Clarify

WHITEPAPER

Next-gen applications of SDoH-decorated data

From data to actionable insights

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Introduction

There is overwhelming evidence to suggest that social and behavioral determinants of health (SBDoH) impact the onset and progression of health conditions, the care that patients receive, and, ultimately, health outcomes.[1,2,3] Yet, little has been done to develop systems of care that fairly and effectively take into account factors such as race, class, geography, lack of transportation, housing stability, economic trajectory, and other socio-behavioral factors to personalize care. As exposed by the COVID-19 outbreak and related infection and death rates, social factors played a significant role in determining who would and wouldn't become severely sick. Addressing health disparities proactively for sub-populations and individuals requires SBDoH-derived insights that are truly actionable, so care teams prioritize the most impactful interventions.

To understand the deep disparities in health outcomes, we need to consider this: medical care only accounts for around 20% of health outcomes, whereas the physical environment, social determinants, and behavioral factors account for about 80% of outcomes.

More specifically, that 80% can be broken down as follows:

- 10% to physical environment
- ~40% to socio-economic factors
- 30% to health behaviors

Examples of socio-economic factors, physical environments, and health behaviors driving health outcomes:

Economic Stability	Education	Food	Community and Social Context	Health Care System	Neighborhood and Physical Environment	Behavior
Employment	Literacy	Hunger	Social integration	Health coverage	Housing	Diet
Income	Language	Access to healthy options	Support systems	Provider availability	Transportation	Activity
Expenses	Early childhood education		Community engagement	Provider linguistic and cultural competency	Safety	Addictions
Debt	Vocational training		Discrimination	Quality of care	Parks	Smoking
Medical bills	Higher education		Stress		Playgrounds	Mood
Support					Walkability	Life
					Zip code / geography	Satisfaction
						Risky behavior

Source: Beyond Health Care: The Role of Social Determinants in Promoting Health and Health Equity

Collectively, these factors describe the social and behavioral determinants of health, that the World Health Organization defines as "the conditions in which people are born, grow, work, live, and age and the wider set of forces and systems shaping the conditions of daily life, including social, behavioral and environmental determinants of health."

1 Josh Lee et al., *Addressing the social determinants of health for Medicare and Medicaid enrollees: Leading strategies for health plans.* Deloitte Center for Government Insights and the Deloitte Center for Health Solutions, 2019.

2 Samantha Artiga et al., Beyond HealthCare: The role of social determinants in promoting health and health equity, 2018. Kaiser Family Foundation.

3 Accountable Health Communities Model. CMS Innovation Center.

Creating the most SBDoH-decorated dataset in the industry

Traditionally in healthcare, we have used clinical data to evaluate health outcomes, predominantly because it is the most easily accessible for analysis. However, given that a patient's care journey is 80% dependent on non-clinical factors (such as employment and housing status, transportation options, education levels, and cultural norms), we need to account for non-clinical factors in our models. That is why Clarify Health has spent years creating the most SBDoH-decorated dataset in the industry.

Using machine learning to clean and link SBDoH data with clinical, claims, and prescription data, we power our predictive models with longitudinal care journeys at the individual patient level. Using this approach, we provide a more complete picture of patient wellness, a better understanding of current and future patient risk and outcomes, accurate forecasting of healthcare cost and utilization, and insight into therapy adoption and adherence. We help healthcare and life sciences organizations understand where taking action or providing assistance outside the clinical setting can provide a greater impact on health outcomes, cost, and wellness.

Using individually attributed, longitudinal SBDoH data sources, Clarify's data science team analyzes social risk data that includes 400+ sociodemographic, economic, neighborhood, and community attributes to identify SBDoH factors that help payers, providers, and life sciences companies deliver higher quality, patient-centered care.

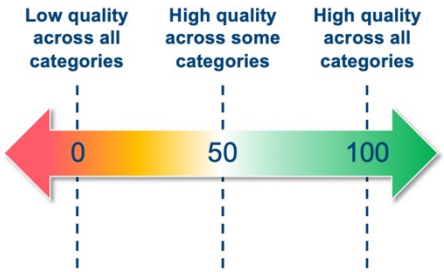
A sample of the SBDoH attributes in Clarify's dataset:

Economic Stability & Education	Neighborhood and Physical Environment	Community Context and Social Support	Housing and Transportation
• Income Level	• Neighborhood crime index, by crime category	• Age	• Address stability
• Accumulated wealth	• Neighborhood poverty index	• Gender	• Homeowner or renter
• Credit stability	• Median area income	• Marital status	• Indication of active phone listing at current address
• Highest educational attainment	• Median home value	• Number of household members, by age group	• Number of registered vehicles – individual
• Level of inferred banking experience	• Percentage of population with limited English	• Presence of caregiver	• Number of registered vehicles – household
		• Number of nearby relatives	

ENSURING RELIABILITY AND USABILITY

To address the challenges of integrating SBDoH data into our predictive models, Clarify Health's data science and clinical informatics teams developed a rigorous process to assess data quality for reliable use. Comprehensive quality assessments allow us to deploy the optimal combination of datasets for every use case, ensuring maximum reliability and usability of patient-level SBDoH data. Validated metrics that are most frequently included in models include **household income, education, marital status, and homeownership**.

Receive data from a variety of sources…	*…evaluate them across key criteria…*	*…and assign quality scores to determine usability of each dataset*
Credit risk agencies	**Match rate**	
	Historical completeness	
Consumer databases	**Data granularity**	
	Missingness	
Public records	**Information lag**	
	Documentation	
Private records	**Predictive power**	



FROM INSIGHTS TO ACTION: APPLYING SBDOH INSIGHTS TO REAL-WORLD APPLICATIONS

Research shows that looking beyond claims data into factors such as sociodemographic, psychological, behavioral, or community allows for a clearer picture of health. With a more holistic view of wellness and member risk, quality improvement and cost optimization programs improve.

While it is widely understood that SBDoH factors impact overall health, it is important to note that not all factors have the same utility in predicting health outcomes or personalizing care. The pathways between SBDoH risk factors and health outcomes are complex and varied. For instance, asthma is a condition that is aggravated by environmental factors such as household dust and secondhand smoke. Some hospital systems that care for patients with frequent visits to the ED for unmanaged asthma and symptoms, such as chest tightness, pain, and breathing problems, will deploy community health workers to the homes of these patients to identify and remove environmental factors that could be adversely impacting patient health. Interventions like these require strong partnerships with community-based organizations, community health workers, and case managers.

For Providers and Payers

With SBDoH data-driven insights, Clarify provides clinicians and health plans with a more holistic view of a patient or member's healthcare risk and likely journey through care to help them identify and engage patients and members in a more tailored and effective treatment plan. For example, Clarify's risk stratification software can more precisely identify sub-cohorts of patients who will benefit from a specific intervention. SBDoH data elements also help providers understand opportunities to improve and how they should be rewarded by adjusting for social risk in case-mix adjusted models.

Here are three concrete ways in which SBDoH-enriched datasets are driving more actionable insights for Clarify's customers.

1. UNDERSTANDING THE DRIVERS OF CHANGE IN CARE AND UTILIZATION PATTERNS

You likely have hypotheses that social determinants impact health and cost outcomes, but can you quantify it for a given population?

Here are two examples of analyses where individually attributed SBDoH attributes for ~3M patients were aggregated at a population level. These show a clear correlation with health and cost outcomes.

Exhibit 1:
Patients with lower household income on average had a higher number of underlying chronic conditions, experienced higher overall medical spend, utilized emergency services more, including a higher percentage of avoidable emergency department (ED) visits, and were hospitalized more often and for longer.

Estimated household earnings	Volume % of total	Avg # chronic conditions	PMPY	ED visits by 1K	Avoidable ED visits	IP days/1000	IP admits/1000
$0 - $40K	14.4%	2.5	$19,421	1070.0	43.7%	1939.6	348.4
$40K - $60K	40.2%	2.2	$16,376	779.3	40.1%	1526.6	287.9
$60K - $80K	30.4%	1.9	$13,784	544.6	35.9%	1167.5	231.9
$80K - $120K	14.8%	1.7	$11,968	429.1	33.9%	934.5	190.9
> $120K	0.1%	1.4	$11,507	338.0	33.1%	676.0	144.7

Exhibit 2:
Patients without access to a household vehicle had a higher rate of ED visits and a higher percentage of avoidable ED visits. One potential reason for this could be that such patients cannot access appropriate primary care and end up being more reliant on emergency services.

Household registered vehicles	Total volume	ED visits admitted & non-admitted per 1000	ED – total avoidable rate
Summary	**2,571,073**	**697.6**	**39.3%**
Has household registered vehicles	1,651,620	618.7	38.0%
No household registered vehicles	919,453	839.2	41.1%

2. USING DESCRIPTIVE ATTRIBUTES TO INFORM CARE DELIVERY

When it comes to care delivery, clinical teams know how important it is to have information specific to a particular patient (vs. assuming that everyone living in the same zip code has similar social attributes).

Here are a few examples of individually attributed SBDoH that Clarify can provide for patients and examples of interventions that the care team may choose to take based on this information.

SBDoH attribute provided by Clarify	Sample intervention
No access to a household vehicle	Offer transportation vouchers through ride share services to facilitate travel related to medical appointments
Lives alone	Prioritize for home health services
Housing instability	Refer individual to community health workers, social workers or housing advocates
Highest education level	Lower education levels could indicate lower health literacy, with the patient benefiting from additional resources, such as a diabetes educator
Low household income + low medication adherence	Offer pharmacy assistance program

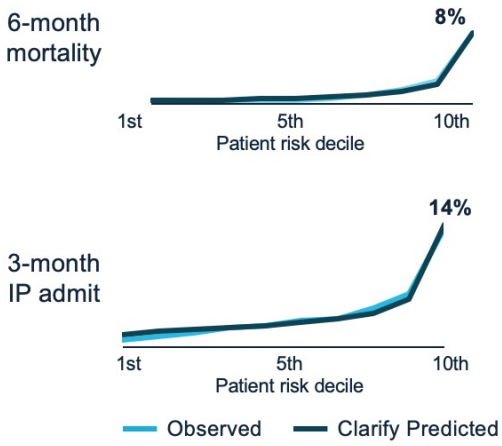
3. IMPROVING RISK PREDICTION

Can SBDoH input in models improve their predictive power?
A Clarify model with SBDoH features proved to be 34% better than Elixhauser at predicting mortality within 12 months.

In another analysis (shown below), our high-quality patient-level data enabled the delivery of better predictiveness and actionability on a 500k patient panel for a provider customer.

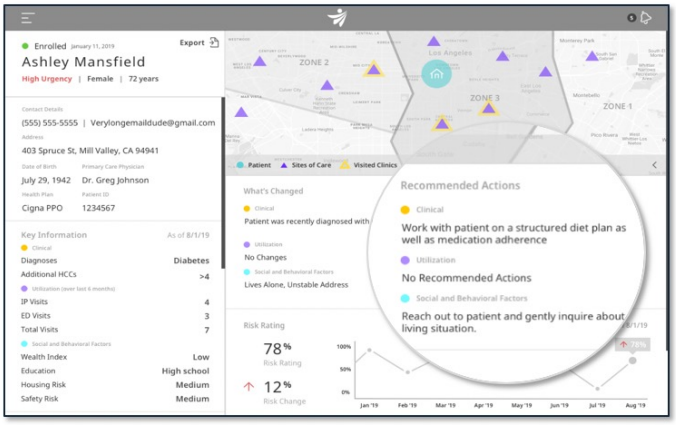
Accurate predictions

Clarify predictions vs. observed data on 500K patient panel for existing provider customer



Actionability

Transparency into key addressable risk drivers for improved targeting of care management efforts



For Life Sciences

SBDoH can help Life Sciences companies to meaningfully improve commercial strategy and execution, and therefore both top-line performance and cost of sales.

Prior to a drug's launch, companies can use SBDoH to reach a much more nuanced understanding of the patient population – for example, to identify sub-populations with disproportionate unmet need or risk of non-adherence. This enables a refined view of target patient archetypes, fit-to-purpose targeting, and messaging, as well as high-impact investment decisions in 'around-the-pill.'

Post-launch, companies are able to track performance against precision cohorts (e.g., patients who have failed first-line therapy AND are highly educated), but also prioritize physicians and providers who treat these specific cohorts with tailored messaging. Furthermore, they can use SBDoH to conduct powerful outcomes analysis around the impact of their therapy on patient productivity, which is of increasing interest to self-insured employers.

Examples:

- **Transportation assistance:** Evidence shows that those with access to non-emergency medical transportation are more likely to be adherent to their clinically recommended appointment schedule to manage their chronic conditions.[4] SBDoH data can help identify patients at risk for missing appointments or failing to adhere to treatment plans due to limited transportation access. For example, working with a company in the process of launching an infusion regimen for sickle cell disease, Clarify found that a higher-than-expected proportion of the population 1) lived relatively far away from the Centers of Excellence where this drug would be administered, and 2) lacked reliable access to transportation. This led the company to shift investment to ensure that patients-in-need would not lack access to care, and in doing so ensured a successful launch.

- **Prescription assistance:** Pharma companies or hospital groups provide subsidized prescription drugs in an effort to help patients who lack insurance or drug coverage. SBDoH data can help to identify such patients who would benefit from these programs – improving patient outcomes and preventing the delay of care that can result in costly medical problems in the future. Evidence indicates that those who are enrolled in a medication assistance program experienced significant improvements in clinical health outcomes.

- **Medication adherence:** There is evidence that medication adherence is higher in patients from cohesive families and lower in patients from families in conflict.[5] SBDoH data can help identify patients at risk to get targeted education around the prescribed medication, medication delivery services, or reminders to take medication at a designated time. For instance, patients enrolled in a community pharmacy medication management program have greater medication adherence, fewer hospital admissions, and fewer outpatient visits.[6]

- **HCP targeting:** SBDoH allows for a more nuanced understanding of target segments (i.e. those patients most likely to disproportionately benefit from a given drug). It can be used to identify sub-segments with high unmet needs and/or explain the unmet need. For example, perhaps adherence to an expensive standard of care is low amongst low-income individuals, causing them to overutilize the ED. A lower-cost entrant may want to target the physicians and practice groups that care for higher volumes of these individuals.

- **Outcomes measurement:** Increasingly, when gauging the value of a given therapy (and therefore willingness-to-pay and formulary placement), payers, self-ensured employers, and governments are looking at the holistic impact of the therapy. In addition to clinical and utilization-related outcomes, this includes productivity measures, such as ability to work. By measuring changes in key SBDoH variables over time, companies develop much more powerful value stories as they pursue market access and even value-based pricing.

4 Michael Adelberg et al., Non-emergency medical transportation: will reshaping Medicaid sacrifice an important benefit. Health Affairs, 2017.

5 M.R. Dimatteo., Social support and patient adherence to medical treatment: a meta-analysis. Health Psychology, 2004.

6 Osayi E. Akinbosoye et al., Improving medication adherence and health care outcomes in a commercial population through a community pharmacy. Population Health Management, 2016.

Utilizing SBDoH data to optimize the go-to-market strategy for a hematology therapy

A global pharma company worked with in-house analysts and a range of external vendors to prepare for the market launch of their new hematology drug. Despite having a thorough launch-planning process, the team was not confident in their understanding of non-clinical factors that impact the patient journey and access to therapy.

The company sought an analytics partner that could help them dissect social and behavioral determinants of health (SBDoH) data to better understand patient preferences and challenges, as they fine-tune targeting and messaging.

SOLUTION

The company selected Clarify Launch, analytics software that helps optimize therapy commercialization due to its ability to exhaustively analyze across disease states and patient and provider characteristics. Additionally, the software explores social factors such as income, education, and access to centers of excellence to better understand drivers of treatment and outcomes. The software was rapidly configured to address three key business questions for the launch team:

1. What are our patients' income levels, and can they afford the out-of-pocket burden of the treatment?
2. Are our patients likely to be receptive to preventive care, based on their education levels?
3. How easy is it for our patients to access hematology centers of excellence (CoEs) for treatment?

RESULTS

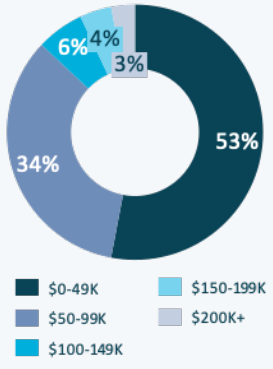
Approximately 80,000 patients were included in the analysis, which drew upon over two years of data, to deliver a comprehensive characterization of the population. The commercial team was particularly interested in insights around access to care, income levels, and education to better understand the patients' likelihood to adopt preventive care.

OVERALL Characterization of population in THE dataset FOR THIS ANALYSIS	
Insurance	~50% Medicaid ~30% Medicare FFS ~20% Commercial (including MA)
Care providers	60%+ were treated by a hematologist / oncologist in the last year 20%+ were treated by a PCP (if not treated by a hematologist/ oncologist)
Access to care	50% of patients had access to a CoE
Pain crisis events	55% had at least one acute episode leading to an ER admission
Treatment patterns	Over 2x more likely for severe patients to be prescribed antibiotics vs. broader patient population

INCOME

Over 60% of the patient population, irrespective of the severity of illness, had income levels that are below the median U.S. household income level of ~$62K. This may have implications on patients' ability to meet co-pays and need for patient assistance programs.

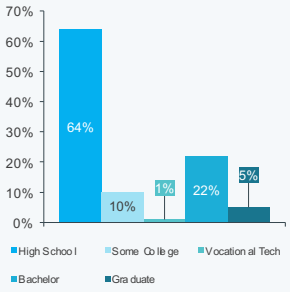
Patient Population by Income



EDUCATION

25-30% of patients across severity levels had a bachelor's degree or higher, which is only slightly below the U.S. population average of 33%. This may have implications on medication adherence and likelihood to seek preventive care.

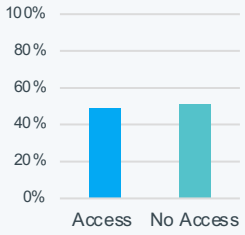
Patient Population by Education



ACCESS TO CARE

Only 50% of patients were found to have access to a hematology CoE*.

Access to Care* for Patient Population



*Note: Access to care is measured having a Hematology Center of Excellence within the patients' Zip3 (county)

NEXT STEPS

The company has defined two additional phases of analysis using Clarify Launch. First, they would like to gain a better understanding of the patient profile on a competitor drug by gaining more granular, descriptive analytical insights into the patients. Second, they will explore and create the ideal patient profile for their therapy and surface the number of patients matching that profile.

Conclusion

SBDoH data-driven insights are the key to bridging inequity in access to healthcare across our communities and establishing coordinated interventions outside of clinical care to deliver “the right care, to the right patient, in the right context, at the right time.”

Frost and Sullivan, a consulting and research firm, estimates that within a year, 40% of health systems and commercial payers in the US will be using some form of "social determinant" data to make patient risk, care intervention, and business decisions.

Much remains to be done in the integration of SDOH data into everyday patient care. As organizations begin to incorporate SBDoH into their services, they must focus on actionability. The goal is to provide payers, providers, and life sciences organizations access to insights that drive a higher quality of service and care to patients and ultimately deliver better outcomes.

To find out how Clarify’s technology solutions can help you answer your most important business questions and deliver better patient care, visit www.clarifyhealth.com.

About Clarify Health

At Clarify Health, we turn data into insights, so our provider, payer, and life sciences partners can turn insights into impact. The Clarify Health Platform is the only enterprise analytics platform to power stakeholders across the industry. Our growing data set – the most comprehensive longitudinal data set in the US – links clinical, claims, prescription, lab, and social determinant of health data on over 300 million lives. Our industry-leading analytics platform applies externally validated statistical modeling, machine learning, and AI to process and harness the power of this data to improve patient care and optimize clinical trials.