Problem Statement

Medical Debt

Analysis of medical debt levels[1] and household survey data[2] reveals that medical debt is both pervasive and troubling for many Americans. Contributing to, and exacerbating this issue, is the high cost of long-term care for chronic conditions, as individuals suffering from these diseases, such as the more than 38 million Americans who have diabetes[3], pay recurring costs for medication, and high initial cost for expensive devices. Due to the pressures and risk of undertaking large amounts of debt to treat often interminable illness, many forgo treatment[4, 5]. This introduces a vicous cycle, as the longer one puts off medical treatment, the worse their other symptoms may become, leading to an increase in medical cost and a further degredation with regards to quality of life.

Amount	# of people
Some	20 million
>$1,000	14 million
>$10,000	3 million

Caption: Level of medical debt (USD) experienced by Americans. [1]

Open Source BioTech

Several grassroots and non-profit organizations, led by researchers, have pushed to build an open-source environment in biotech, to facilliate greater collaboration and information-sharing[6]. These movements draw on prior work by the Free Software Foundation and other FOSS (Free, Open-Source Software)[1] organizations[7].

Some open source designs, such as the low-cost insulin pump developed in [8], are producable in small batches at a cost less than a sixtieth of the cost of consumer models. That same pump has been tested under international standard and found to be as or more accurate than the majority of commericially available models[9].

Practical Implications

While a 60-fold decrease in procurement cost for an insulin pump may not be completely realisitic when factoring in the specific conditions for the assembly of medical-grade devices, it is clear that making information and innovation accessible to other researchers can cut the development cost for medical devices, and removes copyright or intellectual proprty barriers standing in the way of entities that are not profit-motivated from investing in production[2].

Integration

Many of these devices, despite their price point, would have a hard time peneratrating the market due to issues with integration. Often medical devices are parts of larger networks that use sensor information and various control interfaces, apps, and other closed-loop mechanisms. The way that these systems communicate is often highly propriatary, limiting the reach of open-source products, as they must come complete with an existing ecosystem, which necessarily must be forged from

[1] It is worth clarifying that the word “Free” is meant as in “freedom to modify and redistribute the source under agreed terms”, not necessarily price. In the words of the FSF’s Founder, “think free as in free speech, not free beer.”

[2] There are several examples of previous philanthropic action towards medical debt relief, almost exclusively through grass-roots and religious crowdsourcing to buy medical debt at discounted rates. There still exists no path for non-profits to try and stem the problem at the source, as manufacture of the goods is dependent on expensive R&D and certification. If open-source devices manage certification, funds that would go towards cancelling debt could be used to circumvent a subset of the high prices causing the debt.

scratch due to the opaque communication structure. Our market research (Section 2) revealed that not having to change devices was also a large barrier for consumers, and that there is a strong desire for cheaper hardware that “just works” with their current sensors, allow them to use their phone as a control device, etc.

While some devices are designed to have bluetooth uplinks or other future network capabilities, they do not have an already established way of communicating with sensor systems.

MEDKIT

M.E.D.K.I.T seeks to help solve this problem by providing a uniform, general-purpose framework for communication over medical device networks, **The Protocol**, and providing adaptive hardware and software to enable existing devices to interact with the protocol in a packaged known as **The Bridge Device**.

This document outlines the overall structure of the two components and the design choices that shaped the details of their implementation.

Citations

[1] https://www.healthsystemtracker.org/brief/the-burden-of-medical-debt-in-the-united-states/#Share%20of%20adults%20who%20have%20medical%20debt,%20by%20health%20status%20and%20disability%20status,%202021

[2] https://www.cdc.gov/nchs/data/nhsr/nhsr180.pdf

[3] https://www.cdc.gov/diabetes/php/data-research/index.html#cdc_report_pub_study_section_2-prevalence-of-both-diagnosed-and-undiagnosed-diabetes

[4] https://diabetesjournals.org/care/article/45/3/594/139257/Cost-Related-Medication-Nonadherence-in-Adults

[5] https://www.sciencedirect.com/science/article/pii/S0168822718305345?via%3Dihub

[6] https://cambia.org/bios-landing/

[7] https://fsf.org

[8] https://tyromancy.art/ece2799/pump.pdf

[9] https://pmc.ncbi.nlm.nih.gov/articles/PMC11089868/