinations.

PART 3: INTERVENTIONS FOR FUTURE ACTION

Part 3 builds on the lessons from **Part 1** and analyses from **Part 2** to outline options for increasing preventive health rates. The root causes of observed differences in preventive health services rates are not fully known; even so, the recommendations leverage insights on what may be driving disparities. This section includes guiding principles, intervention options, and executional approaches. I offer a replicable model for these and other health outcomes within Intermountain's population.

Guiding Principles for Health Disparity Interventions

- **Targeted:** built to address the needs of underserved or under-resourced patient cohorts
- **Community-oriented:** designed with and for community members
- **Resourced:** supported by funding, human resources, and executive champions
- **Data-driven:** implemented to achieve clear metrics, with ongoing data collection

Targeted – Interventions require efforts adapted to distinct needs. In my analysis, lack of physician attribution was strongly correlated with reduced rates of cancer screening. But the drivers of non-attribution vary by region. In southern Utah, the 6-10% of patients who are not attributed live, on average, farther away from health facilities than attributed patients. In Salt Lake County, non-attribution is more common among non-White patients. These datapoints indicate that interventions addressing non-attribution should be tailored to each group.

Community-oriented – Health equity programs should be developed in conjunction with community members and organizations, from local government to educators to patients. Grassroots collaboration with the community is often more effective at achieving sustained, lasting change. For example, efforts to increase vaccinations rates among children will likely be met with resistance if parents are not brought on board (see the [CCHMC case study](#)). Community involvement and feedback should be actively solicited.

Resourced – Health systems should deliver on public statements in support of health equity through programs with dedicated resources, clear owners, and accountable leaders. For example, Intermountain pediatricians currently use clinical pathways to help track vaccination rates among their patients. It is unlikely that family medicine providers will be able to achieve the same levels of vaccinations without assigning people to be responsible for change management – for example, by working with clinic staff on modified EMR pathways.

Data-driven – Through all phases of intervention design and implementation, data should inform decision-making, identify patients in need of interventions, and track progress. Collecting and publishing data will allow for increased transparency and visibility of Intermountain's progress towards health equity.

Intervention Proposals

Going forward, Intermountain can choose from a set of options for addressing differences in preventive health measures. **Table 9** provides a framework for categorizing approaches.

Replicating Best Practices

The first category of interventions builds on the “positive deviation” approached outlined in the [CCHMC case study](#), in which a health system used high-performing clinics as models for process improvements. Within Intermountain, this intervention category builds on insights about the most important variables in preventive health models from **Part 2**: patients utilize services differently depending on provider type and health insurance. Interventions in this category acknowledge that one cannot flip a switch and move children living in rural areas (where there are fewer pediatricians) to Salt Lake City (where there are more). Instead, I assess what might be driving success in certain parts of the organization and translate those lessons to areas that are relatively underperforming. Examples include:

Medicare ACO → Medicare Advantage: patient outreach





Patients enrolled in the ACO have higher rates of cancer screening than Medicare Advantage enrollees. Anecdotally, practices that may be driving differences include the fact that patients in the ACO receive mailings from Intermountain multiple times per year reminding them what screenings they are due for. Based on interviews, the Medicare Advantage plan does not currently use these practices. However, given that Medicare Advantage providers are financially reimbursed for providing cancer screenings, there is a clear clinical and financial motive to invest in relatively low-cost patient outreach like mailings.

Pediatrician → Family Medicine: incentives and parent education

For both MMR and HPV vaccines, patients who saw pediatricians had higher vaccinations rates. Several factors may be driving this dynamic. One is regional differences: in Salt Lake City, there are more pediatricians; further, cultural norms around vaccinations are likely quite different in different parts of Utah. Another factor is that Intermountain uses clinical pathways to standardize physician workflows according to specialty-specific guidelines. Clinical pathways for pediatricians include explicit vaccination trackers, whereas Family Medicine providers, responsible for a host of medical needs and patient types, do not.

Some practices can be translated from Pediatrics to Family Medicine. First, Family Medicine providers may be able to use existing clinical pathways when treating children. Second, an Intermountain clinic has piloted “Family Unit Vaccination Visits,” in which family medicine providers run through required vaccinations for every family member at the time of a visit. Both of these methods, if applied broadly, may help Family Medicine providers increase vaccinations.

Table 9: Sample interventions to increase utilization of preventive health measures.

INTERVENTION TYPE	EXPLANATION	EXAMPLES	ESTIMATED RELATIVE COST
 <p>REPLICATING BEST PRACTICES</p>	<p><i>Apply existing models of excellence to broader organization</i></p>	<ul style="list-style-type: none"> • ACO → Medicare Advantage: proactive mailings to patients on what preventive care is needed • Peds → FM: vaccine-centered clinical pathways, family unit vaccination visits, HPV at 11 years old 	<p><i>Lower (\$)</i></p>
 <p>NOVEL APPROACHES TO ACCESS</p>	<p><i>Radically increase patient access to health care by removing barriers</i></p>	<ul style="list-style-type: none"> • Proactive, feature-based patient identification and outreach through Arcadia (similar to Pediatric Equity) • Home delivery of colon screening kits • Transportation services for colonoscopies 	<p><i>Higher (\$\$)</i></p>
 <p>HIGH-TOUCH INTERVENTIONS</p>	<p><i>Engage with community stakeholders for longer-term programs & initiatives</i></p>	<ul style="list-style-type: none"> • In partnership with government, schools, faith-based orgs, reach patients in communities (e.g., through Intermountain West HPV Coalition) • Human capital (e.g., Health Equity Advocates) and data investments (e.g., PRAPARE survey) 	<p><i>Highest (\$\$\$)</i></p>
 <p>FURTHER EXPLORATION & RESEARCH</p>	<p><i>Use qualitative and quantitative research to understand drivers</i></p>	<ul style="list-style-type: none"> • Why are patients not attributed? • How does culture affect vaccine rates? • How do non-English speaking patients navigate IHC? 	<p><i>Lower (\$)</i></p>

Source: Developed by author; with input from interviewees

Third, providers may have suggestions for how to speak to parents and children experiencing vaccine hesitancy associated with the HPV vaccine (which is culturally associated with sex), or the MMR vaccine (which was, at one time, falsely associated with autism). Providers who have successfully encouraged uptake of these vaccines, even in the face of resistance, are powerful resources. Their experiences should be leveraged so that other providers can have sample language for conversations with patients and parents. One interviewee recommended that children be vaccinated on the younger end of the CDC-proposed age range, to decrease associations with sex that might trigger parent resistance. Another recommended that clinics track instances of parents refusing vaccines to better document differences across regions.

Novel Approaches to Access

The second category of interventions involves increasing patient access to preventive health screening through non-traditional approaches to providing care. This category may not always be distinct from Replicating Best Practices, but I highlight it as a separate category to encourage leaders to brainstorm new approaches to care delivery.

Proactive identification of patients less likely to be screened

Castell deploys a comprehensive data platform, called Arcadia, to coordinate patient health. This platform sends “action items” to providers and Care Traffic Controllers based on patient status. For example, a patient overdue for a post-operative visit will be “flagged,” and a care team can help coordinate a follow-up visit. Using insights from **Part 2**, Castell could proactively create flags for patients with characteristics associated with lower rates of preventive health screening. This intervention could be used to create flags for Medicare patients who, for example, do not identify as married, do not speak English, or who live in census blocks with high poverty. This may allow Castell to proactively address cancer screening differences.

Direct-to-consumer preventive health

To encourage colonoscopies and reduce logistical and socioeconomic barriers associated with transportation, Intermountain could train employees as medical escorts and offer free or reduced transportation to and from colonoscopy visits.⁴⁴ Since one driver of reduced colon cancer screening was areas of higher poverty, the provision of transportation services could support financially constrained patients who might otherwise not take off work, or seek assistance of a friend likewise required to take leave, in order to receive screening. A program like this could assess how well, and at what cost, this intervention affects screening rates.

Further, for colon cancer screening, a number of non-invasive, at-home sample collection options may assist patients facing access barriers. Products from companies like Everlywell, Second Generation, EZ Detect, LetsGetChecked, Pixel, and Cologuard have been qualified or are in the process of being qualified under Healthcare Effectiveness Data and Information Set

⁴⁴ Elizabeth Rourke. Interview 31 March 2021.

(HEDIS) guidelines. For patients in rural areas, or patients with demonstrated lower rates of colon cancer screening, Intermountain may pilot options to send tests to patient homes (many can be ordered as a prescription) as a way to boost screening rates. A 2017 Mayo Clinic research collaboration with Kaiser Permanente on the effect of sending fecal immunochemical testing (FIT) kits to patients found increased screening in response to the mailed kits (+20%), as well as follow-on increases in screening due to automated reminders (+6%) and personal outreach (+4%).⁴⁵ This study took place over a six-week period.

High-Touch Community Interventions

A third category of interventions for reducing differences in health measures involves initiatives that are more costly, more comprehensive, and more likely to address upstream factors like varying rates of health literacy and health education among patient populations.

School and Faith Based Organization Education and Delivery

Some U.S. health systems have used community-based organizations to address healthcare education and delivery within key populations. Los Angeles-based Cedars Sinai hosts cancer education workshops for Korean Americans, Filipino Americans, and African American residents in churches and recreation centers.⁴⁶ In recent years, Kaiser Permanente of Northern California has hosted weekly workshops in churches serving primarily Latinx populations, where Kaiser has both provided education on preventive health measures and offered vaccines to members and non-members at the end of the workshops.⁴⁷

Similarly, Intermountain could turn to faith-based organizations or schools as venues for cancer and vaccine education and distribution. For example, Utah's Department of Public Health has an HPV vaccination target of 80%, though rates currently hover in the 40-50% range.⁴⁸ A high-touch effort could involve the existing Intermountain West HPV Vaccination Coalition (not related to Intermountain Health Care), a decade-old organization launched to improve HPV vaccination rates in the Western United States.⁴⁹ By convening parents, educators, faith leaders, and state public health agents, Intermountain could spearhead events to dramatically increase vaccination rates. This effort would likely require state funding to enact, as not all children served would be Intermountain members. While this type of intervention is more costly and complicated, it has a number of positive externalities for Intermountain, because it showcases leadership in public health, health equity, and community programs.

⁴⁵ Selby K, Jenson C, Levin T, Lee J, Schottinger J, Zhao W, Corley D, Doubeni C. "Program Components and Results From an Organized Colorectal Cancer Screening Program Using Annual Fecal Immunochemical Testing." *Clinical Gastroenterology and Hepatology*, 2020, ISSN 1542-3565, <https://doi.org/10.1016/j.cgh.2020.09.042>. <https://www.sciencedirect.com/science/article/pii/S1542356520313720?dgcid=coauthor>

⁴⁶ Gooch, Kelly. "'We alone can do our part': How US News' top 10 hospitals are addressing health disparities." *Becker's Hospital Review*. 6 August 2020. <https://www.beckershospitalreview.com/hospital-management-administration/how-us-news-top-10-hospitals-work-to-limit-health-disparities-inequities.html>

⁴⁷ Chris White. Interview 28 January 2021.

⁴⁸ State of Utah. "Early Childhood Immunization 2019 – State of Utah." Utah.Gov 2019. https://immunize.utah.gov/wp-content/uploads/2019/12/StateofUtah_2019_ImmunizationCoverageReport.pdf

⁴⁹ Kepka, Deanna. "Making it real: Why HPV vaccination matters to pediatric offices." *American Academic of Pediatrics, Utah Chapter*. Presentation delivered 9 February 2018. http://www.aaputah.org/wp-content/uploads/2018/02/Kepka_AAP_2.9.18_final_dk.pdf

Next Steps for Intermountain / Castell Leadership

Any health system assessing interventions will want to assess criteria like costs, ease of implementation, time to results, and likely effects. To build a knowledge base, health systems can use pilots as shorter, lower-cost options for learning more about a program before a broader, more complex roll-out.

Below, I offer considerations for individuals making operational decisions on preventive health disparities at Intermountain and Castell. Because Intermountain's existing strategic initiatives already include improving quality, increasing value, and advancing health equity, Intermountain and Castell can use this collection of strategic initiatives to build alignment and momentum around implementation. Of course, which interventions to deploy will depend on financial and human resource availability.

Prioritizing Interventions

One of Castell's differentiators is its Arcadia data platform. Therefore, implementing interventions that leverage Arcadia could serve a dual purpose of increasing preventive health screening rates and allowing Castell to build capacity to operationalize analytical insights. Using the data platform, Castell could run small-scale experiments – for example, over a period of months, randomizing a set of Medicare Advantage enrollees to be called to schedule cancer screenings and measuring the effect on control and trial groups. Because Castell already employs Care Traffic Controllers familiar with deploying insights from Arcadia to coordinate care for patients, it may be easier to deploy these types of interventions.

Intermountain is also well-suited to explore process improvements in preventive health by using the “Replicating Best Practices” intervention. Intermountain has a rich history of deploying quality, value, and cost-reduction efforts. In a case study discussed in the appendix, [Cincinnati Children's Hospital](#) sent hospital executives to be trained in process improvement at Intermountain.⁵⁰ Collaborating with broader parts of the health system to improve outcomes is not novel to Intermountain, and best practice sharing is a muscle that Intermountain will continue to flex in its pursuit of health equity.

Finally, because high-touch community interventions are more costly, complicated to execute, and harder to see results from, I recommend that Intermountain and Castell leaders not start with these interventions unless there is existing (likely external) financial support. A high-touch intervention executed at the same time as another intervention may complicate the ability to assess program effectiveness. For the pediatric vaccinations, it may be worth exploring a relationship with the Intermountain West HPV Vaccination Coalition and assessing whether existing resources exist to design higher-touch patient interventions.

⁵⁰ Tucker A, Edmondson A. “Cincinnati Children's Hospital Medical Center.” Harvard Business School. 9-609-109. 25 April 2011.

Approaching Interventions

Finally, acknowledging that an Intermountain-specific challenge identified in **Part 1** was building and sustaining cultural change, I offer a set of ideas for approaching health equity interventions to offset or limit potential resistance from employees.

- **Multi-phase programs** – To build buy-in and ownership, Intermountain could begin health equity efforts with a multi-month ‘listening phase,’ in which Intermountain administrators state the organizational goals of the program while actively soliciting feedback from frontline caregivers on what barriers exist to providing care. This phase can preface a more operational period in which Intermountain tracks progress and compares outcomes across clinics or specialties. Intermountain should be prepared to deploy resources to address stated barriers (e.g., if a clinic states that the barrier to providing higher MMR vaccination rates is fridge capacity, Intermountain should be willing to purchase an additional fridge or otherwise manage that barrier).
- **Radical data transparency** – To ensure that relevant employee (and perhaps, patient) stakeholders are aligned about the current status of cancer screening rates or vaccinations, Intermountain could publish (internally or externally) information about preventive health rates by region or health clinic. Publicly available data transparency can counteract reactions from individuals who might otherwise ignore or diminish differences in health outcomes.
- **Gamification** – With data transparency as a foundation, behavior change at the specialty, clinic, or provider level could be motivated through friendly, publicized competition. For example, leadership could create a social status associated with health equity interventions by publicly announcing family medicine centers in the top 10% of vaccination rates every quarter. If it was deemed appropriate and ethical, there could even be a financial prize (e.g., free breakfast for the clinic) associated with outperformance in certain health outcomes.
- **Champions** – When Intermountain faced a major technology shift – migrating its thousands of employees to new Microsoft Office software products – different medical specialties and administrative floors identified “Office 365 Champions.” These individuals offered themselves as resources for colleagues with questions or concerns about the software migration. Building on this process, Intermountain could motivate health equity efforts by establishing “Equity Champions” for specific interventions. The individuals, representing clinic, region, or specialty, could spearhead and lead major efforts, building buy-in at all levels of the organization.

CONCLUSION

America is at a critical juncture in its path towards a more equitable society. Broad groups of stakeholders are acknowledging the effects of structural racism and taking steps to offset systemic oppression. Leaders in healthcare are making bold verbal and financial commitments to improve health equity. The Biden Administration, recognizing the burden that COVID-19 has disproportionately placed on communities of color and low-income communities, has established a COVID-19 Health Equity Task Force charged with building recommendations for addressing racial disparities that the COVID-19 pandemic has caused and exacerbated.⁵¹ Institutional inertia is shifting, and momentum is building to increase accountability for the stakeholders whose collective actions affect the health and wellbeing of Americans. Health systems are charged with meeting this challenge and with setting new standards for the industry in the process.

Any health system engaging in health equity efforts will be entering an evolving landscape, and many health equity interventions currently lack clear financial return on investment (ROI) metrics. Nevertheless, the moral imperative of reducing health disparities transcends traditional profit motives. Meanwhile, novel health delivery models are emerging, in part because of the pandemic, and leaders can use research and experience to guide them. This report has explored the underlying causes of health inequity in the American health system; expanded on University of Chicago's Dr. Marshall Chin's health equity advancement framework to understand how health systems have engaged in efforts to promote health equity; analyzed rates of preventive health measures for Intermountain patients; and offered a set of interventions for Intermountain to use to increase cancer screening and vaccination rates.

While the report focuses on Intermountain, many of its findings are consistent with broader national trends, and many of the lessons can be applied to other health systems and patients. The author hopes that this report may offer a springboard for Intermountain and Castell in its health equity journey, and that Intermountain can continue to offer new standards of excellence for other health systems. I offer a few takeaways below.

Key Takeaways

Health systems must take bold action in their commitments to health equity

America's inequitable health outcomes are, in part, the result of marginalized communities experiencing generations of poverty and oppression, at times exacerbated by the healthcare system and the actions of players within it. A cursory reshuffling of an organizational structure or a one-time investment is not enough to disrupt the systems that constrain patients. Health

⁵¹ "President Biden Announces Members of the Biden-Harris Administration COVID-19 Health Equity Task Force." The White House Briefing Room. 10 February 2021. <https://www.whitehouse.gov/briefing-room/press-briefings/2021/02/10/president-biden-announces-members-of-the-biden-harris-administration-covid-19-health-equity-task-force/>

systems may lack the power to single-handedly make sweeping societal changes, but healthcare leaders can do their part in advocating for and piloting bold solutions.

Health equity is more easily fostered when financial incentives and patient incentives align

The author is particularly inspired by the actions that Intermountain leadership has taken to innovate through “Reimagined Primary Care” and Castell. In addition to empowering leaders who are champions for health equity, Castell is embracing a business model in which healthier patients are better for Intermountain. I hope that other health systems can grapple with having greater accountability for the lives of patients and the wellbeing of communities.

Models of good health equity interventions exist already

My conversations with Intermountain and other health system sparked reflections on what is needed at an organizational and patient level to improve equity. Health systems can learn from research, using the breadth of academic literature as a starting point for interventions. Health systems can learn from themselves – using high-performing centers or experimental pilots to build data and operational expertise. Health systems can learn from each other, engaging in intra-industry collaboration to build plans and track outcomes. And health systems can, always, learn from their communities, as patients are powerful sources of wisdom about what it means to navigate and thrive within the healthcare system.

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ABBREVIATIONS

ACO – Accountable Care Organization
ACS – American Community Survey
AMA – American Medical Association
AUC – Area Under the Curve
CCHMC – Cincinnati Children’s Hospital Medical Center
CDC – Centers for Disease Control
CF – Cystic Fibrosis
CHA – Cambridge Health Alliance
CI – Confidence Interval
CMS – Centers for Medicare and Medicaid Services
ED – Emergency Department
EMR – Electronic Medical Record
FFS – Fee-for-Service
FP – Family Medicine
FPL – Federal Poverty Level
FQHC – Federally Qualified Health Center
GDP – Gross Domestic Product
HEDIS - Healthcare Effectiveness Data and Information Set
HMO – Health Maintenance Organization
HPV – Human papillomavirus
IHC – Intermountain Healthcare
KP – Kaiser Permanente
LAP – Language Access Program
LIME - Local Interpretable Model-agnostic Explanations
MGH – Massachusetts General Hospital
MRI – Magnetic resonance imaging
MMR – Measles, mumps, rubella
NCQA – National Committee for Quality Assurance
OECD – Organization for Economic Cooperation and Development
PCP – Primary Care Physician
PPO – Preferred Provider Organization
ROI – return on investment
RPC – Reimagined Primary Care
RVU – Relative value unit
SLC – Salt Lake City
XGBoost – eXtreme Gradient Boosting

APPENDIX

Case Studies – Health Equity Interventions

Table 10: Case Studies of Health Equity Interventions

ORGANIZATION	LOCATION	INTERVENTION	OUTCOMES (if any)
Massachusetts General Hospital	Chelsea, Massachusetts and Revere, Massachusetts	Multi-sector Education and Public Policy Program	Changes in local policy (substance use response, open space, nutrition) and 50% increase in high school graduation rates
Kaiser Permanente of Northern California	Central Valley, California	"My Quality of Life" Housing Intervention	Double digit reduction in re-hospitalization for members (pilot in progress)
Cambridge Health Alliance	Cambridge, Massachusetts and Boston, Massachusetts	Language Access Program (LAP)	Standardization of time from intake to triage for patients entering hospital, regardless of language spoken
University of Chicago Hospital	Chicago, Illinois	Critical Consciousness Training for Leadership	No outcomes tracked currently
KP Bernard J. Tyson School of Medicine	Pasadena, California	Health Equity Curriculum	Program in progress
Cincinnati Children's Hospital Medical Center	Cincinnati, Ohio	Quality Improvement for Cystic Fibrosis (CF) patients	Patient outcomes improved to 95th percentile nationally from 20th percentile nationally over seven years

Source: Author's interviews, CCHMC case

Massachusetts General Hospital (MGH) – Community Health Programs

Population: Communities of color in two cities in Massachusetts

Goals of program: Policy change, improved graduation rates, etc.

Outcomes: Expansion of community health needs assessments; policy to improve physical space and healthy food access; 50% increase in high school graduation rates for students in program



Overview: MGH is one of the oldest not-for-profit hospital systems in the country, serving approximately 800,000 patients per year. It operates predominantly under a fee-for-service model, but it also serves some patients through a longer-term global payment model called an Alternative Quality Contract, which offers fixed reimbursement rates for select patient groups under Blue Cross Blue Shield (BCBS) of Massachusetts.¹ For years, MGH has been investing community health resources into two of the lowest-income communities in Massachusetts, Chelsea and Revere, which are areas of high transience and areas with high populations of communities of color. Their efforts in the area are two-fold.

First, MGH has functioned as a convener of a coalition of community leaders from key sectors in the area, including representatives from local government, businesses, faith-based organizations, parents, youth, school systems, and the police. This coalition of stakeholders collectively oversees the process of implementing community health assessments and pushing for policy change. For example, the Chelsea Fire Department was one of the first in Massachusetts to carry Narcan for responding to victims of the opioid epidemic, and the coalition has successfully advocated for the building of public bike trails and healthier food choices in schools.

Second, MGH has focused on a more defined cohort of young people of color in Boston Public Schools, Chelsea, and Revere, for whom to provide Science, Technology, Engineering and Math (STEM) after-school programming and resources like college preparedness and career exposure. This program serves approximately 1,000 young people every year, and graduation completion rates are 50% higher than public-school graduation rates in the city of Boston.

Source: Quinlan, Joan. Massachusetts General Hospital. Interview 8 January 2021. Betancourt, Joe. Massachusetts General Hospital. Interview 22 January 2021.

Kaiser Permanente of Northern California (KP NorCal) – “My Quality of Life” Program

Population: Frequent hospital utilizers in Northern California’s Central Valley

Goals of program: Reduced high-acuity health needs through preventive interventions

Outcomes: Increased access to housing, double-digit reduction in avoidable hospitalizations



Overview: Kaiser Permanente of Northern California is a not-for-profit integrated system that includes a capitated health insurance plan, a physician group, and a set of inpatient and outpatient health facilities. They serve approximately 4.4 million patients per year. In 2019, KP NorCal launched an intervention focused on reducing repeated, high-cost hospital visits for members living in California’s Central Valley, a relatively low-income area compared to other parts of California, whose patients had worse health outcomes than other Kaiser Permanente of Northern California members.

KP NorCal’s intervention is to send community health workers to the homes of patients who repeatedly return to the emergency department. If community health workers determine that patients are living in environments that are unsafe or unhealthy, Kaiser coordinates with local housing authorities to pay for patients to live in alternative settings. Notably, KP NorCal is incentivized to implement programs like “My Quality of Life,” which directly address social determinants of health, because Kaiser is one of the only fully capitated systems in the country. As a result, reduction in costly emergency department visits benefits not only the patient, but also the business. The pilot is still underway, but KP NorCal has seen 20%+ reduction in hospital visits.

Cambridge Health Alliance (CHA) – Language Access Program (LAP)

Population: Non-English-speaking patients in Boston and surrounding neighborhoods

Goals of program: Improving access to care, regardless of language spoken

Outcomes: Hospital intake process for non-English speakers at parity with English-speakers



Overview: CHA is a community healthcare system serving Boston’s metro-north communities in Massachusetts. The system serves about 140,000 patients per year, including tens of thousands of patients who speak Portuguese, Spanish, Haitian Creole, Arabic, Nepali or another of approximately 70 languages. The hospital is a fee-for-service provider with a focus on serving underserved communities, and it receives lump sum subsidies from the state to compensate for the costs of serving a high percentage of low-income patients.

Over the past decade, CHA has built a Language Access Program (LAP) that includes 100 interpreters and almost 200 bilingual health providers that are vetted for language proficiency. Their interpreters are a mix of employed (approximately 60%) and per diem contractors (approximately 40%), and they provide a mix of in-person and remote (telephone or video) interpretation services. A key goal of the program was to reduce the time from hospital arrival through patient triage for non-English speaking patients to 5 minutes, which was the average time it takes for an English patient to enter and be triaged at a hospital. CHA achieved this goal by offering a hybrid mix of video and phone interpretation services when needed during non-English patient triage. Patients report high satisfaction of this flexible, hybrid model because it avoids delays in care.

University of Chicago – Critical Consciousness Leadership Training

Population: Employees at University of Chicago Hospital

Goals of program: Train employees and catalyze progress towards health equity

Outcomes: In progress



Overview: The University of Chicago is a not-for-profit, academic teaching hospital serving approximately 200,000 patients per year in the Chicago metropolitan area. In 2019, trained social worker and professor Dr. Jelena Todic, along with a set of colleagues, developed a multi-day, offsite training with University of Chicago Vice Presidents and a set of 30 other employees, resulting in a training on anti-oppression, experimental social justice, and critical consciousness.

Dr. Todic notes that the training was deliberately designed to be a dramatic intervention, in which health system leaders were meant to understand how many of them are taking part in maintaining oppressive structures. By failing to acknowledge and name factors like structural racism and sexism in health care, the training posits, they are colluding to perpetuate violence and oppression against marginalized groups. Further, the training program was designed to not be over-inclusive of the entire leadership team at the hospital, but instead to target training towards individuals with influence who were already thinking about health equity and anti-oppression in health care. The intervention relied on intergroup dialogue to facilitate experiential learning, build relationships, and create a sense of shared accountability for tackling problems at the University of Chicago and beyond.

While there were no tracked metrics for “success” associated with this training, the author includes it as the boldest example of health equity training found over the course of interviews.

Kaiser Permanente Bernard J. Tyson School of Medicine – Health Equity Curriculum

Population: Medical students

Goals of program: Train physicians to understand and practice health equity

Outcomes: Program in progress



Overview: In Pasadena, California, Kaiser Permanente’s Southern California regional headquarter, Kaiser Permanente launched a medical school that inaugurated its first class of 50 medical students in July of 2020. Dr. Walter Conwell, the school’s Dean of Equity, Inclusion, and Diversity along with a broader team, developed a health equity curriculum with the goal of being a model for other medical schools and other health systems.

Dean Conwell and his team have developed and launched a health equity strategy that spans six key pillars of the medical school: community engagement, pathway programs, admissions and recruitment, faculty and staff, curriculum and clinical experience, and student support. The “curriculum and clinical experience” pillar is built on a competency-based curriculum, with sessions on topics like inclusion, cognitive bias, stereotype threat, microaggressions, personality trait adaptability, social adaptability, and humility and narrative change. These sessions, which include 30 hours of in-person content, are meant to orient students towards a more nuanced understanding of self, community, and system.

Beyond these sessions, students also learn about the social determinants of health and the history of racism in the American medical system during medical school. In future years, a mandatory part of educational programming will require students to be embedded in local Federally Qualified Health Centers (FQHCs), which serve disproportionately lower income populations, where they will develop programs with community health and social workers. This combination of training and experiential education is meant to train a future generation of physicians more oriented towards patient and community needs – as well as issues of health equity – than ever before.

Because the Bernard J. Tyson School of Medicine has only just started, there are not yet any outcomes associated with the program.

Cincinnati Children's Hospital Medical Center – Cystic Fibrosis (CF) Quality Improvement

Population: Pediatric patients

Goals of program: Improve outcomes for patients with Cystic Fibrosis (CF)

Outcomes: Boost from 20th to 95th percentile in patient outcomes over seven years



Overview: The Cincinnati Children's Hospital Medical Center (CCHMC) is a not-for-profit, academic medical center that served more than 90,000 children in their emergency department per year in the early 2000s. Between 2002 and 2007, CCHMC led a multi-year effort, funded by the Robert Wood Johnson Foundation, to dramatically improve outcomes for pediatric Cystic Fibrosis (CF) patients.

The overall hospital transformation started with strategic initiatives calling for process improvements, performance scorecards, and quality management at the system level. For the pulmonary division of the hospital, the CF project began by assessing the hospital's patient outcomes for CF, as measured by lung function, compared to other CF clinics around the country. Patient outcomes revealed that CCHMC was performing in the bottom 20th percentile of CF centers nationally. These results were shared publicly and ultimately brought a number of physicians on board to improve the program.

To develop changes, the team included seventeen parents of CF patients. A key learning from this collaboration was that CCHMC staff members thought that parents would prioritize getting their children as quickly in and out of the clinic as was possible. Surprisingly to the providers, parents were actually most concerned about getting all of the information they needed from a visit, regardless of the time it took. To improve outcomes, CCHMC took a "positive deviance" approach, where they identified national CF centers with the best outcomes and implemented lessons and best practices from them. Further, instead of implementing a plan that affected all children at once, the team began by focusing on the children experiencing the worst clinical outcomes, with the goal of moving them incrementally from the most at-risk tier to one level better.

Lung function outcomes improved so dramatically that the CF clinics at CCHMC were in the 95th percentile of all CF clinics by 2007.

Quantitative Methodology

Health Measure Information

The Centers for Medicaid and Medicare Services (CMS) use Healthcare Effectiveness Data and Information Set (HEDIS) to standardize performance measures for health plans.

HEDIS guidelines specify the administration of Breast Cancer Screening, in the form of a mammogram once every two years for women between the ages of 50 and 74. Breast cancer is one of the most common forms of cancer for women, and early detection can increase survival rates. In 2018, the average Breast Cancer Screening adherence rate for patients enrolled in Medicare plans was 74%.⁵²

HEDIS guidelines also specify colon cancer screening for adults between the ages of 50 and 75. There are a range of colon cancer screening options, such as an annual fecal blood test or a colonoscopy test every 10 years. Identifying colon cancer in its earliest stage can lead to an almost 90% five-year survival rate. In 2018, the average Colon Cancer Screening adherence for patients enrolled in Medicare plans was about 73%.⁵³

The Centers for Disease Control (CDC) offer national guidelines on vaccination administration to children. The Measles, Mumps, and Rubella (MMR) vaccine is administered in two doses, with the first dose between 12 and 15 months of age, and the second dose between 4 and 6 years of age. The CDC reports that in 2018, 91.5% of children received their first MMR dose. For the purposes of my analysis, I only assess whether or not a child has received the second MMR dose according to the CDC vaccination schedule, as older children have more robust data at Intermountain (e.g., census-block level indicators).

The Human Papilloma Virus (HPV) vaccine protects against a virus that can increase risk of cervical cancer. HPV is recommended in two doses, with the first dose when a child is 11 or 12 years old and no later than 15 years old. A second dose is required 6-12 months after the first dose,⁵⁴ and there is a three-dose schedule for children who do not receive the first dose until above the age of 15. The CDC reports that in 2018, the average HPV vaccination rate was about 40%.⁵⁵ For the purposes of my analysis, I assess whether children between the ages of 10 and 16 are adherent to the HPV vaccination schedule based on their first dose.

⁵² "Breast Cancer Screening (BCS)." *National Committee for Quality Assurance*. 2020. <https://www.ncqa.org/hedis/measures/breast-cancer-screening/>

⁵³ "Colorectal Cancer Screening (COL)." *National Committee for Quality Assurance*. 2020. <https://www.ncqa.org/hedis/measures/colorectal-cancer-screening/>

⁵⁴ "HPV Vaccine Recommendations." *Centers for Disease Control*. Reviewed 03/17/2020. <https://www.cdc.gov/vaccines/vpd/hpv/hcp/recommendations.html>

⁵⁵ "HPV Vaccine Recommendations." *Centers for Disease Control*. Reviewed 03/17/2020. <https://www.cdc.gov/vaccines/vpd/hpv/hcp/recommendations.html>

Demographic Tables with Confidence Intervals

Table 11: Preventive Health Measures by Demographic Variables, with Confidence Intervals

	BREAST CANCER SCREENING		COLON CANCER SCREENING	
	(average rate)	(95% CI)	(average rate)	(95% CI)
Sex				
Female	78%	(77%, 79%)	75%	(74%, 75%)
Male	-	-	75%	(74%, 75%)
Insurance				
Medicare ACO	81%	(80%, 82%)	79%	(79%, 80%)
Medicare Advantage	73%	(72%, 74%)	69%	(68%, 70%)
Race/Ethnicity				
White	78%	(77%, 79%)	75%	(75%, 76%)
Hispanic	74%	(71%, 78%)	70%	(68%, 73%)
Asian	79%	(73%, 84%)	75%	(71%, 79%)
Black	80%	(68%, 92%)	77%	(69%, 84%)
American Indian / Alaska Native	77%	(66%, 90%)	71%	(62%, 80%)
Native Hawaiian / Pacific Islander	63%	(52%, 76%)	61%	(53%, 69%)
Multiple	63%	(26%, 100%)	75%	(50%, 100%)
Declined	80%	(71%, 86%)	71%	(65%, 77%)
Not Available	37%	(31%, 45%)	40%	(36%, 45%)
Marital Status				
Married	80%	(79%, 81%)	77%	(76%, 77%)
Divorced	71%	(68%, 73%)	69%	(68%, 71%)
Single	71%	(69%, 74%)	68%	(66%, 69%)
Widowed	77%	(75%, 79%)	75%	(74%, 77%)
Primary Care Physician Attribution				
IHC Employed	82%	(82%, 83%)	84%	(83%, 84%)
IHC Affiliated	69%	(68%, 71%)	58%	(57%, 59%)
Not Attributed	49%	(46%, 52%)	49%	(47%, 51%)

	MMR VACCINE		HPV VACCINE	
	(average rate)	(95% CI)	(average rate)	(95% CI)
Sex				
Female	85%	(84%, 86%)	41%	(40%, 42%)
Male	84%	(83%, 85%)	38%	(37%, 39%)
Insurance				
SelectHealth Commercial	86%	(85%, 87%)	40%	(39%, 40%)
Medicaid	81%	(80%, 82%)	39%	(38%, 40%)
Race/Ethnicity				
White	84%	(84%, 85%)	39%	(38%, 39%)
Hispanic	84%	(82%, 86%)	44%	(43%, 46%)
Asian	90%	(86%, 93%)	55%	(51%, 59%)
Black	86%	(81%, 91%)	43%	(39%, 47%)
American Indian / Alaska Native	82%	(74%, 91%)	42%	(35%, 48%)
Native Hawaiian / Pacific Islander	86%	(81%, 90%)	41%	(37%, 45%)
Multiple	71%	(55%, 87%)	46%	(33%, 60%)
Declined	86%	(82%, 91%)	48%	(44%, 52%)
Not Available	63%	(48%, 72%)	35%	(29%, 40%)
Physician Type				
Pediatrician	87%	(87%, 88%)	45%	(45%, 46%)
Family Medicine	72%	(71%, 74%)	28%	(27%, 29%)

Source: Author's analysis

Model Methodology

For each of three models – logistic regression, Random Forest, and XGBoost – I split the dataset into a randomly selected training set (60-70% of the data) and a validation set (30-40% of the data). The model is built using datapoints from the training set, and the accuracy of the model is assessed by measuring how well the model predicts the outcomes of the validation set. I used a ten-fold cross-validation technique to assess the average accuracy of each model type.

Table 12 shows the average AUC (a measure of overall accuracy) for each model using a ten-fold cross-validation. For both cancer screenings and vaccinations, the logistic regression and XGBoost models had the highest accuracy, as measured by AUC.

Table 12: Model AUC

AUC BY DATASET, MODEL		
	AUC	95% CI
Breast Cancer Screening		
Logistic Regression	63%	[0.62 , 0.64]
Random Forest	54%	[0.54 , 0.55]
XGBoost	63%	[0.61 , 0.64]
Colon Cancer Screening		
Logistic Regression	65%	[0.64 , 0.65]
Random Forest	55%	[0.54 , 0.55]
XGBoost	65%	[0.64 , 0.65]
MMR Vaccinations		
Logistic Regression	63%	[0.61 , 0.65]
Random Forest	51%	[0.51 , 0.52]
XGBoost	63%	[0.62 , 0.64]
HPV Vaccinations		
Logistic Regression	62%	[0.61 , 0.62]
Random Forest	57%	[0.56 , 0.57]
XGBoost	63%	[0.62 , 0.63]

Source: Author's analysis

Logistic Regression

Logistic regressions model the probability of events happening. The output of the model is a number between 0 (prediction that the patient did not get screened or vaccinated) and 1 (prediction that the patient got screened or vaccinated).

In a logistic regression, the coefficients on the variables in the model are called log odds. In general, the larger and more positive (negative) the log odds coefficient, the more that the presence of or a unit increase in that variable contributes to an increased (decreased) probability of a vaccination or screening occurring, holding all else equal.

In my regression analyses, I assess the AUC of the model, the statistical significance of each variable at the $p < .05$ level, and the direction and magnitude of the log odds coefficients. I convert my log odds to a more generally understood probability for purposes of interpretation (e.g., holding all else equal, for a married patient, we expect to see a 35% increase in the likelihood of receiving a cancer screen).

Random Forest Classification

Random Forest is a supervised learning algorithm that builds a set of decision trees to allow for prediction of a health outcome for any given patient. Each decision tree is built using the training set (60-70% of the dataset), and a tree is grown by recursively splitting the data to create decision nodes based on variables. For example, one decision node might separate the tree into two branches: patients who live in areas with greater than 30% poverty, and patients who live in areas with less than 30% poverty. After producing a “forest” of decision trees, the model predicts the probability of any individual patient in the validation set by averaging the probabilities from all trees in the forest.

In my random forest analyses, I assess the AUC of the model and the relative importance of each variable in the construction of trees. Further, for the purposes of interpretation, I present a simplified overview of a sample tree from the forest to show how the model classifies patients into cohorts based on variables in the model.

XGBoost

Conceptually, XGBoost, or eXtreme Gradient Boosting, is a model constructed similarly to a random forest. However, whereas the “trees” in a random forest are constructed independently of each other, an XGBoost model adds trees sequentially, learning from the prior trees to create more and more accurate constructions. This process of learning from prior models, called “gradient boosting,” allows the model to improve over time. Similar to Random Forests, my XGBoost model builds trees based on a training set and predicts outcomes based on a validation set.

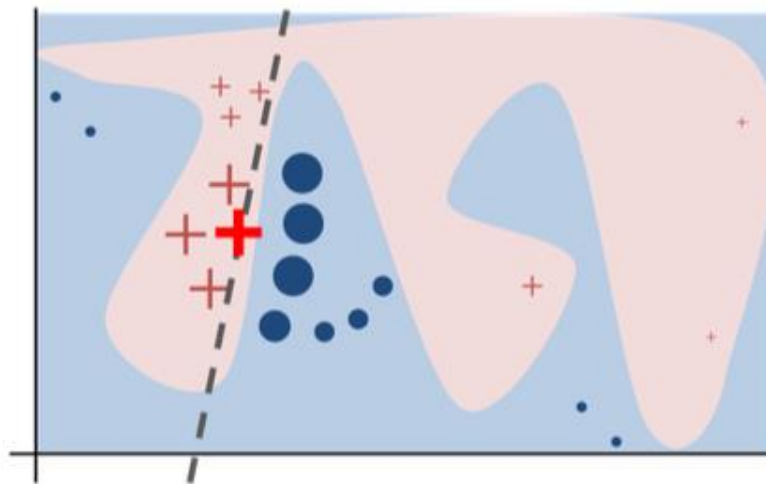
Gradient boosting solves two weaknesses associated with random forest models: first, random forest models do not exhaustively explore all possible relationships between variables, whereas gradient boosting models do; second, random forests have high variance, often leading to lower AUC (accuracy). Notably, my XGBoost models consistently had higher accuracy than my random forest models. One weakness of XGBoost models, however, is that the model is a “black box,” and somewhat less interpretable than Random Forest trees.

Similar to Random Forest models, I assess the AUC of the XGBoost model and the relative importance of each variable in the construction of the model. Further, for the purposes of interpretation, I present a simplified view of how the model works at specific points in the dataset using a Local Interpretable Model-agnostic Explanations (LIME) explainer. LIME is an

explanation technique that allows us to interpret how the XGBoost model works locally – not for the overall model, but for a subset of the data.

Figure 12 visualizes how a LIME explainer works. While we cannot easily approximate how the overall, global XGBoost model works (the blue / pink regions of the figure), we can select a specific patient (bolded red cross) and understand how predictions are made for that patient by approximating a local, linear model (dashed gray line). This local explainer model is faithful to the local selection of the data (the set of red crosses) but not globally faithful to the entire XGBoost model (the blue / pink region).⁵⁶

Figure 12: A visual explanation of a LIME explainer in an XGBoost model.



Source: *Decrypting your Machine Learning Model Using LIME – Towards Data Science*

Quantitative Output and Discussion

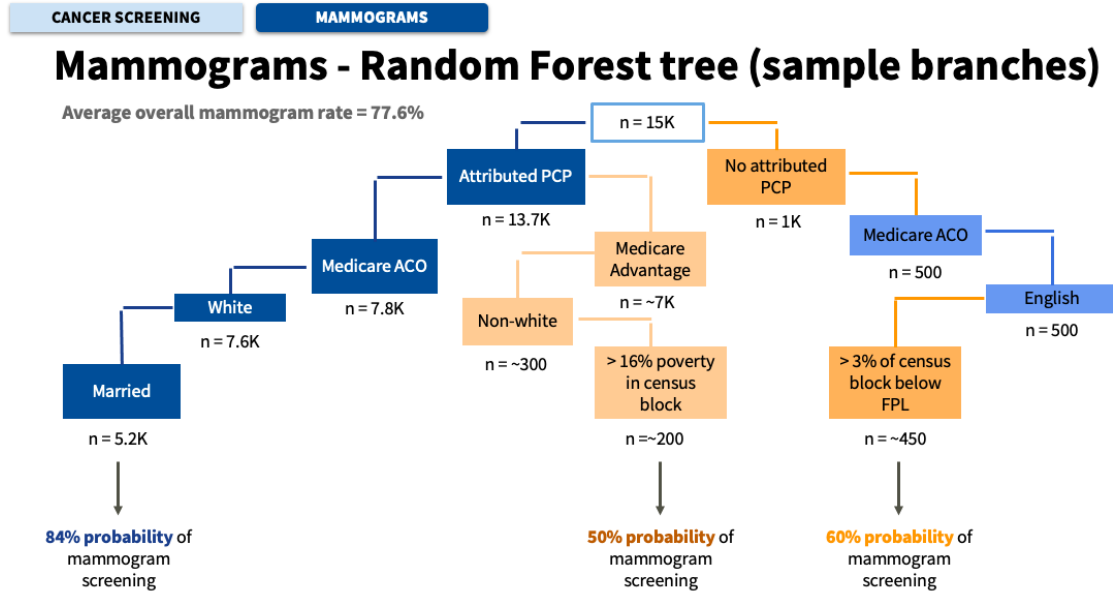
Medicare-Eligible Cancer Screening

Figures 13 and **14** show a sample set of branches from a “tree” in the random forest. Approximately 1/3 of the patients in the mammogram dataset are attributed to a primary care physician, enrolled in the Medicare ACO, white, and married; their mammogram rates are more than 6 percentage points higher than the average. Meanwhile, patients enrolled in Medicare Advantage, that live in census blocks with higher rates of poverty, and who are non-White have lower mammogram rates.

⁵⁶ Sharma, Abishek. “Decrypting your Machine Learning model using LIME.” *Towards Data Science*. 4 November 2018. [https://towardsdatascience.com/decrypting-your-machine-learning-model-using-lime-5adc035109b5#:~:text=LIME%20\(%20Local%20Interpretable%20Model%20Dagnostic,model%20locally%20around%20the%20prediction.](https://towardsdatascience.com/decrypting-your-machine-learning-model-using-lime-5adc035109b5#:~:text=LIME%20(%20Local%20Interpretable%20Model%20Dagnostic,model%20locally%20around%20the%20prediction.)

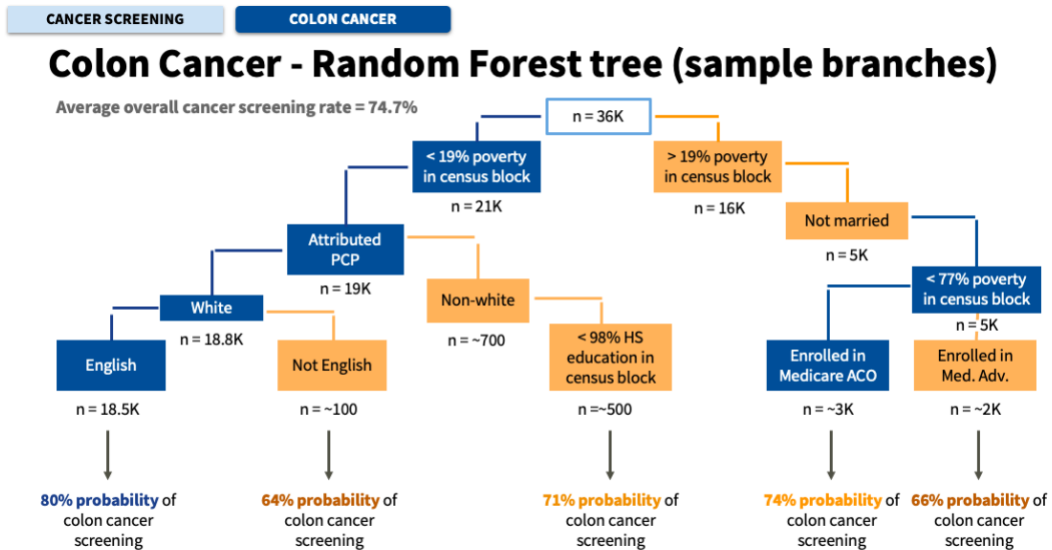
Approximately ½ of the patients in the colon cancer screening dataset live in census blocks with less than 19% poverty, are enrolled in the Medicare ACO, are white, and speak English. Their colon cancer screening rates are more than 5 percentage points higher than the dataset average. Meanwhile, non-English-speaking patients with otherwise similar characteristics have 16 percentage point lower colon cancer screening rates.

Figure 13: Sample Tree from Breast Cancer Screening Random Forest Analysis



Source: Intermountain data, author's analysis

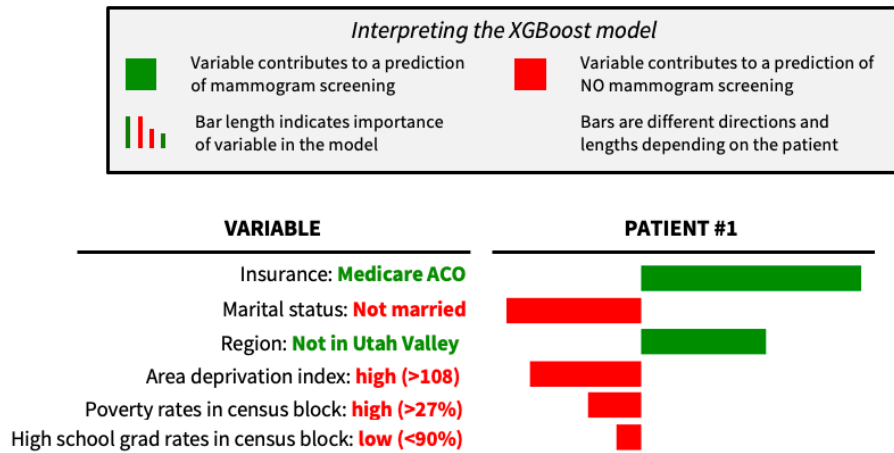
Figure 14: Sample Tree from Colon Cancer Screening Random Forest Analysis



Source: Intermountain data, author's analysis

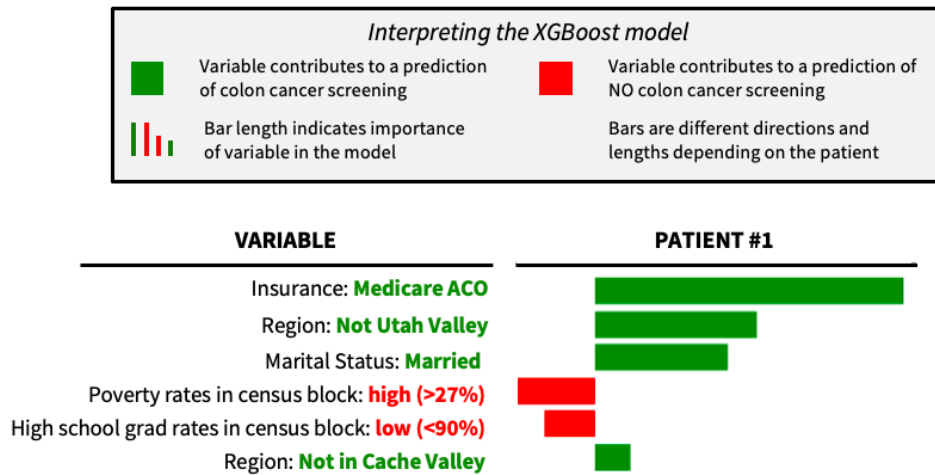
Figures 15 and 16 show a sample LIME explainer for breast and colon cancer screening. The local LIME model explainers reveal similar logic to the logistic regression. Enrollment in the Medicare ACO, being married, living in areas with low poverty and high education rates, and not living in certain regions in the Utah South market were all associated with higher rates of cancer screening, for both colon cancer and breast cancer screening.

Figure 15: XGBoost LIME Explainer for Breast Cancer Screening



Source: Intermountain patient data, author’s analysis

Figure 16: XGBoost LIME Explainer for Colon Cancer Screening



Source: Intermountain patient data, author’s analysis

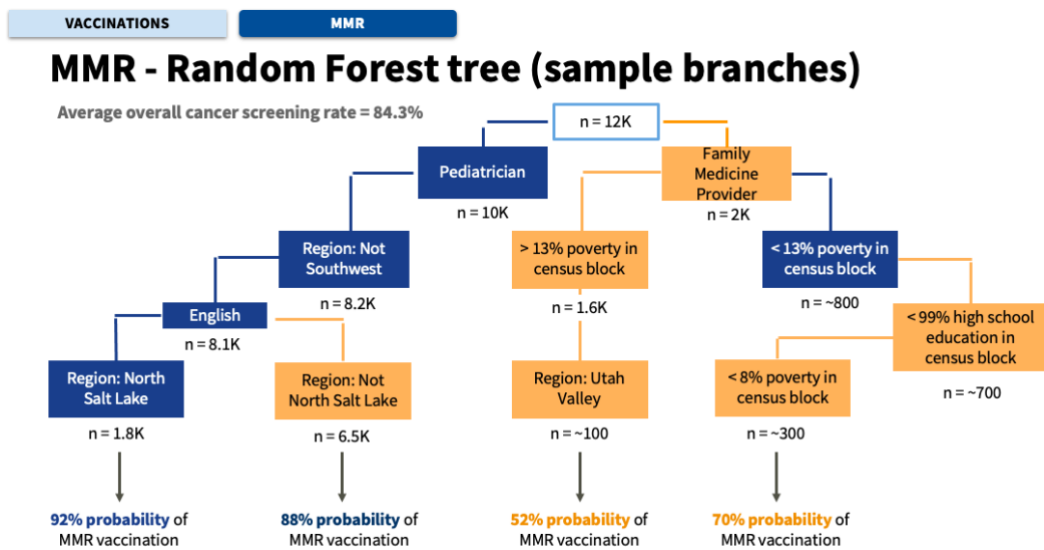
Pediatric Vaccinations

Figures 17 and 18 show sample branches from a “tree” in the random forest for each vaccine. For MMR Vaccinations, approximately 70% of the dataset are children who see pediatricians, who do not live in the Southwest region (where MMR vaccination rates are the lowest), and

who speak English. For this group, the difference in vaccination rates between children who live in North Salt Lake and any of the remaining six regions is four percentage points. On the other hand, children who live in Utah Valley, in areas with high poverty, and who see family medicine providers have MMR vaccination rates almost 32 percentage points lower than the average.

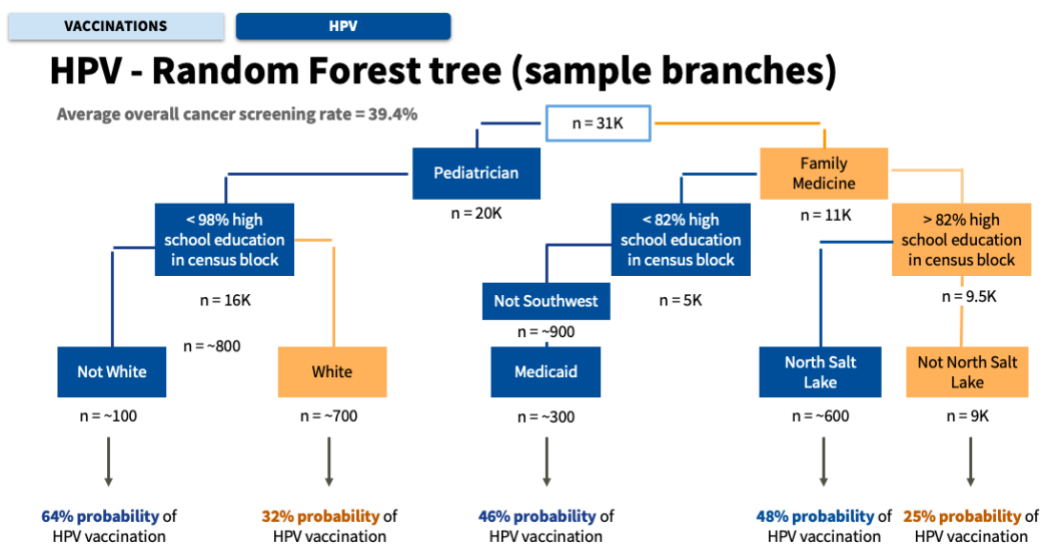
In the HPV random forest, there are exceptions to the logic for other health services. HPV vaccination rates are higher in groups with lower census block education and for non-White patients. There is regional variation in rates, and children seeing pediatricians have higher rates.

Figure 17: Sample Tree from MMR Vaccination Random Forest Analysis



Source: Intermountain data, author's analysis

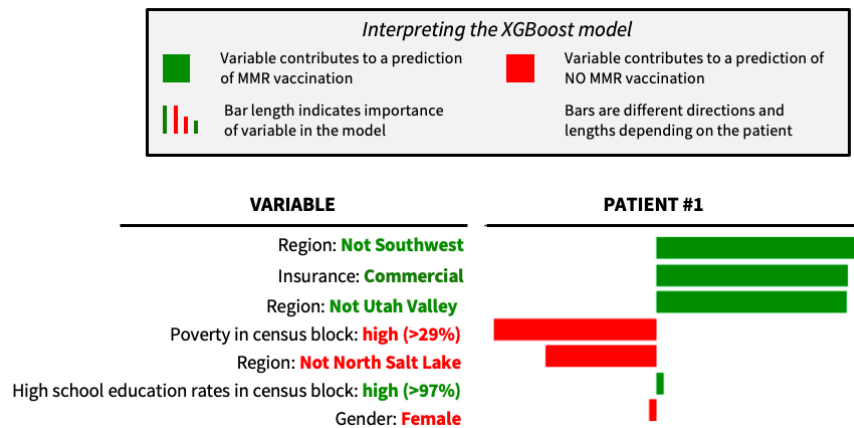
Figure 18: Sample Tree from HPV Vaccination Random Forest Analysis



Source: Intermountain data, author's analysis

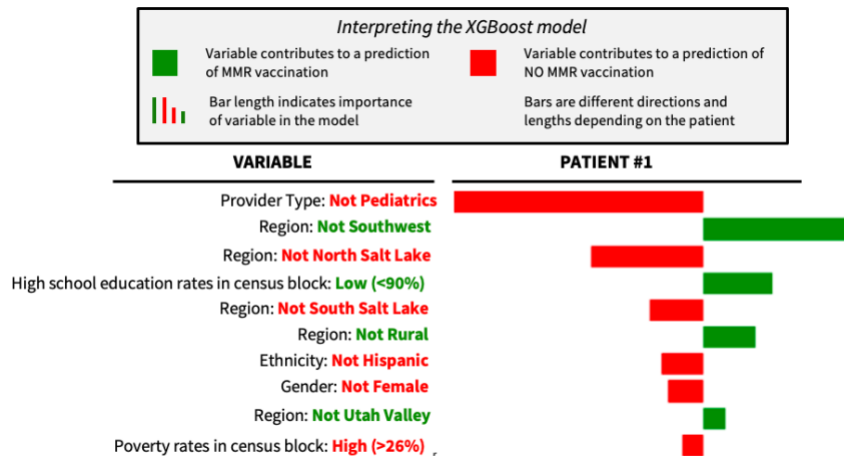
Figures 19 and 20 shows a sample LIME explainer for MMR and HPV vaccinations. The XGBoost models are consistent with their respective logistic regressions. For MMR, the model rewards patients for not being in select Utah South regions (Utah Valley and Southwest) that have much lower vaccination rates. Commercial insurance and census blocks with low rates of poverty are also beneficial. The HPV XGBoost explainer is consistent with the logistic regression, meaning it also offers a number of exceptions to the logic of the other preventive health measures – a patient who lives in a census block with low high school education rates is, counterintuitively, more likely to be predicted as getting vaccinated.

Figure 19: XGBoost LIME Explainer for MMR Vaccinations



Source: Intermountain data, author's analysis

Figure 5: XGBoost LIME Explainer for HPV Vaccinations



Source: Intermountain data, author's analysis

Academic Literature on Cancer Screening and Vaccinations

Geography and Region

Similar to my analysis, the Utah Department of Public Health finds high levels of regional variation in breast cancer and colon screening rate by county – Southeastern San Juan County has breast cancer screening rates of only 33%.⁵⁷ Intermountain’s cancer screening rates for Medicare populations – ~78% for breast cancer and ~75% for colon cancer– are higher than Utah’s overall cancer screening rates – ~65% for breast cancer in women over 40 and ~70% for colon cancer for adults ages 50-74.^{58,59}

While limited data exists on regional variation of vaccination rates in Utah, parents can claim religious exemptions to not vaccinate their children, and the state has seen declines in vaccination rates in the last decade.⁶⁰ While rates have improved slightly since then, Utah had the lowest rates of HPV vaccination of any state in 2015.⁶¹ Intermountain’s HPV vaccination rate for male children is on par with the national average (and well above the 2016 state average), but Intermountain’s vaccination rate for female children is lower than the national average (and about consistent with the 2016 state average).⁶²

Health Delivery Factors - Health Insurance

Existing research has found that enrollment in a Medicare ACO slightly reduces breast cancer screening and slightly increases colon cancer screening rates in patients.⁶³ Other research has found that, compared to fee-for-service Medicare, patients enrolled in Medicare Advantage plans have higher rates of mammograms.⁶⁴ As the Intermountain dataset does not include fee-for-service Medicare enrollees, there are not perfectly transferable insights from Intermountain to academic literature. However, it is notable that Intermountain’s Medicare ACO has higher rates than SelectHealth’s Medicare Advantage plan, surprising since Medicare Advantage quality payments are tied to completion of health measures like cancer screening.

⁵⁷ “Cancer in Your Community – Breast Cancer.” *Utah Department of Public Health Cancer Control Program*. <https://cancerutah.org/cancers/breast-cancer/cancer-in-your-community/>

⁵⁸ “Complete Health Indicator Report of Breast Cancer Screening (Mammography).” *Utah Department of Public Health Indicator Based Information System (IBIS)*. Updated 10/15/20. https://ibis.health.utah.gov/ibisph-view/indicator/complete_profile/BreCAMam.html

⁵⁹ “Complete Health Indicator Report of Colorectal Cancer Screening.” *Utah Department of Public Health Indicator Based Information System (IBIS)*. Updated 10/08/20. https://ibis.health.utah.gov/ibisph-view/indicator/complete_profile/ColCAScr.html#:~:text=Colorectal%20cancer%20screening%20rates%20in,geography%20and%20other%20sociodemographic%20factors.

⁶⁰ Geisel, H. “Study: Utah has seen third-largest decrease in vaccination rates in US in past decade.” *KUTV* 23 November 2019. <https://kutv.com/news/local/study-utah-has-seen-third-largest-decrease-in-vaccination-rates-in-us-in-past-decade>

⁶¹ Jones KP, Kepka D. “UTAH HAS THE LOWEST VACCINATION RATE OF THIS CANCER-REDUCING VACCINE.” *University of Utah – The Scope*. Podcast Transcript. 19 February 2015. https://healthcare.utah.edu/the-scope/shows.php?shows=0_mlnshgi9

⁶² “Utah Cancer Control Program recommendation – HPV 2016.” *Utah Department of Health – Cancer Control Program*. <https://cancerutah.org/healthcare-professionals/hpv/>

⁶³ Resnick M, Graves A, Gambrel R, Thapa S, Buntin M, Penson D. “The association between Medicare accountable care organization enrollment and breast, colorectal, and prostate cancer screening.” *American Cancer Society – Cancer*. 2018 November; 124(22) 4366-4373. <https://doi.org/10.1002/cncr.31700>. <https://acsjournals.onlinelibrary.wiley.com/doi/full/10.1002/cncr.31700>

⁶⁴ Hung A, Stuart B, Harris I. “The Effect of Medicare Advantage Enrollment on Mammographic Screening.” *The American Journal of Managed Care*, February 2016, Volume 22, Issue 2 <https://www.ajmc.com/view/the-effect-of-medicare-advantage-enrollment-on-mammographic-screening>

Studies have found that children on Medicaid, similar to my findings, have lower rates of MMR vaccinations than commercially insured children.⁶⁵ A 2013 study have found that commercial HMO insurance plans (similar to Intermountain’s SelectHealth Commercial coverage) have higher rates of HPV vaccinations than commercial PPO plans. The same study found that children on Medicaid were more likely to have received HPV vaccinations than children on commercial plans,⁶⁶ which is inconsistent with my findings. A 2015 study also found that children on Medicaid have higher HPV vaccination rates.⁶⁷

Socioeconomic indicators

Existing research supports my findings that patients living in areas of higher poverty have lower cancer screening rates. Across U.S. metropolitan areas, increases in poverty have been shown to be associated with never having had a mammogram or colon cancer screening.⁶⁸ The CDC finds that patients identified as ‘poor’ or ‘near poor’ have lower rates of colon cancer screening than ‘not poor’ individuals.⁶⁹ These datapoints are positioned within broader literature that finds lower health access and worse health outcomes for people living in poverty.⁷⁰

The CDC reports lower MMR vaccinations rates for children living below poverty.⁷¹ For HPV vaccinations, however, a 2016 study found the highest uptick of HPV vaccination rates for girls living in poverty.⁷² My analysis did not find statistically significant effects of census poverty on MMR or vaccination rates. Another study found that increasing maternal education was associated with higher rates of HPV in children,⁷³ which is inconsistent with my findings that increasing high school education in a child’s census block was associated with lower rates of HPV vaccination.

⁶⁵ Hill H, Singleton J, Yankey D, Elam-Evans L, Pingali S, Kang Y. “Vaccination Coverage by Age 24 Months Among Children Born in 2015 and 2016 — National Immunization Survey-Child, United States, 2016–2018.” *MMWR Morb Mortal Wkly Rep.* 2019 Oct 18; 68(41): 913–918. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6802679/>

⁶⁶ Ng J, Ye F, Roth L, Sobel K, Byron S, Barton M, Lindley M, Stokely S. “Human Papillomavirus Vaccination Coverage Among Female Adolescents in Managed Care Plans — United States, 2013.” *MMWR Morb Mortal Wkly* 2015 64(42);1185-9. <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6442a1.htm>

⁶⁷ Chen S, Huybrechts B, Batemen B, Hernandez-Diaz S. “Trends in Human Papillomavirus Vaccination in Commercially Insured Children in the United States.” *Pediatrics* Oct 2020, 146 (4) e20193557; DOI: 10.1542/peds.2019-3557 <https://pediatrics.aappublications.org/content/146/4/e20193557>

⁶⁸ Schootman M, Jeffe D, Baker E, Walker M. “Effect of area poverty rate on cancer screening across US communities.” *J Epidemiol Community Health.* 2006 Mar; 60(3): 202–207. doi: 10.1136/jech.2005.041020 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2465556/>

⁶⁹ “QuickStats: Percentage* of Adults Aged 50–75 Years Who Received Colorectal Cancer Screening, by Poverty Status and Year — National Health Interview Survey, United States, 2010 and 2018.” *MMWR Morb Mortal Wkly Rep* 2020; 69:976. DOI: <http://dx.doi.org/10.15585/mmwr.mm6929a6>.

<https://www.cdc.gov/mmwr/volumes/69/wr/mm6929a6.htm#:~:text=The%20percentage%20increased%20from%202010,highest%20among%20not%20poor%20adults>.

⁷⁰ Braveman P, Cubbin C, Egerter S, Williams D, Pamuk E. “Socioeconomic Disparities in Health in the United States: What the Patterns Tell Us.” *Am J Public Health.* 2010 April; 100(Suppl 1): S186–S196. doi: 10.2105/AJPH.2009.166082 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2837459/>

⁷¹ Hill H, Elam-Evans L, Yankey D, Singleton J, Kang Y. “Vaccination Coverage Among Children Aged 19–35 Months — United States, 2016.” *MMWR Morb Mortal Wkly Rep* 2017;66:1171–1177. DOI: <http://dx.doi.org/10.15585/mmwr.mm6643a3>. <https://www.cdc.gov/mmwr/volumes/66/wr/mm6643a3.htm>

⁷² American Association for Cancer Research. “HPV vaccine uptake is highest among girls in high poverty, majority Hispanic communities.” *ScienceDaily* 14 January 2016. <https://www.sciencedaily.com/releases/2016/01/160114100729.htm>

⁷³ Franco M, Mazzucca S, Padek M. et al. “Going beyond the individual: how state-level characteristics relate to HPV vaccine rates in the United States.” *BMC Public Health* 19, 246 (2019). <https://doi.org/10.1186/s12889-019-6566-y> <https://bmcpubhealth.biomedcentral.com/articles/10.1186/s12889-019-6566-y>

Patient Demographics

The patterns of demographic associations I found in my analysis are generally confirmed by existing literature. American studies have found that marriage is associated with higher colon cancer⁷⁴ and breast cancer^{75,76} screening rates. A Chicago study found that women who speak only Spanish have 30% lower rates of mammograms than English speakers;⁷⁷ similar patterns have been found for colon cancer screening.⁷⁸ The CDC reports that, based on 2015 data, colon cancer screening rates were higher for individuals who identify as white than for other races.⁷⁹ Thus, findings on marital status, language, and race in colon cancer screenings are consistent with other studies. National data on 2018 mammography rates indicate that African Americans and White women have higher rates of mammography than individuals who identify as Asian or American Indian / Alaska Native, and women with higher educational attainment have higher rates.⁸⁰ I was unable to confirm this in my analysis due to low sample size of non-White women.

For vaccinations, the Utah Department of Public Health has found that girls are more likely to receive HPV vaccinations than boys.⁸¹ Other studies have found that Hispanic girls are more likely to receive HPV vaccinations than communities that are primarily non-Hispanic white.⁸² Both of these datapoints are consistent with my analysis. The CDC has found variation in MMR vaccination by race, with Asian American and White children reporting the highest rates.⁸³

Overall, while the Intermountain dataset lacked sufficient sample size to assess preventive health measures by individual non-White racial groups, other datapoints reflect that Intermountain's demographic differences in cancer screening and vaccinations are consistent with the national landscape, which has overall lower rates of screening and MMR vaccinations for minorities (mammograms rates for African Americans being the only exception) and higher rates of HPV vaccinations for minorities.

⁷⁴ El-Haddad B, Dong F, Kallail KJ, Hines R. "Association of marital status and colorectal cancer screening participation in the USA." *Colorectal Disease* 2015 17:5. DOI: 10.1111/codi.12926.
https://www.researchgate.net/publication/272569452_Association_of_marital_status_and_colorectal_cancer_screening_participation_in_the_USA

⁷⁵ Pagan H, Asch D, Brown C, Guerra C, Armstrong K. "Lack of Community Insurance and Mammography Screening Rates Among Insured and Uninsured Women." *Journal of Clinical Oncology* 2008 26:11, 1865-1870 <https://ascopubs.org/doi/10.1200/JCO.2007.14.5664>

⁷⁶ Badgwell B, Giordano S, Duan Z, Fang S, Bedrosian I, Kuerer H, Singletary SE, Hunt K, Hortobagyi G, Babiera G. "Mammography Before Diagnosis Among Women Age 80 Years and Older with Breast Cancer." *Journal of Clinical Oncology* 2008 26:15, 2482-2488.
<https://ascopubs.org/doi/10.1200/JCO.2007.12.8058>

⁷⁷ American College of Surgeons. "Female Spanish-only speakers get screening mammograms less often than other women." *Clinical Congress* 2020. 3-7 October, 2020. <https://www.facs.org/Media/Press-Releases/2020/cataneo-cruz100320>

⁷⁸ Diaz JA, Roberts MB, Goldman RE, Weitzen S, Eaton CB. "Effect of language on colorectal cancer screening among Latinos and non-Latinos." *Cancer Epidemiol Biomarkers Prev.* 2008 Aug;17(8):2169-73. doi: 10.1158/1055-9965.EPI-07-2692. PMID: 18708410; PMCID: PMC2568081.

⁷⁹ "QuickStats: Colorectal Cancer Screening Among Adults Aged 50–75 Years, by Race/Ethnicity — National Health Interview Survey, United States, 2000–2015." *MMWR Morb Mortal Wkly Rep* 2016; 65:1042. DOI: <http://dx.doi.org/10.15585/mmwr.mm6538a6>

⁸⁰ <https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/breast-cancer-facts-and-figures/breast-cancer-facts-and-figures-2019-2020.pdf>

⁸¹ State of Utah. "State of Utah Early Childhood Immunization." 2020. https://immunize.utah.gov/wp-content/uploads/2021/01/2020_Immunization_Coverage_Report_StateofUtah.pdf

⁸² American Association for Cancer Research. "HPV vaccine uptake is highest among girls in high poverty, majority Hispanic communities." *ScienceDaily*. ScienceDaily, 14 January 2016. www.sciencedaily.com/releases/2016/01/160114100729.htm.

⁸³ "Table 31. Vaccination coverage for selected diseases among children aged 19–35 months, by race, Hispanic origin, poverty level, and location of residence in metropolitan statistical area: United States, selected years 1998–2017." *Centers for Disease Control*. 2018. <https://www.cdc.gov/nchs/data/hus/2018/031.pdf>