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Social Determinants As Public Goods: A New Approach To Financing Key Investments In Healthy Communities

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ABSTRACT Good research evidence exists to suggest that social determinants of health, including access to housing, nutrition, and transportation, can influence health outcomes and health care use for vulnerable populations. Yet adequate, sustainable financing for interventions that improve social determinants of health has eluded most if not all US communities. This article argues that underinvestment in social determinants of health stems from the fact that such investments are in effect public goods, and thus benefits cannot be efficiently limited to those who pay for them—which makes it more difficult to capture return on investment. Drawing on lesser-known economic models and available data, we show how a properly governed, collaborative approach to financing could enable self-interested health stakeholders to earn a financial return on and sustain their social determinants investments.

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The tenuous survival of the Affordable Care Act (ACA), the 2017 tax cut and 2018 spending increases, and the disappointing cost savings from ACA payment reform pilots all presage a coming push for entitlement reform and political pressure to lower health care costs. Amid calls for more effective cost reduction,¹ few payment reform options can rival the cost-saving potential of squarely addressing the deficits in social determinants of health that constrain health and drive spending trajectories for many low-income Americans.

Decades of research have demonstrated that economic stability, physical environment, education, food, and social context are powerful upstream factors that largely determine one's health before the health system is able to intervene. Social determinants of health also influence the effectiveness of medical interventions. Antibiotics are of little help to those who drink polluted water every day.² Recent work by

Elizabeth Bradley, Lauren Taylor, and others has investigated how social spending influences health outcomes in many industrialized countries, including the US.³⁻⁵ System dynamics experts^{6,7} and public health researchers⁸ have developed the capacity to model the impact of nonmedical spending choices on health outcomes. There is growing awareness that funding for interventions related to social determinants of health has long been inadequate, leaving health systems to treat the survivors of a frayed social safety net.

The ACA's hospital readmission penalties forced health care organizations to reconsider their role and self-interest in addressing deficits in social determinants of health in the community. Many learned that paying attention to the reality of people's lives at home can reduce readmissions and utilization generally^{9,10} and that community-based organizations and nonmedical personnel such as social workers and community health workers can be more efficient

than medical personnel in engaging upstream with patients who have complex conditions.¹¹ Several high-profile health systems have opted to use community benefit spending as an opportunity to address social determinants of health.¹² Nevertheless, substantial funding from hospitals or health plans for social determinants remains rare.

Parallel to the attention on social determinants, a focus on achieving greater equity in health outcomes has emerged.^{13,14} Energized by the ACA's Prevention and Public Health Fund,¹⁵ health equity advocates have helped develop new requirements for community health needs assessments and action plans among nonprofit hospitals. These actions have revealed substantial health disparities in virtually every community.¹⁶ Nevertheless, payers and providers struggle to internalize health equity as a key goal, as clinical quality improvement and cost reduction remain the commonly incentivized priorities.

In this article we aim to demonstrate that the underprovision of interventions on social determinants of health can be addressed through a novel but practical community financing mechanism. We characterize these interventions as a type of public good that health care delivery and payer entities at risk for the uninsured and insured, respectively, have a common interest in financing. Throughout the article we refer to these entities collectively as key (health care) stakeholders. We have in mind a financing model that works similarly to the taxation of benefits to reframe, as a type of investment, spending that has long been considered charity.¹⁷ This reframing would allow such investments to become sustainable, if the payment policies remained in place.¹⁸ We further assert that this type of financing model might help reduce cost growth in the long run, as improving the various environments that underlie health would reduce the percentage of the population moving from healthy to unhealthy states. Vastly more spending could be avoided by reducing the percentage of the population that acquired an illness than by better management of a larger population with that illness.¹⁹ Below, we provide a real-world example to illustrate the potential for investments in social determinants to yield diffuse benefits.

Social Determinants Programs In Action

A low-income, elderly woman who uses a wheelchair, enrolled in a Medicare Advantage plan, repeatedly missed clinical appointments, frustrating clinical staff at her local federally qualified health center as well as the care coordinator assigned by her managed care company. This

health center, like most of its kind, operates primarily on a fee-for-service financing model. Her truancy cost the clinic revenue from the empty appointment slots and denied the woman primary care and comprehensive case management that could stave off emergency department (ED) admissions and even hospitalizations. An Area Agency on Aging volunteer, who coordinated the woman's Meals on Wheels deliveries, learned of the missed appointments and contacted the clinic to explain that the woman lived on the third floor of a walkup apartment building without an elevator. As a result, the only time she was able to go to the doctor was when her husband, who drove a cab part time, was home and could carry her down the stairs. Unfortunately, the clinic had no programs or resources to address the problem.

The volunteer discovered that the woman was eligible for transportation services provided by a local nonprofit funded by the county government. With transportation secured, the woman never missed another appointment, and both her diabetes and blood pressure became well controlled. Transportation services—even those that entailed carrying her down and back up the stairs—cost far less than ED visits or a single hospitalization, particularly when a 911 call had to be made.

Why Health Entities Don't Invest In Social Determinants

Multiple stakeholders gained from the upstream intervention: the patient, to be sure, but also payers, health and social services providers, and potentially taxpayers. Additionally, reducing these types of social determinants deficits can reduce health disparities.²⁰ Even so, social determinants interventions such as the non-emergency medical transportation provided in the example above are rarely pursued by health care organizations. Three reasons for this underinvestment deserve unpacking.

First, it is difficult for individual health care organizations to credibly estimate the full net benefit of their investments. High-quality data on relevant costs and benefits are difficult to find and interpret across varied locales.

Second, health care organizations may doubt whether social services can be delivered efficiently to the target group, as this work is often done outside hospital or clinic walls by non-health care personnel. This doubt stems partly from a lack of familiarity with and trust in the local social services ecosystem.

Third, health care organizations are concerned about losing the benefit from their investment if a patient switches insurance plans or

providers after the investment is made but before the benefit is realized. This fear is particularly well grounded for Medicaid enrollees because churning—the frequent exit and reentry of beneficiaries as their eligibility changes—has long been a problem for both administrators and recipients.²¹ Additionally, plan switching among commercial-plan enrollees is fairly common, in the range of 10–43 percent of enrollees each year.^{22,23} There is a similar but smaller risk of plan switching in Medicare Advantage plans.²³

Social Determinants Investments Are Public Goods

Given these realities, we argue that upstream spending on social determinants of health has the properties of a public good. In contrast to private goods such as tennis racquets or ice cream, public goods deliver benefits to different people and sectors simultaneously (a property called nonrivalrous), and those benefits cannot be efficiently limited to those who pay directly for them (a property called nonexcludable). The theory of and experience with public goods such as national defense and transportation infrastructure suggest that public goods will be undersupplied by self-interested actors in a free market, even in cases where the market is dominated by nonprofit health care provider organizations, nonprofit health plans, and governments at every level. This undersupply is called the “free-rider problem,” a name that reflects the fact that investors cannot easily prevent nonpayers from benefiting and thereby capturing some of the return on the investment. The free-rider problem is why governments typically finance from taxation pure public goods such as national defense.

This phenomenon is related to the “wrong pocket problem,” in which “investments from one part of the government are not reimbursed by the benefits that accrue to another part of government, discouraging cross-agency investment.”²⁴

Solving The Free-Rider Problem

Given the barriers to investing in social determinants interventions described above, health care stakeholders are unwilling to voluntarily contribute enough resources to solve common problems.

We have identified a financing model that enables each stakeholder to recognize that revealing its true willingness to pay for a social determinants intervention is in its own self-interest. This self-interest is what makes the intervention an investment, rather than a donation. Investments that generate positive returns are sustain-

able in the long run. The model is a variant of the Vickrey-Clarke-Groves mechanism, which was originally developed in the 1970s as economists searched for ways to solve free-rider problems without relying completely on the government.²⁵

There are necessary preconditions for the Vickrey-Clarke-Groves mechanism to work. Most important, there must be a local “trusted broker” that is financially neutral, such as a local nonprofit or philanthropy, and that can convene local health system stakeholders such as health plans, hospital systems, employers, community health centers, and county health and social service departments. Researchers or academics could initially function as technical advisers to the trusted broker and could play facilitation, data analytics, and communication roles until essential mechanisms and models became self-evident and were successfully implemented, and the advisers were no longer needed.

We envision a twelve-step process for communities that are willing to pursue this financing model.

CONVENING KEY STAKEHOLDERS AND GATHERING INFORMATION Informal conversations between technical advisers and key stakeholders (all health care entities that bear financial risk for the health care use of socially vulnerable patients) can identify potential trusted brokers and existing reports or evaluations that highlight important deficits in social determinants of health in the community.

CHOOSING A TRUSTED BROKER The selection of the right trusted broker is a linchpin of the process. Essential characteristics of a trusted broker include managerial competence, the ability to keep sensitive financial information confidential and be impartial, and communications savvy to promote the stakeholders’ joint investment.

GATHERING INPUT, ADDRESSING CONCERNS, AND ESTABLISHING TRUST The participation of all stakeholders who bear financial risk for the selected population is essential. The process of establishing trust among stakeholders could be informed by lessons from political scientist Elinor Ostrom on managing “common-pool” resources;²⁶ from the collaborations of social and health services managers in Scandinavian countries;⁵ successful health-sector coalitions;²⁷ county-level planning and models developed by ReThink Health²⁸ or Altarum;⁸ and collective impact arrangements, in which different sectors commit to a common agenda for solving a social or environmental problem.²⁹

ASSESSING THE CURRENT HEALTH LANDSCAPE AND SOCIAL DETERMINANTS DEFICITS Together, the group must agree on the largest social determinants deficits in their community. Agreement could emerge from a landscape assessment

based on existing or new quantitative and qualitative data, including community health needs assessments.

PROJECTING RETURN ON INVESTMENT FROM ONE OR MORE INTERVENTIONS Once one or more social determinants deficits have been targeted for action, technical advisers can project the return on investment (ROI) for one or more potential interventions, using local data and rigorous evaluations from other communities.

SELECTING AN INTERVENTION The trusted broker shares the projections with stakeholders, who must then agree to enter a “bidding” process to jointly fund a communitywide intervention.

SOLICITING BIDS Stakeholders individually consider (with help from the trusted broker and technical advisers) what they are willing to pay (or “bid”) to reduce the social determinant deficit. Call these revealed values. The trusted broker chooses the scale that maximizes collective value (willingness to pay). In economic terms, the investment is worth undertaking if the collective value is greater than the total cost of the social determinant investment at scale. Of note, some stakeholders may attach value to improved health outcomes, not just to cost savings. With these data, the broker can calculate what each payer should pay and expect to reap from the social determinant investment scheme. Perhaps most importantly, the trusted broker can show each stakeholder the implications of their joint strategies, including doing nothing and forgoing the potential individual and mutual gains. Examples of how to calculate collective value and prices are in exhibit 1 and in the online appendix.³⁰

ASSIGNING PRICES The trusted broker calculates what each stakeholder must pay for the intervention to be implemented at scale. The

optimal price calculation has two parts: an initial cost share, set so that the proper scale of the intervention is paid for, and a “tax” (economists might call it a “side payment”), set so that the externalities (positive or negative consequences that affect others) each stakeholder imposes on the others is fully reflected in each stakeholder’s net price. It is in setting the tax, or side payment, that the Vickrey-Clarke-Groves mechanism excels (the tax can be positive, negative, or zero). For the joint investment to go forward and be sustainable, it is necessary for all stakeholders to gain. (A more complete example of how the model would determine prices for all stakeholders is in the appendix.)³⁰

CONTRACTING WITH A VENDOR TO IMPLEMENT THE INTERVENTION The trusted broker and stakeholders review the available options of “implementers” (for example, transportation companies) of the selected intervention.

IMPLEMENTING THE INTERVENTION The vendor implements the intervention, guided by a contract with specific conditions, data reporting requirements, and deliverables.

PROVIDING OVERSIGHT AND QUALITY ASSURANCE The trusted broker manages the contract, providing regular updates to stakeholders and ensuring the quality and fidelity of the intervention.

RECONCILING THE DATA After the first year, the trusted broker and stakeholders assess how closely the health impacts and returns to each stakeholder matched expectations and repeat the bidding process for funding the intervention, and possibly others, in subsequent years.

Long-standing, place-based nonprofits such as the Family League of Baltimore are well-situated to play the role of the trusted broker throughout the twelve-step process. The Family League

EXHIBIT 1

Values and costs of a hypothetical social determinants investment in nonemergency medical transportation

| Stakeholder | Targeted patients covered | Thousands of dollars | | | | | |
|-------------------------------|---------------------------|---------------------------|------------------------|-----------|-------------------------|---------------------|-----------|
| | | Gross value of investment | Loss from reduced care | Net value | Cost share ^a | Tax or side payment | Net price |
| Medicaid | 50% | 7,700 | 0 | 7,700 | 1,312.5 | 500 | 1,812.5 |
| Medicare | 20 | 3,080 | 0 | 3,080 | 1,312.5 | 200 | 1,512.5 |
| Private insurer | 10 | 1,540 | 0 | 1,540 | 1,312.5 | 100 | 1,412.5 |
| Providers or uninsured people | 20 | 3,080 | 2,464 | 616 | 1,312.5 | -800 | 512.5 |
| All | 100 | 15,400 | 2,464 | 12,320 | 5,250.0 | 0 | 5,250.0 |

SOURCE Authors’ analysis based on updated cost and savings data from Paul Hughes-Cromwick, codirector of Sustainable Spending Strategies, Altarum Institute, personal communication, August 4, 2017. **NOTES** We assumed an overall population of 300,000, of whom 7,000 would be transportation-disadvantaged patients. Gross value of investment, or gross willingness to pay, is the savings per person (assumed to be \$2,200) times the number of people. For example, Medicaid covers 50 percent of the 7,000 patients, or 3,500 people, and \$2,200 times 3,500 equals \$7.7 million. ^aTotal cost (net cost of \$750 times 7,000 patients) divided by 4.

Investing in social determinants requires some degree of patience from investors before returns are realized.

already functions as a funding hub and has demonstrated the advantages of pooling and coordinating funding from hospital community benefits, philanthropy, and government.³¹ Our model would improve upon existing practice by solving the free-rider problem without coercion by revealing cooperative solutions that are in the self-interest of local stakeholders, without appeals to their charity alone.

Applying The Model To Nonemergency Medical Transportation

Using updated data from the literature on the costs and benefits of providing nonemergency medical transportation (rounded off for simplicity)²⁷ and a hypothetical community of 300,000 people,³² we demonstrate how all local health stakeholders could benefit financially from a joint investment in nonemergency medical transportation, using our proposed model to set prices for each stakeholder. Our hypothetical community includes a diverse set of risk bearers and payers.

The transportation-disadvantaged population who miss nonemergency medical care each year has been estimated to be at least 2.3 percent of the US population (almost 7.5 million people in 2017) (a 2004 estimate updated with 2015 data from the National Health Interview Survey by Paul Hughes-Cromwick, codirector of Sustainable Spending Strategies, Altarum Institute, personal communication, August 4, 2017) but is not representative of the broader population. People who miss appointments due to lack of transportation are more likely to be low income, uninsured, older, female, less educated, and members of a racial/ethnic minority group. They are also two to three times more likely to have a serious chronic condition, more likely to have comorbidities, and almost four times more likely to have an ED visit within a given year.³³ Perhaps

surprisingly, they are equally likely to be urban or rural.

The Transportation Research Board's cost-benefit analysis of providing nonemergency medical transportation drew on the peer-reviewed literature and expert panels to estimate cost differentials between well-managed patients (those who received recommended tests and therapies in a timely fashion) and patients who were not well managed because of missed appointments. The authors estimated the differentials across twelve health conditions (ranging from depression to pregnancy), the cost of transportation for different types of patient needs (ambulatory, wheelchair, or stretcher), the number of medical visits recommended for good management of the specific conditions, the number of visits transportation-disadvantaged patients managed to attend without interventions in a given year, and expected compliance with all clinical recommendations. We updated the health savings and transportation cost estimates of the analysis to 2017 numbers, using the growth rates in the medical Consumer Price Index (CPI) and in the transportation services CPI, respectively, as a first-order approximation of current average savings possibilities.³⁴

In our hypothetical population of 300,000, we estimated that 7,000 people (about 2.3 percent) would be transportation-disadvantaged. Net savings from getting these patients to scheduled appointments are projected to be \$2,200 per person per year, and net costs are expected to be \$750 per person for a year (the total cost share, or \$5,250,000, divided by 7,000 people). The data necessary for these calculations are displayed in exhibit 1.

For interventions that reduce utilization by the insured and uninsured alike, payers gain the most, unambiguously. Providers, especially hospitals, would gain from reduced health care use by the uninsured but would lose from reduced use by paying customers. We assumed that providers would lose 20 percent of the gross revenue from insured patients ($2,464 = 0.20 * [7,700 + 3,080 + 1,540]$) (exhibit 1). This is a conservative estimate in that 20 percent is likely larger than most providers' profit margins on insured patients, and, depending on the locale, they might be able to substitute other insured patients for the transportation-disadvantaged patients who had previously cost them money by using ED or hospital resources.

The tax is set to make sure providers are willing to participate—that is, to compensate them for the externality they would suffer if the project went forward and everyone paid their simple cost share alone. Each payer is assessed a tax to compensate providers in proportion to its market

share, since their contributions to providers' losses from reduced utilization are proportional to their market share. Note that all stakeholders pay, on net, less than their revealed values, or initially accepted bids.

Note also that exhibit 1 summarizes stakeholder classes. In a given locale, there may be only fee-for-service Medicare, one Medicaid managed care organization, one dominant private insurer, and one hospital system. In other locales, there may be multiple players in each class. A larger number of stakeholders will make the trust-building process more complicated, but not insoluble.

The literature suggests other social determinants interventions that could both improve health outcomes and reduce health care use and spending for low-income populations, such as Housing First, which we discuss in more detail in the appendix.³⁰ Other interventions include nutrition support for new mothers (via the Special Supplemental Nutrition Program for Women, Infants, and Children) and older Americans (via Meals on Wheels and similar programs), and case management with home visitation. Access to Supplemental Nutrition Assistance Program benefits (formerly known as food stamps) has also recently been shown to lower Medicaid expenditures.³⁵

Complexities And Challenges

While we believe that such a financing mechanism would be an improvement over current, piecemeal efforts to invest in the social determinants of health, at least three challenges remain.

First, choosing the right geographic scale is not obvious. This must be determined by each trusted broker and set of stakeholders. Some communities may be prepared to handle county-wide interventions, while others would likely prefer to focus on a single hospital's catchment area, or even a single census tract in which a target population is known to live. The number of stakeholders required is a factor, as is the willingness of larger stakeholders to focus on a subset of their patients, and how large an area an implementer could reasonably service.

Second, investing in social determinants requires some degree of patience from investors before returns are realized. Nonemergency medical transportation, Housing First, and nutrition assistance may offer returns in the first year or two. Other social determinants investments will likely require longer time horizons, such as three to five years or even longer. This reflects the time needed to design local community-level interventions (for example, early childhood education) appropriately and to reap positive returns.

A pragmatic approach for creating long-run financing mechanisms for historically underfunded services is needed.

Recently, organizations and elected officials have had a poor track record of making investments with future payoffs (think infrastructure and climate change). Given this reality, we suggest focusing on "early wins," which can strengthen trust in budding local multistakeholder coalitions.³⁶

Third, this kind of upstream investment might require statutory changes to the scope of services that public programs such as Medicaid and Medicare can pay for. Demonstration waivers and special pilot authorities may be required of state Medicaid offices. This is an unfortunate reality, even though social determinants spending is unambiguously intended—and very likely—to improve health outcomes and lower health care spending.³⁷ In the interim, health systems and payers may be able to direct community benefit and other less restricted funding sources to support investments in social determinants of health.

Summary And Next Steps

Considerable evidence⁵ that paying serious attention to the social determinants of health could improve health and lower health care spending, particularly among low-income communities, has existed for many years. Additionally, addressing social determinants deficits could reduce health disparities. What has been holding back efforts to fund social determinants interventions is the lack of an incentive framework, based on rigorous analysis, that could lead to a sustainable level of investment free from heavy-handed government policies or piecemeal altruism among inherently self-interested stakeholders.

It is important to recognize that using this kind of incentive-based scheme will not deliver us to full health equity or justice, but will enable substantially more upstream investment than currently exists in competitive health care

markets focused on short-run returns. Some may question whether ROI to individual stakeholders is an appropriate metric by which to decide which social determinants investments are worth making. Sometimes interventions with a small ROI for health care could have a large ROI for society, particularly if they affect more people or have substantial spillover effects. Moreover, few health care innovations truly pay for themselves. Consider decisions to cover new cancer drugs or magnetic resonance imaging scans instead of x-rays, in which the benefit to patients, clinicians, the health care system, and society is weighed against the net cost of the innovation. We argue that this standard should be applied to social determinants of health innovations as well.³⁸

Nevertheless, a pragmatic approach for creating long-run financing mechanisms for historically underfunded services is needed. As imperfect a measure as it may be, ROI is necessary for contributions to be considered sustainable investments by stakeholders. As trust among stakeholders builds over time, a broader definition of benefits (such as improved health status, not just financial returns) might permit different investments to yield a positive ROI, with a properly

defined numerator.

In this article we have formulated a pragmatic framework by which health care organizations can jointly invest in social determinants of health projects. The framework is grounded in organizations' pursuit of their own self-interest and is therefore reasonably sustainable under the current norms of US health care. The self-interest on which we are relying is enlightened in that the framework requires stakeholders to overcome an inherent public good problem by imagining a better set of mutual outcomes and to invest in developing the trust required by a local social compact that can govern the sustainable distribution of costs and benefits over time. Given the post-ACA focus on population health, reducing readmissions and health costs generally, and improving the equity of the diverse and unequal US society, we believe that there now are sufficient incentives to encourage participation in the remediation of key social determinants deficits. Enlightened self-interest might not get us to the Promised Land, but if properly channeled, it could make local health systems considerably more efficient and humane than they are today. ■

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 - 34 If health spending grew faster than the medical CPI since 2004, as is likely, using the medical CPI to update the savings' estimates yields a conservative estimate.
 - 35 Berkowitz SA, Seligman HK, Rigdon J, Meigs JB, Basu S. Supplemental Nutrition Assistance Program (SNAP) participation and health care expenditures among low-income adults. *JAMA Intern Med*. 2017;177(11):1642-9.
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Appendix

In this Appendix we describe in more detail the logic of how the Vickrey-Clarke-Groves (VCG) model could be applied in a SDOH context, and how the model may be applied to a specific housing example.

The Logic of the VCG Approach

The fundamental problem we are trying to solve is the free rider problem, or how to get self-interested stakeholders to reveal their actual willingness to pay for a service that generates benefits that are shared with other stakeholders. We contend that this is the core barrier to proper financing of SDOH.

Our proposal is based on a VCG mechanism, which has proven to effectively coax self-interested stakeholders to reveal what they are willing to pay for a public good that will benefit them *and* the community at large, *under certain conditions*. The origins of the VCG mechanism can be traced to a novel sealed-bid auction theory first promulgated in 1961.ⁱ Today, a variant is used by the world's largest online auction house, eBay.ⁱⁱ The trusted broker selection and stakeholder convening process we have in mind is described in a fair amount of detail in the text of the paper itself. In this appendix we elaborate on why the logic of the VCG payment mechanism is applicable to the particular free rider problem associated with SDOH deficits. We also iterate the necessary conditions for it to work in many if not most communities in the US. We do not claim to have discovered a way to solve the free rider problem in all circumstances, nor can this mechanism work for most non-public good auctions.

Given a trusted broker and a properly convened table of stakeholders, the first order of business is to decide which SDOH deficit to address and how to generate the requisite analysis of what investment impacts are possible and likely in each particular community, generating information necessary for stakeholders to evaluate so that the trusted broker may eventually assemble something similar to our Exhibit 1 in the paper. Given a considered appraisal of agreed-upon data, there must be a general agreement that reducing the chosen SDOH deficit is worth doing, for the individual stakeholders and for the community as a whole, *at some scale*. This agreement is partly the responsibility of the trusted broker to engender but requires stakeholders to see available data and the potential for their organization to be made better off through intervention as credible. Without these beliefs in place, the process cannot succeed, and would likely not even begin.

The questions then become, (1) at what scale (x) must a deficit be addressed, and (2) what must each stakeholder pay (p) or invest for the community to achieve said scale?

Given the agreement that some SDOH investment is worthwhile, each stakeholder knows they will pay something toward the joint investment. They also know that larger scales will require them, or someone, to pay more. (Note: Some stakeholders are making essentially charitable

contributions toward SDOH investments now, albeit rarely in tandem with other institutions and rarely with clear, expected payouts.)

The intuition behind our proffered solution is, each stakeholder's participation and potential gain enlarges the optimal scale, and thus enlarges the private and shared cost of the public good. Thus each stakeholder's participation is somewhat like an externality for all the others. The "tax," which will affect the net price that each stakeholder will ultimately be asked to pay, will internalize the externality. The payment scheme we have in mind, based on the VCG mechanism in the economics literature,ⁱⁱⁱ induces each stakeholder to reveal the truth about their own valuation of the SDOH deficit reduction because their self-interest is better served by truthful revelation than by strategic understatement, given stakeholder agreement to participate in the payment mechanism. In other words, if you are otherwise going to suffer through a suboptimal amount of collective SDOH spending and repeatedly suffer the organizational consequences (higher health care costs, lower health status) of SDOH deficits, you would be better off to join the group and use a cost-sharing mechanism that can rationalize your own and the collective SDOH investment into a better outcome for you – and incidentally, for all. While traditional free rider observers would expect people to underbid, or strategically lie, truth telling regarding your own valuation turns out to be in your interest when a VCG payment mechanism is properly structured and executed. This is why the model is sustainable over time as well.

The trusted broker asks each agent to report – to the trusted broker alone -- how much they value the SDOH implementation at scale, i.e., how much would they be willing to pay to reduce the SDOH deficit for a targeted group of people? Clearly they would consider their own knowledge of how many patients or enrollees they have now who could benefit, and how much those service benefits could improve their constituents' well-being and quite possibly reduce their own organizations' costs. Call these revealed values $v_i(x)$. Note, the bid values are revealed only to the trusted broker and multiple scales of target populations (or x values) could be possible in which stakeholders were asked to bid on each scenario.

The trusted broker chooses the scale x^* that maximizes collective value, where $V = \sum_i v_i(x^*)$. In economic terms, the investment is worth undertaking if $V > C(x^*)$, the total cost of the SDOH investment at scale x^* . The collective value or willingness to pay must exceed the total cost of the intervention.^{iv}

The trusted broker then calculates what each agent must pay for x^* to be implemented. The optimal payment calculation has two parts, an initial share, c_i , set so that $\sum c_i = C(x^*)$, so the proper scale of the intervention is paid for, and a 'tax' (economists might say "side payment") so that the externality (positive or negative) each stakeholder imposes on others based on their participation in the process is fully reflected in their net price. The price they will be asked to pay, p_i , will be $p_i = c_i + t_i$, and it is in setting the t_i that the VCG mechanism excels, for the t_i guarantee that for each stakeholder, $p_i \leq v_i$, i.e., no stakeholder ever pays more than they were

willing to pay, and some, maybe most or even all, will pay less. VCG requires each stakeholder to pay the extra cost they impose, i.e., the difference between the total value of the public good / SDOH investment with them included and the total value of the investment if they were not to participate. The trusted broker will undertake the necessary calculations of the total value for each stakeholder with and without each agent i included. Let

$W_i = \sum_{j \neq i} v_j(z \neq x^*)$, and $R_i = \sum_{j \neq i} v_j(x^*)$. Each agent then is asked to pay c_i plus a “tax” equal to $t_i = W_i - R_i$.

A concrete example may be clarifying. Suppose there are three stakeholders, two hospitals X and Y, and one health plan, Z. Let the proposed intervention in question, transportation on a scale for the identified patients with transportation challenges, cost \$180k per year. Let the values each stakeholder puts on the transportation services reflect expected net cost savings to them alone, and are 40k for X, 50k for Y, and 110k for Z. Then V , the sum of all values, is 200 and exceeds C , the cost of the intervention, by 20k, so the intervention is worth doing, in the aggregate. The intervention should go forward as a jointly-funded investment. What should each stakeholder pay to make the intervention sustainable?

For simplicity, the cost component, c_i might be set at a simple average, $C/3$, or 60k each. But if this were all there is to it, then X and Y would rather not have the intervention at all, since for the hospitals, $c_i > v_i$. Health plan Z however could compensate them for their net losses (-20 and -10, respectively), and still gain $110 - (60 + 30) = 20$. This possibility is guaranteed by the condition that $V > C(x^*)$. We can infer that Z imposes an externality on X and Y equal to 30k, for without Z's values included in the calculation, the intervention at x^* would not take place. So if X and Y pay 60 but receive side payments of 20 and 10 respectively, so that their net payments are 40 and 50, respectively, and Z pays 90 on net, the intervention is paid for, everyone gains or does not lose, the SDOH environment is improved, and health outcomes improve while health costs fall enough to pay for the transportation. Also note, on net, everyone pays exactly or less than their revealed willingness to pay. This is why our pricing scheme is a form of benefit taxation, consistent with self-interest and therefore sustainable.

The only remaining question is, will the stakeholders tell the truth in the first place if they know the pricing scheme works this way? Ostensibly, all stakeholders have an incentive to bid lower-than-actual valuations of the intervention to decrease their net payments. Thankfully, there are many formal proofs of the VCG truth-eliciting proposition in the literature, Varian has an intuitive one in his textbook,⁹ but we can walk through the basic logic here.

Consider hospital X. If it reported its value in step 3 of our process as zero and not 40, then x^* would not happen, V' would be 160 not 200 and $V' < C = 180$. Recall x^* yields a gross cost savings gain of 40 to hospital X. The same logic is true for all three of the stakeholders: lying by under-revealing expected costs savings then prevents potential gains they would be obtained

only if they tell the truth. Now the hospitals in the real world might argue for a larger share of the savings the health plan obtains at a price of 90, so that they are not technically indifferent but indeed gain from the intervention, and that could be worked out over time at the trusted broker table as well. Note, even after paying 90, Z has a surplus of 20 with which to compensate X and Y. Practically speaking, this may be necessary if hospitals lose revenue in addition to experience lower costs from SDOH improvements, as in the example of NEMT we used in the text of our article.

So, given the VCG mechanism and the nature of the SDOH public goods in question, stakeholders can and will tell the truth and still end up better off while sustainably addressing SDOH deficits in communities across the US.

Conditions

Trust: The legitimacy of the trusted broker is a function of stakeholder perceptions' of the brokers' impartiality and competency. Specifically, stakeholders must trust the broker to undertake a number of tasks on their behalf, namely to find and present rigorous data, keep bids confidential, correctly analyze and ascribe prices and ensure appropriate payouts. While trust has many definitions, we use the term to refer to stakeholders' willingness to be vulnerable in relationship to the broker without fears that the broker will exploit them. In our example, stakeholders' vulnerability could take a number of forms but may be seen most concretely in a willingness to share proprietary information regarding business operations. In the absence of such trust, one or more stakeholders may elect not to participate in the bid process, thereby nullifying the opportunity for collective action.

No income effects: Another condition for a VCG mechanism to work is for there to be no effect of the tax on the initial bid or value revelation. In practice this means the v_i and p_i must be small relative to the total budgets of the stakeholder organizations. In all SDOH impact calculations we can imagine, this is very likely to be true for hospitals and health plans, perhaps not so much for community based organizations or local governmental units. In those cases, care might be taken to set the initial c_i proportional to the organizations' budgets, and thereby minimize the necessary magnitudes of the t_i they might need to receive in a simplified mechanism.

No collusion: All small numbers games and markets are vulnerable to collusion. The basic logic preventing lying and understatement also would prevent collusion, since collusion to lower stated values risks undermining the potential for a joint SDOH intervention to take place. Give the prerequisite trust we expect to be placed in the broker, we do not think the collusion risk is large and certainly not as great in the public goods applications of VCG as they it has been shown to be in private good auctions.

Application of the Social Determinants as Public Goods to Housing First

Ly and Latimer recently completed a review of 12 rigorous evaluations of Housing First (HF) programs, some with more than one site, in the US and Canada.^{vi} The defining characteristic of Housing First is to provide housing and sometimes other support services to chronically homeless people without first requiring them to achieve sobriety or participate in treatment activities. Since many people who are homeless are also diagnosed with a serious mental illness (SMI), have substance use disorders (SUD), or both, these pre-housing requirements have frequently proved insurmountable in attaining stable housing. It is well known that people who are homeless with SMI and/or SUD utilize a substantial amount of social resources, including criminal justice, temporary housing, and health care resources, mostly at local governments' expense. Housing First is based on the plausible theory that immediate access to stable housing can be immensely stress-reducing and catalytic for recipients to then address and improve behaviors and conditions that had previously inhibited independent living.

In the majority of studies reviewed, substantial reductions in health care and criminal justice costs were observed, but they were typically not large enough to completely offset the housing costs, except in cases which focused on the highest need homeless only (e.g, those with SMI or chronic physical illness, including AIDS). In noting this reality, it is important to remember that few health care innovations truly pay for themselves. Think of decisions to cover new cancer drugs or MRI scans instead of x-rays, wherein the benefit to patients, clinicians, the health care system and society is weighed against the net cost of the innovation. We would argue this standard should be applied to SDOH innovations as well, in agreement with Kertesz et al^{vii} as well as Ly and Latimer:

While our review may cast doubt on whether HF programs can be expected to pay for themselves, the certainty of significant cost offsets, together with the evidence of their effectiveness in increasing residential stability and improving the lives of an especially vulnerable population, means that they represent a more efficient allocation of resources than traditional services.

To illustrate VCG in the case of Housing First, we present Exhibit 2, based on data and results in the Basu et al^{viii} RCT of chronically ill homeless adults, reviewed by Ly and Latimer. We chose this study because it was one of the few that tested for differences among and listed health, housing, criminal justice, and case management intervention costs separately. The target population, and the randomized control group, was homeless adults with a chronic condition, not necessarily SMI or SUD. Finally this study included 405 individuals, a relatively large study as Housing First evaluations go, and roughly equal to the number of homeless one would expect on average in a community of 300,000 in the US.

In the Basu et al study, all the homeless were uninsured. Therefore the only stakeholders who must bid are (1) health care providers who would gain from reductions in uncompensated care (note, in this case they would not lose revenue from reductions in use from insured patients),

and (2) local criminal justice units who would be able to devote fewer resources to the housed population with fewer reasons to interact with law enforcement due to loitering, public nuisance, trespassing or other issues. We use point estimates of cost differences by treatment and control groups arising from the Basu et al intent-to-treat design. The cost of the intervention, measured as mean difference in housing and case management costs between intervention and control groups, was \$3,337 per person. The data necessary for a VCG calculation are:

Exhibit 2. Values and Costs of SDOH Investment in Housing First plus Case Management (all dollar amounts per person)

| Stake-holder | Market Share of Target Patients | Gross value of investment | Loss from reduced care | Net Value, bid to trusted broker | Cost share | Tax or side payment | Net price |
|------------------|---------------------------------|---------------------------|------------------------|----------------------------------|------------|---------------------|-----------|
| Providers | 100% | 8,593 | 0 | 8,593 | 1,668.5 | 800 | 2,468.5 |
| Criminal Justice | 100% | 1,051 | 0 | 1,051 | 1,668.5 | -800 | 868.5 |
| TOTALS | 100% | 9,644 | 0 | 9,644 | 3,337 | 0 | 3,337 |

Authors calculations based on results reported in Basu et al. This VCG price scheme is perfectly consistent with the estimated net savings of \$6,307 per homeless person.

For our purposes, Housing First is more complicated than NEMT since most rigorous studies with a proper control group find that the reduction in health and criminal justice costs, while substantial, incompletely offset increased housing and case management services. Even in the Basu et al study, if we only used mean difference estimates with conventional statistical significance (.05), the intervention would be estimated to cost \$2,633 per person on net. Many of the mean differences are significant at the $p=.1$ level, which suggests that with more statistical power (Basu et al only had 405 participants) more savings would have been statistically significant. But any set of real stakeholders is likely to take their confidence in net savings or cost estimates into account when bidding their v_i , and when deciding what net p_i and t_i they will accept.

Perhaps no domain of SDOH intervention is more poignant than housing, since ultimately local stakeholders will have to put an implicit value on improved health and quality of life outcomes among a target population versus the money these interventions will cost. Precisely because of this poignancy, having stakeholders make these determinations after establishing trust with a broker and with each other may be among the best of circumstances in which to articulate the implicit values which define us all.

ⁱVickrey W. Counterspeculation, Auctions, and Competitive Sealed Tenders. *Journal of Finance*. 1961;16:8-37.

ⁱⁱVarian, H. *Intermediate Microeconomics*, 9th Edition. New York (NY): W.W. Norton. New York (2016), p. 336.

ⁱⁱⁱ Varian has a nice exposition of VCG in chapter 37. McMillan has a very useful survey of the foundational economic theory work in this area. McMillan J. The Free Rider Problem: A Survey. *The Economic Record*. 1979;55(2):95-107.

^{iv} Governments and other stakeholders may need to “value” improved outcomes for the uninsured for this condition to hold in some cases.

^vVarian, op cit., p. 733.

^{vi}Ly A and Latimer E. Housing First Impact on Costs and Associated Cost Offsets: A Review of the Literature. *Canadian Journal of Psychiatry*. 2015;60(11):475-87.

^{vii} Kertesz SG, Baggett TP, O’Connell JJ, Buck DS, and Kushel MB. Permanent Supportive Housing for Homeless People—Reframing the Debate. *New England Journal of Medicine*. 2016;375(22):2115-17.

^{viii}Basu A, Kee R, Buchanan D, and Sadowski LS. Comparative Cost Analysis of Housing and Case Management Program for Chronically Ill Homeless Adults Compared to Usual Care. *Health Services Research*. 2012;47(1):523-43.

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