

**monetizing big data™: how cost equality among  
different levels of health literacy in charlotte can save  
billions**

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## DEFINE: HEALTH LITERACY

Health literacy (HL) is the ability to read, understand and act upon medical information that is essential when making decisions about your health. Lacking these skills could impose obvious consequences on your health, as misunderstanding information often leads to not following the doctor's orders (which potentially worsens conditions). Populations that are the most likely to suffer from low HL are the elderly, under-educated, impoverished, minority groups, and immigrants.

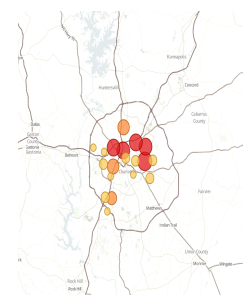
## IDENTIFY: THE RELATIONSHIP WITH COST

Low health literacy triggers a domino effect that ultimately results in a higher cost of healthcare. Low health literacy is also associated with a poorer health status, which requires more care, and since nothing in life is free (especially not American healthcare), these patients become more expensive. The estimated cost due to low HL in the US is around \$612 billion annually. That expense alone is close to THREE TIMES as much as the total amount that Canada spends on healthcare. Charlotte, NC spent approximately \$526 million alone due to low HL, which is 4.23% of the city's annual healthcare expenditures.

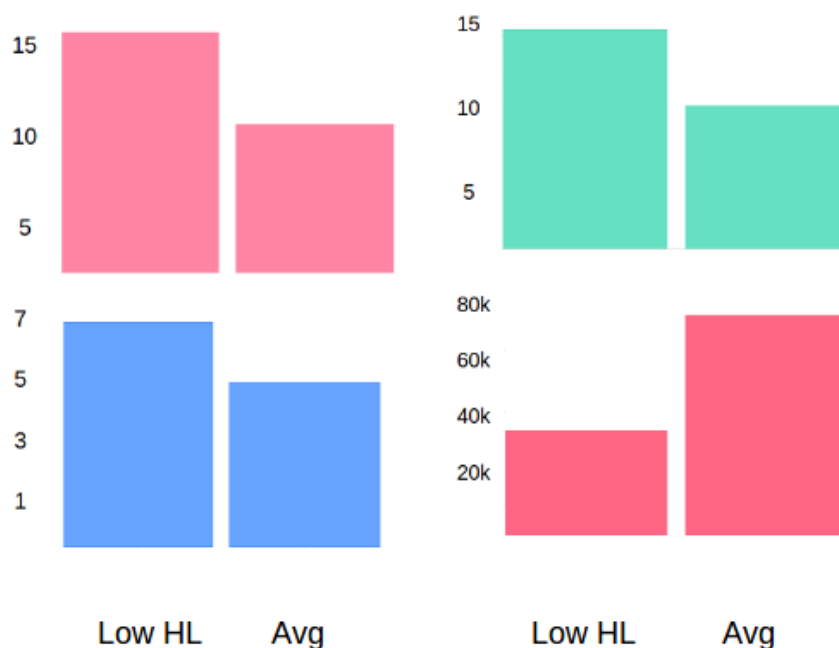
Ways to start eliminating this financial load would be to proactively pinpoint the patients with insufficient health literacy skills and ensure that they are receiving the necessary care to keep them healthy. For example, self-management education can foster a sense of responsibility of personal health; and care coordination for patients with chronic disease takes the burden off the patient when accessing the care they need in a timely manner.

## ANALYZE: THE PROBLEM AT HAND

In general, people who are impoverished and have less than a high school education have the highest risk of struggling with HL skills. Individuals that fall into this category are charged nearly 90% more annually than people outside this category for healthcare. 54 census tracts (right), that contain over 28% of Charlotte's population, have exceptionally low health literacy. These communities have lower income, more chronic disease, and require more care (below).



**Figure 1:** The areas of Charlotte with exceptionally low health literacy



*Figure 2: Comparison of disease prevalence and income in the census tracts with exceptionally low HL vs. the average. Stroke prevalence % (top left), Diabetes prevalence % (top right), Coronary Heart Disease prevalence % (bottom left), Median Family Income (bottom right)*

Ameliorating the impact of low HL from unnecessary cost burdens through better coordination and improved health education would benefit the individual and society as a whole. Answering the following resulted in a solution to deflate this inequity:

1. **How does the magnitude of healthcare charges vary by among patients with higher and lower levels of health literacy?**
2. **How can we close the gap in Charlotte, NC?**

### **ANATOMIZE: THE DATA ASSETS**

Individualized data with over 600,000 records of socioeconomic statistics as well as medical expenditure measurements from the MEPS (Medical Expenditure Panel Survey) dataset was used to analyze the relationship between cost of care and health literacy level. Poverty status and education level were used as a proxy to put each observation into either the low or high HL categories.

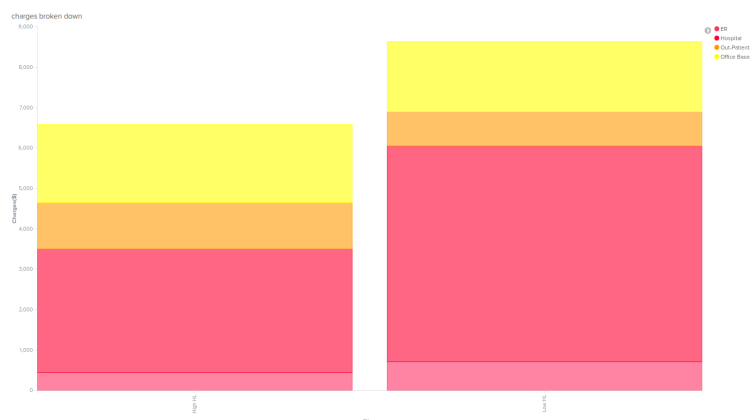
Census tract level data from the CDC's 500 cities database provided health statistics for each

census tract in Charlotte (i.e. disease prevalence, median family income, insured/uninsured prevalence, etc.), and this was paired with the United States Health Literacy data map created by researchers at UNC-Chapel Hill that quantified a continuous health literacy score for each census tract. Tresata's software located the specific census tracts with exceptionally low HL and uncovered how they were suffering.

Using TIDES to visualize the robust individual-level relationships and apply them to localized information led to a solution specific to Charlotte that could potentially (\*\*SPOILER ALERT\*\*) save billions of dollars.

## MONETIZE: THE RESULTS

- **THE PROBLEM - People with low HL are more expensive than average**  
On average, people with insufficient HL are charged 21% more for their healthcare every year. It is obvious that this could get expensive if a hefty proportion of a population has low HL.
- **THE REASON - Hospitalizations are the main contributor to the inequity at scale**  
TIDES made it simple to visualize the drivers of the cost burden. It was revealed that people with low, compared to high, health literacy are twice as expensive when it comes to hospital charges, shown in figure 3 below. This could be due to increased prevalence or severity of chronic diseases in these populations, or unnecessary hospital visits.



**Figure 3:** Comparison of the charges incurred by people with high HL (left) to low HL (right) depicted in Tresata TIDES. The charges are also broken down into ER (light pink), Hospital (dark pink), Out-Patient (Orange), and Office Based (yellow).

- **THE PHENOMENON - Medicaid evens the playing field**  
The previous result was then subsetted into different types of insurance (VA, Private, Medicare, and Medicaid) to see if the pattern held regardless of the

type of coverage a patient had. It is true that low health literacy is correlated to higher medical expenses for every type of insurance... EXCEPT Medicaid (see figure below). Medicaid, despite the more medically-needy client base, almost entirely TIDES (pun intended) over the inequity between patients with high and low HL. This is most likely due to resources like care coordination and community care networks that Medicaid provides to its clients, which are meant to keep their patients healthier, out of the hospital and therefore, less expensive.



**Figure 4:** Comparison of how the relationship in **Figure 3** holds across different types of insurance

- **THE PREDICTION - Costs will skyrocket by 2065**

With population and healthcare costs growing exponentially, so the cost burden due to low health literacy has nowhere to go but up. Taking into account the following:

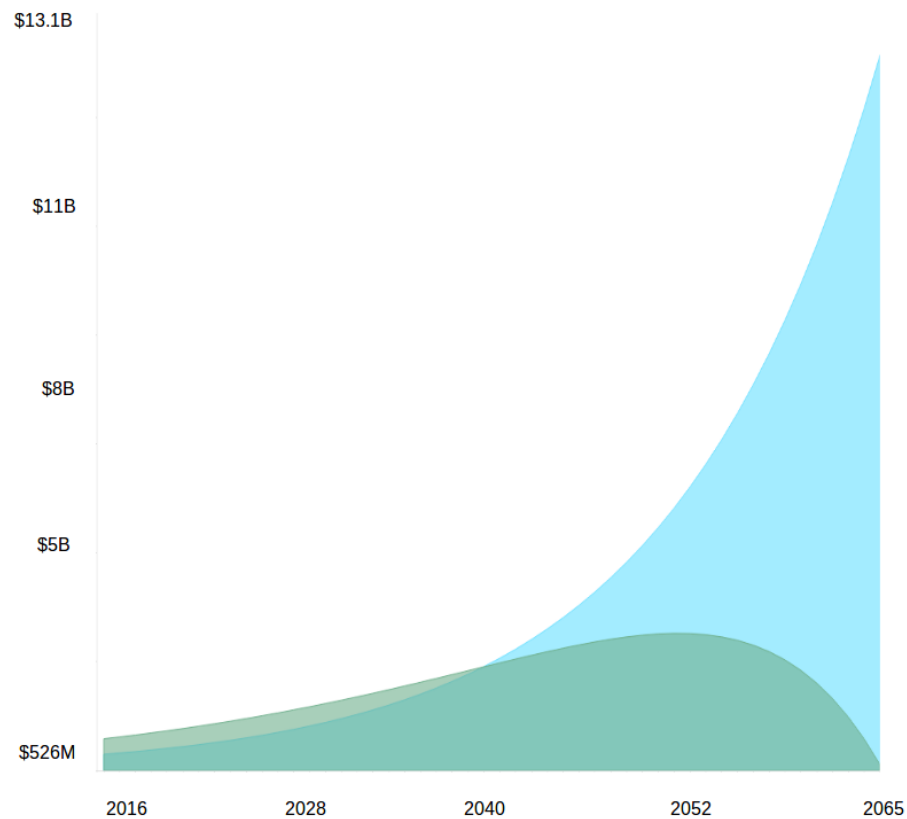
- Charlotte's population and its 1.9% growth rate
- The 6% annual growth rate of healthcare costs
- The ratio of cost of care for someone with low HL to the average, which is evident from preceding findings - 1.21 (**let's call this R**)
- The average cost of care

The predicted the cost burden of low HL in Charlotte in 2065 is **\$13,141,717,353** (shown in light blue below).

- **THE SOLUTION - Make R = 1**

Looking solely at Medicaid beneficiaries, there is little to no gap between the cost of care for people with low and high HL. This means, while  $R = 1.21$  for the whole population,  $R \cong 1$  for people on Medicaid. Therefore, if everyone below a certain level of HL was on Medicaid by 2065 (decreasing the cost burden by .4% each year), the inequity would be eliminated and the cost burden would fall to zero (shown in dark blue below). As mentioned, nothing is free in this industry, so here's the price tag: \$7.1 billion, over the course of 20 years (just 20 easy

payments of \$309.5 million). This would be the necessary investment in order to provide the entire low HL population with Medicaid's resources by 2065. However, if Charlotte made the commitment to completely eradicate this expense over the next 47 years, the total amount saved would be **\$93,743,340,445** (a 1300% ROI).



**Figure 5:** Time series prediction of how the cost burden of low HL will change by 2065 (light blue) in comparison to how the proposed solution would extinguish the excess expense (green).

## CRISIS AVERTED

The main take away from this study is that people with low health literacy can greatly benefit from Medicaid's resources. Medicaid is designed to help its patients navigate their way through the healthcare system. Getting more of the low HL population on Medicaid will shrink the financial chasm, improve health, save billions, and thus **enrich life™**.

FORMULAS USED (adapted from a similar study at GWU, Vernon et al. 2016):

$$\omega = p\alpha Q(\gamma)^n C_A(\mu)^n (R - (1 - Rp)/1 - p)$$

$$\omega' = p\alpha Q(\gamma)^n C_M(\mu)^n (R - (1 - Rp)/1 - p)$$

$$S = \sum_0^n \omega - \omega'$$

$\omega$  = predicted cost burden of low HL n years from now

$\omega'$  = predicted cost burden of low HL with average cost of Medicaid

$p$  = proportion of people with low HL

$\alpha$  = control for covariates [1/3, 2/3]

$Q$  = total population

$\gamma$  = population growth rate

$\mu$  = health care cost growth rate

$C_A$  = average cost of care

$C_M$  = average cost of care on Medicaid

$R$  = ratio of cost of care for someone with low HL to the average

$S$  = predicted savings over the next n years

# ENRICH LIFE™