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How organizations shape medical technology allocation: Insulin pumps and pediatric patients with type 1 diabetes

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Abstract

Although guidelines for prescribing insulin pumps to patients with type 1 diabetes (T1D) focus on patient assessment, sociological research shows decision-making is influenced by the organizations within which actors are embedded. However, how organizational context shapes unequal resource allocation by race and class is less well understood. To investigate this, we compare two pediatric endocrinology centers differing in racial and socio-economic equity in pump use. Using over 400 h of observations and 16 provider interviews, we find allocation is shaped by how organizations use patient cultural health capital to determine pump eligibility, frame technology use, and structure decision-making processes. Overall, findings extend health inequalities research by describing how organizations shape technology resource allocation by race and class.

Keywords

Medical technology; Diabetes; Health disparities; Organizations; Gatekeeping; Decision-making; Culture; Sociology

1. Introduction

Health inequality research demonstrates disparities in health outcomes by patient social class and race (Deaton, 2002; Williams and Collins, 1995). Critical to research is understanding how patient behavior and knowledge, provider behavior, or the organizational and institutional environments of healthcare provision shape these disparities. However, it is difficult to separate these factors because patient background leads patients into particular healthcare settings, making it a challenge to pull apart patient background from healthcare

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CRedit authorship contribution statement

Cassidy Puckett: Conceptualization, Methodology, Investigation, Resources, Software, Formal analysis, Writing - original draft, Writing - review & editing, Supervision, Project administration, Funding acquisition. **Jenise C. Wong:** Funding acquisition, Resources, Data curation, Software, Formal analysis, Validation, Writing - review & editing. **Tania C. Daley:** Resources, Data curation, Validation, Writing - review & editing. **Kristina Cossen:** Resources, Data curation, Writing - review & editing.

context (Gengler, 2014). Thus, gaps exist in understanding factors contributing to healthcare inequalities by race and class.

While health insurance coverage can shape access to treatment, research on gatekeeping prior to prescription shows resource allocation can vary by patient-provider interaction. Implicit racial bias can shape patient-provider interactions, treatment decisions, and patient health outcomes (Hall et al., 2015). Providers also reward knowledge, skill, and interaction styles (“cultural health capital” or CHC) in line with higher socio-economic status (SES), allocating resources unequally by SES—within organizations where patients have access to similar resources (Gage-Bouchard, 2017; Shim, 2010). While insightful, less is known about how allocation is shaped by organizational decision-making processes, structures, and histories. We ask: How does organizational context contribute to health inequality by race and class?

To answer this, we use the case of insulin pump allocation to pediatric patients with type 1 diabetes (T1D). This is an important case because newly diagnosed cases are growing (Mayer-Davis et al., 2017), management can be technology-intensive, and new technologies can exacerbate health inequality, particularly for chronic diseases (Case, 2005). While multiple daily injections (MDI) and pump therapy are considered acceptable approaches to insulin delivery (American Diabetes Association, 2020), research suggests pumps can be beneficial (Blackman et al., 2014; Miller et al. 2015). Yet, inequities in pump allocation by race and class persist (O’Connor et al., 2019). Professional guidelines for pump prescription emphasize patient assessment, including diabetes management knowledge, mental and psychological status, and adherence to self-care (Grunberger et al., 2014). While guidelines also mention clinical context, including a comprehensive pump management program and provider expertise in pump therapy, how clinics make allocation decisions is not well understood—nor is how this process may be linked to inequities by race and class.

We compare two similar American Diabetes Association (ADA)-recognized pediatric endocrinology centers differing in overall pump use (86.5% vs. 30.2%) and pump allocation equity by race and class. The clinic with higher pump use we call *West Clinic* has no significant differences by SES and between non-Hispanic white and underrepresented minority (URM) patients. In contrast, the clinic with lower pump use we call *South Clinic* has significant differences by SES and race. Using over 400 h of observation of patient encounters and decision-making processes, and sixteen interviews with pediatric endocrinologists, nurse practitioners (NPs), registered nurses, certified diabetes educators (CDEs), and other staff at both clinics, we find allocation is shaped by three intertwining organizational factors emerging from organizational history: if organizations constitute patient CHC to determine pump eligibility, how they frame technology use, and how they structure decision-making processes.

Overall, the study extends research on health inequality by describing how organizational context shapes medical technology allocation among patients by race and class. With the continual introduction of new technologies and changes in federal regulation there is no consensus on pump use, therefore providers rely on local organizational contexts to determine allocation. Thus, our study makes a critical contribution by showing how

organizations influence the stratification of healthcare experiences—and the potential but not guaranteed exacerbation of health inequalities with new technologies—issues increasingly central to debates in sociology, public health, technology policy, and medicine.

2. Background

2.1. Health disparities by race and SES, new technologies, and mechanisms

Research shows health outcomes like life expectancy are related to both class and race. Across age groups, SES is associated with health outcomes, where those with lower SES have worse health and higher mortality rates—a phenomenon called the “health-wealth gradient” (Deaton, 2002; Robert and House, 1994). This association is stable across national contexts and time periods (Link et al., 1998). Much work has tried to specify mechanisms underlying the relationship between SES and health (Mechanic, 2000; Williams, 1990). SES is a “fundamental cause” of health inequality because of the multiplicity of ways SES affects health (Lutfey and Freese, 2005). Research on race and racism shows these are another “fundamental cause” through two pathways: racism is a fundamental cause of racial difference in SES, which affects health, and has independent effects on health (Phelan and Link 2015).

Research suggests pump use can improve health outcomes (Sherr et al., 2016). Yet, it can amplify inequalities if use systematically differs by race and class. Economic research shows new technologies exacerbate health inequality, particularly for diseases experiencing rapid technological change like T1D (Glied and Lleras-Muney, 2008; Lleras-Muney and Lichtenberg, 2002). In general, device diffusion to lower SES and URM patients lags behind higher SES and white patients (Ferris et al., 2006; Weiss et al., 2018). With pumps, both race/ethnicity and SES (education, insurance) are associated with differences in device use (Wong et al., 2015).

Explanatory mechanisms for class- and race-based inequities in healthcare technology utilization follow three overlapping strands. The first is individual explanations where differences in human capital, operationalized as numeracy or literacy, result in unequal utilization (e.g., Nutbeam, 2008). This research suggests human capital shapes patients’ “ability to process new information and to take advantage of new technologies” (Cutler et al., 2011:35). From this perspective, more educated individuals learn to adopt medical technologies faster than less educated individuals, thus experience higher survival rates from diseases with rapid technological advancements.

The second and third explanatory strands focus on structural and cultural explanations. In terms of structure, lower-SES and URM patients have poorer access to healthcare resources through selection into lesser-resourced healthcare organizations and/or worse insurance coverage (Lutfey and Freese, 2005). Researchers take this into account by including organizational measures, such as hospitals’ mean rates for delays in treatment, explaining some but not all race- and class-based disparities (Bradley et al., 2004; Lucas et al., 2006). In terms of culture, poor patient-provider relationships result in worse health outcomes for lower-SES and URM patients. Poor relationships can stem from patient mistrust of providers or vice versa (Ozawa and Sripad, 2013; Siembida et al., 2018). For example, providers may

rely on patient CHC as predictive of “adherence” or race-biased understandings of illness to determine treatment (Lutfey et al., 2008; Shim, 2014).

While all three explanatory strands may in part account for class- and race-based health inequality and the exacerbation of inequalities with new technologies, little research considers how organizational processes (e.g., resource-patient matching) and structures (e.g., who sees patients and does prescribing) shape the unequal provision of healthcare technologies. Therefore, in this study we address this theoretical and empirical gap by describing how organizational context shapes healthcare technology allocation by race and class.

2.2. Institutional logics, organizational frames and structures, and technology allocation

In this study we apply a “technology-in-practice” perspective where technologies are understood as “embedded in relations with other tools, practices, groups, professionals and patients” and shaped by organizational context (Johnson, 1988; Timmermans and Berg, 2003b:104). The organizational meaning of technologies is shaped by local negotiation of broader “institutional logics,” the central ideas, symbols, and practices constraining the means and ends of individual and organizational behavior (Friedland and Alford, 1991). These logics include ideas about healthcare provision, framed by U.S. policy as a private good, not a basic right (Mason et al., 2016). A second institutional logic is medical professional guidelines; the ADA recommends allocation be determined by patient assessment, with brief mention of clinical context (Grunberger et al., 2014).

These broader institutional logics suggest patient characteristics determine the unequal use of medical devices by race and class. But, technologies can be understood in organization-specific ways (Horlick-Jones, 2007). For example, in a study of medical implant communication systems (MICS) used to diagnose and treat illness, Edmondson et al. (2001) found distinct organizational frames emerged “held by leaders and communicated to others in subtle ways...matter[ed] in how team members construed the technology and...their role in making it work for patients and for the organization” (Edmondson et al., 2001: 708). While helpful, research largely focuses on “indirect-use gatekeeper devices” providers use (Weiss et al., 2018). Less is known about how organizational frames shape provider-prescribed “direct-use gatekeeper technologies” like insulin pumps, by race and class.

This is an important gap, given the growing number of devices targeted for patient use and trends towards “self-management” (Santilli and Vogenberg 2015). Studies of pumps suggest they can improve glycemic control and reduce hypoglycemia when worn regularly (Wong et al., 2015). But, pumps change insulin delivery, which early studies suggested increased medical risk (Franklin, 2016). Patients using MDI inject “basal” or “long-acting” insulin slowly released throughout the day, and (ideally) a “bolus” of “short-acting” insulin before eating, according to carbohydrate amount and blood glucose level. Patients using pumps receive micro-doses of short-acting insulin throughout the day instead of long-acting insulin and bolus using the pump (Franklin, 2016).

Further, because technologies and federal regulations have changed rapidly, there is a lack of evidence-based clinical guidelines concerning best practices for pump allocation (Pickup,

2019). The ADA Standards of Care in Diabetes suggest, “pump therapy may be considered as an option for all adults children and adolescents with type 1 diabetes who are able to safely manage the device” (American Diabetes Association, 2020: S82). They explain, “there is no consensus to guide choosing which form of insulin administration is best for a given patient” (S83). This lack of consensus may be resolved in organization-specific ways (Kaplan, 2008). Indeed, ADA guidelines suggest pump adoption can vary by clinic characteristics.

Finally, organizational structure can shape decision-making and the unequal allocation of resources by race and class (Scott et al., 2000). For example, Heimer (1999) studied how decision-making occurs in neonatal intensive care units (NICUs), to understand how the family, medical field, and legal field influenced day-to-day practice. Heimer found key to asserting authority over decision-making were: 1) actors present during decision-making processes and 2) actors’ ability to leverage evidence to support decisions through knowledge of particular laws. Families not included in decision-making meetings had least power, beyond moving their child(ren) to another NICU (Heimer, 1999). Organizational structure can also shape how responsive providers are to patient requests; providers in larger practices, hospitals, and medical schools are less responsive (Menchik and Jin, 2014).

Further, organizational structure can influence how providers understand and deploy organizational frames in decision-making. For example, a study of pharmacists in retail and hospital settings found inter-professional power dynamics, proximity to patients, and access to information shapes how physicians “construct gatekeeping processes and make ethical decisions in daily practice” (Chiarello, 2013:327). Organizational structure and practices are shaped by field- and organization-specific histories (Scott, 2014). In healthcare, these histories include the emergence of healthcare management organizations and rapid technological advances (Faulkner, 2009). Thus, pump allocation may be shaped by who is present during decision-making, their role and power in decision-making, and the resources (data, frames) they can leverage as evidence to support their perspective. But we know little about how decision-making varies across organizations to shape equity in allocation.

Organizational studies also show “composition” (i.e., organizational demographics) can shape outcomes—but some suggest this depends on organizational context (e.g., Duncan et al., 1998; Gamoran and An 2016). For example, in a study of clinic vaccine provision, Duncan et al. (1998) found while there were compositional effects by patient SES, “[I]t seems several clinics are working hard to overcome the general tendency for their clients to have low uptakes. There is, therefore, an important degree of contextuality in vaccination uptake performance” (111). Yet, little research in healthcare looks at how organizational context shapes differences in resource allocation by race and class. Thus, we use a comparative approach to investigate how organizational context shapes pump allocation among pediatric patients with T1D by race and class.

3. Data & methods

3.1. Site selection

We selected cases and analyzed data using an abductive approach, which builds upon grounded theory's methodological heuristics while at the same time facilitates theoretical innovation by focusing on puzzling empirical observations (Tavory and Timmermans, 2014; Timmermans and Tavory, 2012). In this case, we use "intersituational variation" where researchers "follow a phenomenon across settings and situations" to find surprising cases (Tavory and Timmermans, 2014:72). We look at pump allocation, subject to the same broader institutional logics (i.e., healthcare policy and medical professional guidelines), in organizational settings that vary in allocation.

We selected two specialty pediatric endocrinology clinics, in the same national T1D clinic registry network—one in the south (*South Clinic*) because pump use is lower than the registry (30.2% in the clinic vs. 63% in 2016 registry data; see Foster et al., 2019) and allocation follows patterns of health disparities by race and class. We selected the other, *West Clinic*, in the western U.S., because pump use is higher than the registry (86.5%) and there are no differences by race and class. Thus, clinic selection allowed us to investigate how organizational differences shape differences in allocation by race and class.

Beyond pump use, the clinics are similar in many ways. They are both "small" according to providers' definition—although *West Clinic* serves ~1000 patients and *South Clinic* serves ~3000 patients. They are in the same professional T1D network and both university-based in urban centers with "satellite" clinics. In terms of T1D patient population, as shown in Table 1, both serve a range of racial/ethnic backgrounds (38.8% URM patients at *West Clinic* and 49% at *South Clinic*) and are majority white clinics.

The clinics do vary by patient SES—*West Clinic* is more affluent than *South Clinic* (65.9% private insurance and 34.1% public or no insurance at *West Clinic* vs. 49% private insurance and 51% public or no insurance at *South Clinic*). However, the SES status of racial/ethnic subgroups does not vary significantly by clinic. For example, the proportion of African American patients with private insurance is 33.5% in *South Clinic* and 28.6% in *West Clinic* ($p = 0.71$), and for Hispanic patients, 46.2% in *South Clinic* and 39.4% in *West Clinic* ($p = 0.65$).

This overall compositional difference in SES may explain organizational differences in pump allocation if patients with private insurance receive pumps and patients with public or no insurance do not. However, this is not the case in either clinic. Table 2 shows the proportion of pump use by race, insurance type, and combined race and insurance type.

Investigating race and insurance status separately, *West Clinic* has no significant differences in pump use by race (chi-square p -value=0.67) or insurance status (chi-square p -value=0.12). In contrast, there are significant differences at *South Clinic* (chi-square p -value 0.001 for both). However, looking at both race and insurance, racial differences at *South Clinic* do not appear to be attributable to insurance status. For example, 25% of Black patients with *private* insurance use pumps, which is close to the 23.2% of white patients with

public insurance using pumps. In contrast *West Clinic* has more equitable pump use, with 77.5–100% use across all subgroups. Thus, SES composition alone cannot explain differences. Therefore, we look at how allocation processes and structures vary across organizations to shape allocation by race and class in strikingly different ways.

Prior to data collection, the Emory University and University of California San Francisco Institutional Review Boards approved the study protocol. All participants gave informed consent; no one refused participation. All information was kept confidential.

3.2. Observations and interviews

To describe how organizational context shapes technology allocation by race and class, we observed *West Clinic* and *South Clinic* for ~400 h from 2017 to 2018. In observations, which total ~800 pages of notes, we documented how clinic staff (administrative personnel, registered nurses, CDEs, nutritionists, social workers, psychologists, NPs, and physicians) use technology in routines and interactions with patients within and beyond the clinics, such as telehealth appointments. We noted the distribution of technology use and expertise across patients and clinic staff and instances of instruction in device use, such as pump classes. We also observed how clinics engage with device companies, insurers, and professional networks related to patient technology use.

We also interviewed 16 clinic staff, including providers in leadership roles, endocrinologists, NPs, registered nurses, CDEs (who are licensed in other areas, thus include some nurses), and other roles (e.g., nutritionist, psychologist, social worker, administrative staff). In both clinics endocrinologists and NPs are responsible for prescribing pumps, with CDEs and other staff providing input. For confidentiality, we leave out detailed interviewee demographics, but they included 4 men and 12 women; 5 White, 5 Asian, 4 Latino, and 2 African Americans. Table 3 shows clinic staff demographics.

During interviews, we asked staff about routines and interactions with patients, device companies, insurers, and professional networks to understand clinic practices. We also asked about device-patient matching, what they do to shape patient device use, and how organizational structure might shape this process. We gave particular attention to how providers defined “pump eligibility” (their term). Interviews lasted 30 min on average, were audio-recorded and transcribed verbatim.

3.3. Analysis

Using observation and interview data, we compared the clinics’ process and structure of decision-making to understand how context differences shape equity in allocation. We began with sensitizing theory about CHC, where we would expect lower SES patients with less CHC to have less resource provision. While this theory fit *South Clinic*, it did not match *West Clinic* where providers expected similar patient interaction but allocated in more equitable ways. Thus we adjusted our theory to better fit the data, comparing cases through iterative rounds of coding and memo writing using Atlas.ti (Deterding and Waters, 2018). We tested the applicability of theories to our data and modified our findings to better fit the data, which moved us towards an organization-focused analysis (Timmermans and Tavory, 2012).

4. Findings

4.1. Clinic constitution of cultural health capital

Overall, findings suggest equity in the allocation of devices depends on three intertwining organizational factors, influenced by organizational history. First, we find patient interaction style can shape allocation, if clinics constitute CHC by linking it to pump eligibility. Observations and interviews suggest both *West Clinic* and *South Clinic* providers expect patients and families to keep in contact between visits. However, this expectation is only tied to pump eligibility at *South Clinic*, which may explain larger differences in pump allocation by patient SES at this clinic.

In both clinics, and in standard practice, families first learn how to give insulin by injection. But they differ in how quickly they introduce pumps. At *South Clinic*, providers typically wait for families to “become familiar with management.” Exact timelines vary by provider and special considerations (e.g., the family has another child using a pump, “family stressors,” “adjustment to chronic illness”). Then, they use a worksheet to assess “eligibility.” A nurse explained this is not a test per se, but includes: 1) at minimum, blood glucose checking four times/day, which also aligns with some insurance documentation requirements, 2) ability to identify and count carbohydrates in meals, measured by at least three days of carbohydrate logs describing what they ate and the number of carbohydrates, 3) knowledge of what ketones are (acids produced by the liver when glucose is low and fat must be used for energy) and when to monitor them, and 4) no recent hospital admittance for diabetic ketoacidosis (DKA; a potentially life-threatening complication caused by excess ketones). Physicians also note they would hesitate to prescribe pumps to patients with HbA1C [average blood glucose over 2–3 months] > 14%.

Patient-reported and clinic-collected information is combined with whether the family is “in regular contact,” an interaction style similar to “vigilant advocacy” where parents generate a collaborative relationship with providers (Gage-Bouchard, 2017). One provider explained contact is stressed to all patients to “circumvent ER visits or hospitalization, provide an opportunity [for providers] to review [patient] blood sugars following a strict protocol, and make changes to the regimen [to help] bring patients closer to their [HbA1C] targets.” This contact requirement, communicated rather than included on the worksheet, seems to weigh heavily in pump eligibility determination. A provider said,

[After the initial wait], a family that comes back and says, “It’s been six months, it’s been a year, we do think that we can move forward with a pump,” what I have in my mind as you-are-pump-eligible is, one, 4–6 blood sugar checks per day. [Two], family keeps in regular contact with our clinic. And, you may ask why is that important? [Because] if they do get in trouble when they’re on the pump, I feel confident that they utilize the resources they have such as calling our after hours line or calling our CDEs during the day to figure out how to navigate through any issues. So, it’s that basic requirement that you’re checking, you’re giving insulin reliably, and you communicate with us between visits. I don’t use [HbA1C] as much of a marker and say, “If you have a [HbA1C] that’s 10% you absolutely can’t get a pump.”...

People who are not “pump eligible” are the opposite. They’re not checking [blood sugar consistently], they’re not taking their insulin regularly [i.e., missing multiple injections]...They don’t call in between visits.

This provider explained he emphasizes contact because calls allow patients to “adjust insulin regimen between visits” and “get blood sugars in target range instead of waiting [for visits] every three months.” *West Clinic* expressed the same desire for patient contact between visits. Yet, only in *South Clinic* does contact help determine pump allocation, thereby advantaging higher SES patients.

Providers at *South Clinic* also noted they respond to families who use vigilant advocacy to advocate for pumps. One provider at *South Clinic* explained more educated families seem to push more for resources, including pumps—even to the point where some teach providers about the technologies:

[Some] highly educated families are more into the pumps and technology because they’re investigating them more. Not to say other families are not [doing research], but maybe they’re waiting for me as a provider to bring that up. There’s a [highly-educated] mom who’s an engineer who quit [her job] to manage things. We work well together; she teaches me...[T]hat’s definitely [part of how resource allocation happens]...the families that push more and ask for [a pump] before we mention it.

While providers at *South Clinic* are consistent in their use of metrics, some believe there are inconsistencies in how providers talk about pumps with patients and how patients view pumps, based on race:

Interviewer: How [is determining eligibility] different or similar across providers?

Provider: [T]here is data that shows there is preferential [treatment]...talking [more] about pumps...[with] Caucasian families as compared to African American families...so I am mindful of that. I try to make sure I am being equal opportunity. Having an equal discussion about it, the opportunity to provide that.

Interviewer: Do you think that’s different among providers?

Provider: Probably...So, here’s something else that I should say that I’ve encountered with [a few] African American families—is the fear of technology.

Interviewer: The fear of it...

Provider: [T]hey are like, “I don’t trust the pump. It can malfunction. I don’t know about *that thing*.” And a part of it that I—I can’t say that this is based on any evidence, it’s just my opinion...the ones who are...hesitant are the ones...not as engaged with Facebook groups, the JDRF [Juvenile Diabetes Research Foundation], and they’re not ingrained in the diabetes community as the ones who are a little bit more like, “Give me the information, let me know what’s going on.”

So, I had this kid...a week ago. We convinced her [and her mom] to get a pump [but] dad said, “There’s no way in hell my child is using that.”...[P]art of it is dad doesn’t want the stigma to be associated with his child and the other thing is they don’t trust the technology.

Interview: Why do you think that is?

Provider: ...I get it as not being connected and not knowing that this is a possibility to explore. Just not understanding the technology. And, also—if you want to take the boxing gloves out—it goes back to the somewhat distrust within the African American community of the medical community that goes back to Tuskegee [and earlier]...I mean, why is my kid going to be a guinea pig? ...[T]here’s some element of *that*...that is not so subtly said. And, if they’re on a [regimen] that works keeping their [HbA1C] in decent control, like, if it’s not broke why are we going to muck it up?

This provider “silently agreed” pumps could malfunction but did not want fear to deter patients from using pumps. Other providers noted similar “fearfulness” among other families based on “not understanding the technology” and/or potential “negative social consequences” of a chronic illness marked by wearing a pump. Thus, families at *South Clinic* exhibiting vigilant advocacy (i.e., in frequent contact, “connected” to the diabetes community, and/or pushing for pumps) were more likely to be deemed “eligible” and adopt pumps. Providers admitted this was problematic given bias in discussing pumps (Hall et al., 2015) and these fears about new technologies based on potential malfunction, stigma, and/or the history of medical abuse and medical mistrust (Gamble, 1997; Sewell, 2015).

In contrast, at *West Clinic* there are few requirements for pump allocation. Providers explain they have “a bit of a test” where they ask patients to keep a detailed food log, count carbohydrates, and record insulin dosing for a week “to see if they can do it.” But there is no rigid metric nor is the concept of “eligibility” used. Instead, providers at *West Clinic* use these tasks to communicate the pump “is going to be work,” but patients do not have to demonstrate “a certain [proficiency] level.” One provider said, “I would like a protocol—if it’s based on evidence. Problem with technology is there isn’t evidence. If there’s evidence waiting six months [is best], sure, but there’s no evidence.”

Instead providers say they prescribe pumps to “anyone who walks through the door.” Rather than requiring patients prove “eligibility,” *West Clinic* recommends pumps to all patients. The clinic also advocates on behalf of patients to insurance companies. In fact, this was the most documented activity, including collecting various data (meter downloads, health records, etc.), making phone calls, and sending faxes. For example, in one interaction, two nurses and a medical assistant discussed evidence to convince public insurance to cover a pump:

Nurse 1: [W]e need documentation for lows [low blood glucose levels] below 55. I have data on [new data visualization application], but...from November and December. [M]ore recent ones are better [for convincing insurance because recent uploads are more complete].

Nurse 2: Because I helped him [upload data].

Nurse 1: The other option [to persuade insurance] is he was running high [in terms of blood glucose] because of the fear of lows. [A narrative they would craft, which a pump could help address].

Nurse 2: He's coming in—he's at camp right now. We can wait... Let him know we'll take care of this when we have more data [from his meter].

Medical Assistant: [Public insurance] wants 6 months.

Nurse 2: Has to be within last 6 months?

Medical Assistant: Yeah.

Nurse 1: Or, fear of lows, running high.

Nurse 2: Everybody has that. So, do you think it's worth resubmitting [data to insurance] with the [new data visualization application]?

Nurse 1: We can, but [Medical Assistant] suggested a letter with it.

Medical Assistant: Yeah, a little explanation.

Nurse 2: Okay, let's hold off for a little bit.

This was one of many conversations about convincing insurance to cover pumps. In fact, *West Clinic* assigned a staff member to work almost fulltime on pump “prior authorizations” and “certificates of medical necessity” to ensure coverage.

While *South Clinic* providers invested substantial time helping patients with insurance once deemed eligible, the clinic does not take on responsibility like *West Clinic*. For example, at *South Clinic* a “pump eligible” white male teen with private insurance expressed frustration during a visit that he had recorded his blood glucose levels, carb intake, and insulin dosing for a year, but insurance still refused to cover it. In contrast, *West Clinic* advocates for patients to meet physicians' orders, building this into the structure of clinic workflow. Overall, *West Clinic* strives—as one provider described—to “meet the patients where they are” without linking pump eligibility to CHC, which can explain why pump users are more representative of their patient population than *South Clinic* and shows how organizational over individual factors can shape pump use.

4.2. Organizational frames and technology use

Another difference between the clinics is how they frame pump use. *South Clinic* providers frame pumps as a medical liability whereas *West Clinic* providers frame pumps as another insulin delivery system. These frames shape clinical decision-making and pump allocation. For example, providers in *South Clinic* wait for a period of time post-diagnosis to introduce pumps because they see it as complex and risky:

Interviewer: How do decisions get made? And, how would a conversation be initiated [about] pumps?

Provider: Who would be pump eligible?

Interviewer: Yes, and who would be considered not pump eligible?

Provider: [U]sually I tell families after the initial diagnosis that I don't talk about pumps... for at minimum six months to a year after diagnosis. Really because there is a learning curve with [T1D] and managing insulin, drawing up insulin, understanding lows and highs... adding the complexity of pump therapy from the beginning would be too much... The reason why is pump therapy is a medical liability because we no longer have Lantus [long acting (basal) insulin]. [The liability] is *larger*. Not to say shots—[MDI]—aren't [a liability]. But you take away your basal insulin... [S]o, if you never check your blood sugars, you can [quickly] go into DKA. And, if you check your blood sugars once a week you may not know [you are hyperglycemic], a pre-warning ... something is going awry [with pump insulin delivery].

In contrast, providers at *West Clinic* say they offer pumps to all patients because it is another form of insulin delivery. One endocrinologist explained:

When it comes right down to it, it's just an alternate delivery system. The perception from [families] is...it's an improved quality of life. Meta-analyses show it's a small improvement [in management], so could you justify the small improvement over [DKA] risk?...[P]atients that could probably benefit most from pumps have the highest [HbA1C], but those are least likely to be placed on the pumps [in general, not at *West Clinic*]. But just wearing the device could help tremendously. There is a huge bias [in pump allocation in general]...For example, a Spanish-speaking family, you put them on the pump, and you see...more data than you ever saw before. There is definitely literature on children with [a history of] keto[acidosis] who...do better [on pumps]...What I think about is, alright great, just put them on the pump and see how well they do. Maybe they're sloppy, or don't test blood sugar. Those two simple parameters—test blood sugar and keep up with boluses—and they'll get within target range.

This physician views technology as neutral; it may help or not. She is open to prescribing pumps, regardless of HbA1C level or language barriers, and seeing “how well they do.” This aligns with the clinic's overall pro-technology framing—that technology can be helpful for patients and providers. Putting this framing into practice takes effort; clinicians, staff, families, and patients must invest time learning about pumps, supporting pump use, and compiling various forms of data into patient records as technologies change. In this way, organizational context is key to pump use.

4.3. Organizational structure

One last organizational factor shaping technology allocation is organizational structure, influenced by organizational history. On the one hand, *South Clinic* is older, established before the invention of insulin pumps. The clinic followed a common healthcare organization trajectory in the last 20 years, significantly increasing its patient population through an organizational merger and restructuring (Scott et al., 2000). To serve more patients, the clinic has increased CDEs' caseloads, creating an expanded hierarchical

structure where the “imprint” of established organizational practice (i.e., MDI) may be more resistant to change (Marquis and Tilcsik, 2013). On the other hand, *West Clinic* was established within the last 10 years through a private donation to create a small autonomous clinic akin to a tech startup in its approach to care, with a flat organizational structure and a focus on adapting to technological change, where new clinicians are trained to support the adoption of new technologies.

As a consequence of this history, in organizational structure *South Clinic* follows a more hierarchical “managed care” model where prescribing providers (physicians and NPs) have less contact with patients and non-prescribing providers and educators (i.e., CDEs) are in greater contact with patients (Emanuel and Neveloff Dubler, 1995). This structure can negatively influence patient-doctor relationships, dividing physician commitments between patient contact and organizational efficiency, which lowers patient trust and can increase health disparities by race and class (e.g., Boyer and Lutfey, 2009; Feldman et al., 1998). A *South Clinic* nurse described a typical visit:

[I]nitial contact would be our front desk people, who check them in...[then] the MA [medical assistant] will come and do vitals and grab the meters...[T]hey would download the meters and do a [HbA1C] and a blood sugar check [then] they're usually roomed... [T]he CDE comes in and gets information around their insulin regimen, prescription refills, and tries to address any deficits within their knowledge of diabetes—whether...carb counting or whatever the case may be... stacking insulin [taking additional doses without accounting for active insulin, which can cause low blood glucose], whatever...[A]fter the CDE, [the nurse] comes in and meets with the family and tries to address all non-diabetes issues [like] med [ication] reconciliation [updating medications list], documenting allergies, etcetera. The CDE...will probably spend 20–30 minutes with the family. The nurse typically spends maybe 5 minutes with the family. And then the provider goes in [who is] the nurse practitioner or MD.

When asked who has most contact with patients, including contact within and outside the clinic, physicians and other providers confirm CDEs have most contact and therefore most information about patients' lives outside of clinic.

With this structure, CDEs gain knowledge of patients' skills and “social dynamics or historical perspectives on the patient or family” pertinent to pump use such as “difficulty with mathematics” or “split parent custody...[where parents] don't do a good job of communicating with each other.” Therefore, many endocrinologists at *South Clinic* turn to CDEs to gather information for pump eligibility determination, though they ultimately prescribe pumps. One prescribing provider explained most “listen to CDEs because [they are] valuable members of the team [and]...often have longstanding relationships with families.”

Interviewer: ...how does that decision [of pump eligibility] get made amongst providers?

Physician ((overlapping)): [Most prescribing providers consult] CDEs.

Interviewer: CDEs?

Physician: CDEs. So, there are quite a few families [where] this is my first time seeing them and I'm like, "Has anyone talked to you about the pump? You guys seem really *great!* You know? Like, why hasn't anyone talked to you about the pump?" And they [respond], "I don't know, I have no idea. I would love the pump." [So I say], "Okay, well, let's explore it at the next visit."

After I'm done seeing them, I go to the CDEs and [ask], "What's the deal on that family? 'Cause I'm just meeting them for the first time and they seem great. Do you guys think they'll be pump eligible [i.e., if there are "red flags" in terms of skills or social dynamics]?" And there's probably one of two things—it'll either be [an emphatic] "no" or "sure." [B]ecause the CDEs, they sit in one room and they really know all patients. There's an intimate relationship with all patients, whereas as [physicians] we don't necessarily have that.

This physician went on to explain patient-CDE relationship building occurs through frequent contact—CDEs may speak with families several times between office visits and even several times per day, if patients practice vigilant advocacy. But he stressed all care decisions are "protocol driven, using protocols developed by physicians."

Unfortunately, the protocols for determining eligibility and the patient-clinic contact requirement advantages higher-SES families, promoting inequality (Gage-Bouchard, 2017; Hall et al., 2015). Thus, the organizational structure of the "managed care" model in this case promotes lower and unequal pump allocation by lowering physician/NP-patient contact, supporting the framing of technologies as risky (among both providers and patients), and encouraging the use of metrics that advantage vigilant families to determine eligibility. This aligns with other research on organizations showing bureaucratic structures and practices can legitimize inequities (Acker, 2006; Byron and Roscigno, 2019; Ray, 2019).

In contrast, *West Clinic* employs few CDEs and endocrinologists and NPs have greater contact with patients. Indeed, prescribing providers at *West Clinic* (MDs or NPs) commonly schedule 45-min appointments and appear to have more overall contact with patients, facilitated by the clinic's smaller size, less hierarchical structure, and greater autonomy. When asked how *West Clinic* compares to other clinics in their training or employment, physicians agree contact is greater than in managed care model clinics. Further, because of the clinic's founding philosophy and reputation, the clinic attracts providers (as well as patients) who are more open to the clinic's technology focus and providers structure extended contact (visits, calls, classes, events, camps) to discuss devices. Workflow is also specifically structured to secure insurance approvals, as noted above.

Thus, the structure of care and decision-making processes interact with organizational framing and definition of eligibility to shape allocation. In the context of *West Clinic's* overall pro-tech framing where eligibility extends to all patients, the use of professional opinion over metrics translates to greater and more equitable pump allocation. Yet, without a pro-tech framing, professional opinion can lead to lower and inequitable tech allocation, as evidenced by continuous glucose monitoring (CGM) use at *South Clinic* (14% in 2018).

CDEs said this was due to a lack of protocol like the one for pumps, without which allocation depended on “provider comfort with technology.” More recent changes in FDA regulations and insurance requirements shifted how the clinic frames CGMs; one provider said they now consider them “relatively minimal risk,” therefore CGM use increased. Thus, in an ongoing and changing dynamic, all three organizational factors work together to shape equity in technology allocation by race and class.

5. Discussion

In this article, we presented a qualitative comparative study of how two pediatric endocrinology clinics serving patients with T1D make clinical decisions resulting in differences in insulin pump allocation by race and class. While research and professional guidelines focus on patient characteristics to explain differences in resource allocation (Grunberger et al., 2014), findings suggest organizational context shapes allocation in important ways. Allocation by race and class is influenced by three intertwining factors, formed through organizational history: clinics’ constitution of CHC to determine eligibility, how clinics frame medical technologies, and how clinics structure care and decision-making processes.

These findings demonstrate how organizations can fundamentally shape health disparities. For example, *South Clinic* constituted CHC by rewarding vigilant advocacy, allocating pumps to higher SES families whose interaction style matched providers. But *West Clinic* did not determine allocation by patient interaction style—in absence of organizational constitution, there was no CHC at *West Clinic*. In line with Bourdieu’s concept of “cultural capital,” CHC is constituted within fields of action (Bourdieu, 1977). In a setting where social hierarchies are disregarded and resources equally distributed as standard policy, this form of distinction is irrelevant. Overall these findings suggest organizational context is critical to understanding health inequalities by race and class, particularly with new healthcare technologies.

The study also points to a central tension in the medical profession about patient technology use, evidence-based medicine, and how to define the “standard of care” in a context of change (Timmermans and Berg, 2003a). Given the evidentiary base lags behind technological change, providers at *West Clinic* and *South Clinic* agree injections or pumps are equally acceptable. Yet they approach technology in different ways. Providers at *West Clinic* believe pumps will be the standard of care, so they move towards universal use. A clinic founder said, “I don’t need to see clear evidence, proven or published to say we’re going to [adopt new technologies]. When something makes sense, I don’t need to be shown.” Given organizational autonomy, this founder explained they “do not have to say ‘this is making money, this is efficient’ [or] ask anybody’s permission. [We] just say ‘this is how we do it.’” Providers at *South Clinic* move in the opposite direction—without strong evidence, patients do not need to use technology. A physician explained, “I stress to families you do not have to have a pump to have excellent control. [Technology] is only as good as the user. If you never establish the practice of checking blood sugars several times per day, starting a pump won’t make [good management] magically occur.” Thus, given ongoing

technological change and debates about pump use (Pickup, 2019), local organizational contexts resolve ambiguity in clinical decision-making.

Our study also ties to the institutional history of healthcare organizations and changing institutional logics driving the US healthcare system over time, from professional dominance through federal responsibility to managerial-market orientation where “practitioners and patients alike are confused...[and] consensus about institutional logics has been reduced” (Fingerman et al., 2012). When this happens to an institutional field, there are “disagreements and disputations over the priorities and goals of the sector and lack of agreement on the appropriate means to be employed in reaching them”(359). While this may be true for the overall healthcare system, this study suggests organizational processes and structures can shape resource allocation—in more equitable ways, if an organizational imperative.

Some data limitations should be taken into account. First, only one type of healthcare organization was included in the study. While specialty clinics are influential in allocation, primary care physicians and school healthcare providers can play a role, suggesting lines of future study in other contexts. Second, since study data are qualitative, we cannot measure the extent to which organizational context versus composition affects unequal allocation. While research using multilevel models shows both types of organization-level effects influence resource allocation (Duncan et al., 1998), T1D datasets with organizational measures to make such an analysis possible are limited. Thus, future studies should gather such data to understand how composition versus context shapes health inequality. However, findings reveal important aspects of organizational context influencing allocation that can be addressed by policy—perhaps more so than organizational composition.

Overall, this study extends research on health inequality by describing how differences in organizational context shape medical technology allocation by race and class. These findings are increasingly important, given ongoing changes in regulation. In 2018, the FDA announced a *Digital Health Innovation Action Plan* to bring medical technologies to market at a faster pace. As a first step, they shifted regulation of medical software to the companies designing them through a “pre-certification” process, followed by post-market monitoring. A press release said,

“We know...consumers and health care providers are increasingly embracing digital health technologies to inform everyday decisions. Given the benefits from empowering consumers, we believe the FDA must encourage the development of tools that can help people be more informed about their health...Our approach to regulating these novel, swiftly evolving products must foster innovation and maintain our gold standard for safety and effectiveness” (U.S Food and Drug Administration, 2018).

This shift suggests providers and organizations will have less evidence for decision-making and may rely more heavily on local organizational culture to determine allocation. Existing inequities in medical device allocation by race and class may be exacerbated without an organizational focus on equity. Thus, understanding allocation mechanisms and the role of organizations in determining patient access to direct-use gatekeeper technologies makes a

critical contribution to research, practice, and policy—particularly as technologies and regulations change.

In terms of practice and policy implications, findings suggest clinics can address inequities in allocation. First, clinics could measure resource distribution by race and class—and investigate ways to address inequitable allocation. For example, clinics could examine if eligibility measures are responsive to family background, if physicians discuss pumps with all patients, and how to address barriers patients face after prescription. Second, clinics could develop explicit goals for equity in resource allocation. Steps might include piloting devices with patients not traditionally eligible, introducing “nudges” to encourage patient-clinic contact with suggested questions for providers rather than relying on family CHC (Patel et al., 2018), and introducing organizational resources like advocates to secure insurance coverage. Finally, our findings suggest healthcare policy and regulation should target organization-level equity in resource provision. This includes emphasizing equity in the institutional framing of resource allocation and monitoring organizational equity by race and class (Braveman, 2003; Kilbourne et al., 2006).

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References

- Acker Joan, 2006. Inequality regimes: gender, class, and race in organizations. *Gend. Soc* 20 (4), 441–464.
- American Diabetes Association, 2020. Diabetes technology: standards of medical care in diabetes—2020. *Diabetes Care* 43 (Suppl. 1), S77–S88. [PubMed: 31862750]
- Blackman Scott M., Raghinaru Dan, Saleh Adi, Simmons Jill H., Ebner-Lyon Laurie, Peter Chase H, Tamborlane William V., Schatz Desmond A., Block Jennifer M., Litton Jean C., Raman Vandana, Foster Nicole C., Kollman Craig R., DuBose Stephanie N., Miller Kellee M., Beck Roy W., DiMeglio Linda A., 2014. Insulin pump use in young children in the T1D exchange clinic registry is associated with lower hemoglobin A1c levels than injection therapy. *Pediatr. Diabetes* 15 (8), 564–572. [PubMed: 24494980]
- Bourdieu Pierre, 1977. *Outline of a Theory of Practice*. Cambridge University Press, Cambridge.
- Boyer Carol A., Lutfey Karen E., 2009. Examining critical health policy issues within and beyond the clinical encounter: patient–provider relationships and help-seeking behaviors. *J. Health Soc. Behav* 51 (S), S80–S93.
- Bradley Elizabeth H., Herrin Jeph, Wang Yongfei, McNamara Robert L., Webster Tashonna R., Magid David J., Blaney Martha, Peterson Eric D., Canto John G., Pollack Charles V., Krumholz Harlan M., 2004. Racial and ethnic differences in time to acute reperfusion therapy for patients hospitalized with myocardial infarction. *J. Am. Med. Assoc* 292 (13), 1563–1572.
- Braveman Paula A., 2003. Monitoring equity in health and healthcare: a conceptual framework. *J. Health Popul. Nutr* 23 (3), 181–192.
- Byron Reginald A., Roscigno Vincent J., 2019. Bureaucracy, discrimination and the racialized character of organizational life. *Res. Sociol. Org* 60, 151–169.

- Case Anne, 2005. The primacy of education. In: Banerjee Abhijit, Benabou Roland, Mookherjee Dilip (Eds.), *Understanding Poverty*. Oxford University Press, Oxford, pp. 269–284.
- Chiarello Elizabeth, 2013. How organizational context affects bioethical decision-making: pharmacists' management of gatekeeping processes in retail and hospital settings. *Soc. Sci. Med* 98, 319–329. [PubMed: 23337832]
- Cutler David M., Lleras-Muney Adriana, Vogl Tom, 2011. Socio-economic status and health: dimensions and mechanisms. In: Glied Sherry, Smith Peter C. (Eds.), *The Oxford Handbook of Health Economics*. Oxford University Press, Cambridge.
- Deaton Angus, 2002. Policy implications of the gradient of health and wealth. *Health Aff.* 21 (2), 339–349.
- Deterding Nicole M., Waters Mary C., 2018. Flexible coding of in-depth interviews: a twenty-first-century approach. *Socio. Methods Res* 10.1177/0049124118799377.
- Duncan Craig, Jones Kelvyn, Moon Graham, 1998. Context, composition, and heterogeneity: using multilevel models in health research. *Soc. Sci. Med* 46 (1), 97–117. [PubMed: 9464672]
- Edmondson AC, Bohmer RM, Pisano GP, 2001. Disrupted routines: team learning and new technology implementation in hospitals. *Adm. Sci. Q* 46 (4), 685–716. 10.2307/3094828. In press.
- Emanuel Ezekiel J., Neveloff Dubler Nancy, 1995. Preserving the physician-patient relationship in the era of managed care. *J. Am. Med. Assoc* 273 (4), 323–329.
- Faulkner Alex, 2009. *Medical Technology into Healthcare and Society: A Sociology of Devices, Innovation and Governance*. Palgrave Macmillan, Houndsmills Basingstoke, England.
- Feldman Debra S., Novack Dennis H., Gracely Edward, 1998. Effects of managed care on physician-patient relationships, quality of care, and the ethical practice of medicine. *Arch. Intern. Med* 158 (15), 1626–1632. [PubMed: 9701096]
- Ferris Timothy G., Kuhlthau Karen, Ausiello John, Perrin James M., Kahn Robert, 2006. Are minority children the last to benefit from a new technology?: technology diffusion and inhaled corticosteroids for asthma. *Med. Care* 44 (1), 81–86. [PubMed: 16365616]
- Fingerman Karen L., Cheng Yen-Pi, Wesselmann Eric D., Zarit Steven, Frank Furstenberg, Birditt Kira S., 2012. Helicopter parents and landing pad kids: intense parental support of grown children. *J. Marriage Fam* 74 (4), 880–896. [PubMed: 26336323]
- Foster Nicole C., Beck Roy W., Kellee M. Miller, Mark A. Clements, Michael R. Rickels, Linda A. DiMeglio, Maahs David M., William V. Tamborlane, Richard Bergenstal, Smith Elizabeth, Olson Beth A., Garg Satish K., for the T1D Exchange Clinic Network, 2019. State of type 1 diabetes management and outcomes from the T1D exchange in 2016–2018. *Diabetes Technol. Therapeut* 21 (2), 66–72.
- Franklin Victoria, 2016. Influences on technology use and efficacy in type 1 diabetes. *J. Diabetes Sci. Technol* 10 (3), 647–655. [PubMed: 27022096]
- Friedland Roger, Alford Robert R., 1991. Bringing society back in: symbols, practices, and institutional contradictions. In: Powell Walter, DiMaggio Paul J. (Eds.), *The New Institutionalism in Organizational Analysis*. University of Chicago Press, Chicago.
- Gage-Bouchard Elizabeth A., 2017. Culture, styles of institutional interactions, and inequalities in healthcare experiences. *J. Health Soc. Behav* 58 (2), 147–165. [PubMed: 28661778]
- Gamble Vanessa Northington, 1997. Under the shadow of tuskegee: African Americans and health care. *Ame. J. Public Health* 87 (11), 1773–1778.
- Gamoran Adam, An Brian P., 2016. Effects of school segregation and school resources in a changing policy context. *Educ. Eval. Pol. Anal* 38 (1), 43–64.
- Gengler Amanda M., 2014. I want you to save my kid: illness management strategies, access, and inequality at an elite university research hospital. *J. Health Soc. Behav* 55 (3), 342–359. [PubMed: 25138201]
- Glied S, Lleras-Muney A, 2008. Technological innovation and inequality in health. *Demography* 45 (3), 741–761. [PubMed: 18939670]
- Grunberger George, Abelseh Jill, Bailey Timothy, Bode Bruce W., Handelsman Yehuda, Hellman Richard, Jovanovi Lois, Lane Wendy, Raskin Philip, Tamborlane William, Rothermel Caitlin, 2014. Consensus statement by the American association of clinical endocrinologists/American

college of endocrinology insulin pump management task force. *Endocr. Pract* 20 (5), 463–489. [PubMed: 24816754]

- Hall William J., Chapman Mimi V., Lee Kent M., Merino Yesenia M., Thomas Tainayah W., Payne Keith, Eng Eugenia, Day Steven H., Coyne-Beasley Tamera, 2015. Implicit racial/ethnic bias among health care professionals and its influence on health care outcomes: A systematic review. *Ame. J. Public Health* 105 (12) e60–e76.
- Heimer Carol, 1999. Competing institutions: law, medicine, and family in neonatal intensive care. *Law Soc. Rev* 33 (1), 17–66.
- Horlick-Jones T, 2007. On the signature of new technologies: materiality, sociality and practical reasoning. In: Bellaby P (Ed.), *Risk and the Public Acceptability of New Technologies*. In Flynn R. Basingstoke Palgrave Macmillan.
- Johnson Jim, 1988. Mixing humans and non-humans together: the sociology of a door-closer. *Soc. Probl* 35 (3), 298–310.
- Kaplan Sarah, 2008. Framing contests: strategy making under uncertainty. *Organ. Sci* 5, 729–752.
- Kilbourne Amy M., Galen Switzer, Kelly Hyman, Crowley-Matoka Megan, Fine Michael J., 2006. Advancing health disparities research within the health care system: a conceptual framework. *Ame. J. Public Health* 96 (12), 2113–2121.
- Link BG, Northridge ME, Phelan JC, Ganz ML, 1998. Social epidemiology and the fundamental cause concept: on the structuring of effective cancer screens by socioeconomic status. *Milbank Q* 76, 375–402. [PubMed: 9738168]
- Lleras-Muney A, Lichtenberg FR, 2002. The Effect of Education on Medical Technology Adoption: Are the More Educated More Likely to Use New Drugs? Working Paper No. 9185. National Bureau of Economic Research (NBER), Cambridge, MA.
- Lucas FL, Stukel Therese A., Morris Arden M., Siewers Andrea E., Birkmeyer John D., 2006. Race and surgical mortality in the United States. *Ann. Surg* 243 (2), 281–286. [PubMed: 16432363]
- Lutfey Karen, Freese Jeremy, 2005. Toward some fundamentals of fundamental causality: socioeconomic status and health in the routine clinic visit for diabetes. *Am. J. Sociol* 110, 1326–1372.
- Lutfey Karen, Campbell Stephen M., Renfrew Megan R., Marceau Lisa D., Roland Martin, McKinlay John B., 2008. How are patient characteristics relevant for physicians' clinical decision making in diabetes? An analysis of qualitative results from a cross-national factorial experiment. *Soc. Sci. Med* 67, 1391–1399. [PubMed: 18703267]
- Marquis Christopher, Tilcsik Andras, 2013. Imprinting: toward a multilevel theory. *Acad. Manag. Ann* 7 (1), 193–243.
- Mason Helen, van Exel Job, Baker Rachel, Brouwer Werner, Donaldson Cam, team, EuroVaQ., 2016. From representing views to representativeness of views: illustrating a new (Q2S) approach in the context of health care priority setting in nine European countries. *Soc. Sci. Med* 166, 205–213. [PubMed: 27575932]
- Mayer-Davis Elizabeth J., Lawrence Jean M., Dana M. Dabelea, Divers Jasmin, Scott Isom, Dolan Lawrence M., Imperatore Giuseppina, Linder Barbara, Marcovina Santica, Pettitt David J., Pihoker Catherine, Saydah Sharon, Wagenknecht Lynne, 2017. Incidence trends of type 1 and type 2 diabetes among youths, 2002–2012. *N. Engl. J. Med* 376, 1419–1429. [PubMed: 28402773]
- Mechanic D, 2000. Rediscovering the social determinants of health. *Health Aff.* 19, 269–276.
- Menchik Daniel A., Jin Lei, 2014. When do doctors follow patients' orders? Organizational mechanisms of physician influence. *Soc. Sci. Res* 48, 171–184. [PubMed: 25131283]
- Miller Kellee M., Foster Nicole C., Beck Roy W., Bergenstal Richard M., DuBose Stephanie N., DiMeglio Linda A., Maahs David M., Tamborlane William V., 2015. Current state of type 1 diabetes treatment in the U.S.: updated data from the T1D exchange clinical registry. *Diabetes Care* 38 (6), 971–978. [PubMed: 25998289]
- Nutbeam Don, 2008. The evolving concept of health literacy. *Soc. Sci. Med* 67 (12), 2072–2078. [PubMed: 18952344]
- O'Connor M. Rebecca, Carlin Kristen, Coker Tumaini, Zierler Brenda, Pihoker Catherine, 2019. Disparities in insulin pump therapy persist in youth with type 1 diabetes despite rising overall pump use rates. *J. Pediatr. Nurs* 44, 16–21. [PubMed: 30581163]

- Ozawa Sachiko, Sripad Pooja, 2013. How do you measure trust in the health system? A systematic review of the literature. *Soc. Sci. Med* 91, 10–14. [PubMed: 23849233]
- Patel Mitesh S., Volpp Kevin G., Asch David A., 2018. Nudge units to improve the delivery of health care. *N. Engl. J. Med* 378 (3), 214–216. [PubMed: 29342387]
- Phelan Jo C., Link Bruce G., 2015. Is racism a fundamental cause of inequalities in health? *Am. Socio. Rev* 41, 311–330.
- Pickup John C., 2019. Is insulin pump therapy effective in type 1 diabetes? *Diabet. Med* 36 (3), 269–278. [PubMed: 30098219]
- Ray Victor, 2019. A theory of racialized organizations. *Am. Socio. Rev* 84 (1), 26–53.
- Robert SA, House JS, 1994. Socioeconomic status and health across the life course. In: Abeles RP, Gift HC, Ory MG (Eds.), *Aging and Quality of Life*. Springer, New York, pp. 253–274.
- Santilli John, Randy Vogenberg F, 2015. Key strategic trends that impact healthcare decision-making and stakeholder roles in the new marketplace. *Am. Health Drug Benefits* 8 (1), 15–20. [PubMed: 25945154]
- Scott W. Richard, 2014. *Institutions and Organizations: Ideas, Interests, and Identities*, fourth ed. Sage Publications, Thousand Oaks, CA.
- Scott W. Richard, Ruef Martin, Mendel Peter J., Caronna Carol A., 2000. *Institutional Change and Healthcare Organizations: from Professional Dominance to Managed Care*. The University of Chicago Press, Chicago, IL.
- Sewell Abigail A., 2015. Disaggregating ethnoracial disparities in physician trust. *Soc. Sci. Res* 54, 1–20. [PubMed: 26463531]
- Sherr Jennifer L., Hermann Julia M., Campbell Fiona, Foster Nicole C., Hofer Sabine E., Allgrove Jeremy, Maahs David M., Kapellen Thomas M., Holman Naomi, Tamborlane William V., Holl Reinhard W., Beck Roy W., Warner Justin T., 2016. Use of insulin pump therapy in children and adolescents with type 1 diabetes and its impact on metabolic control: comparison of results from three large, transatlantic paediatric registries. *Diabetologia* 59 (1), 87–91. [PubMed: 26546085]
- Shim Janet K., 2010. Cultural health capital: a theoretical approach to understanding health care interactions and the dynamics of unequal treatment. *J. Health Soc. Behav* 51 (1), 1–15. [PubMed: 20420291]
- Shim Janet K., 2014. *Heart Sick: the Politics of Risk, Inequality, and Heart Disease*. NYU Press, New York.
- Siembida Elizabeth J., Moss Kerry, Kadan-Lottick Nina, Bellizzi Keith M., 2018. The patient–provider relationship in adolescent oncology: an exploratory factor Analysis of a thirteen-item self-report measure. *J. Adolesc. Health* 63 (4), 509–512. [PubMed: 30131286]
- Tavory Iddo, Timmermans Stefan, 2014. *Abductive Analysis: Theorizing Qualitative Research*. University of Chicago Press, Chicago, IL.
- Timmermans Stefan, Berg Marc, 2003a. *The Gold Standard: the Challenge of Evidence-Based Medicine*. Temple University Press, Philadelphia, PA.
- Timmermans Stefan, Berg Marc, 2003b. The practice of medical technology. *Sociol. Health Illness* 6, 175–200.
- Timmermans Stefan, Tavory Iddo, 2012. Theory construction in qualitative research: from grounded theory to abductive analysis. *Socio. Theor* 30, 167–186.
- U.S Food and Drug Administration, 2018. *FDA in Brief: FDA Brings Additional Efficiency and Modernization to Regulation of Digital Health as Part of the Digital Health Innovation Action Plan*. (Washington, D.C).
- Weiss Daniel, Rydland Håvard T., Øversveen Emil, Jensen Magnus Rom, Solhaug Solvor, Krokstad Steinar, 2018. Innovative technologies and social inequalities in health: a scoping review of the literature. *PloS One* 13 (4), e0195447. [PubMed: 29614114]
- Williams DR, 1990. Socioeconomic differentials in health: a review and redirection. *Soc. Psychol. Q* 53, 81–99.
- Williams David R., Collins Chiquita, 1995. US socioeconomic and racial differences in health: patterns and explanations. *Am. Socio. Rev* 21, 349–386.

Wong Jenise, Dolan Lawrence M., Yang Tony T., Hood Korey K., 2015. Insulin pump use and glycemic control in adolescents with type 1 diabetes: predictors of change in method of insulin delivery across two years. *Pediatr. Diabetes* 16 (8), 592–599. [PubMed: 25387433]

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Table 1

Demographics of T1D cohorts at each clinic.

	West (n = 384) ^a	South (n = 404)	p
Mean age (years)	12.4	12.3	0.71 ^b
Gender (% male)	47%	49%	0.65
Insurance status (% private)	65.9%	51.0%	< 0.001 ^c
Insulin pump use (%)	86.5%	30.2%	< 0.001 ^c
Race/ethnicity (%)			< 0.001 ^c
White, non-Hispanic	61.2%	51.0%	
Black/African American	3.9%	44.5%	
Hispanic/Latino	18.4%	3.2%	
Asian/Pacific Islander	5.6%	0.7%	
Other/mixed ethnicity	10.9%	0.5%	
Missing/declined	7.3%	0.5%	

^a Clinic provided data. *South Clinic* collected surveys during clinic visits; consent was in English decreasing Hispanic/Latino respondents, but there were no other exclusions. *West Clinic* collected data through an electronic medical record search for patients with T1D with two visits in year prior to study. Both clinics have additional URM patients with type 2 diabetes.

^b t-test used to compare mean age.

^c Pearson's chi-square used to compare clinics by gender, insurance status, insulin pump use, and race/ethnicity.

Table 2

Proportion of pump use by race and insurance type.

	West			South		
	Private	Public/None	All insurance	Private	Public/None	All insurance
All races/ethnicities	88.4% ^a	82.4%	86.3% ^b	46.6% ^c	13.3%	30.3% ^b
White, non-Hispanic	88.0%	83.0%	86.8% ^d	57.4%	23.2%	45.9% ^e
Black/African American	100.0%	80.0%	85.7%	25.0%	7.6%	13.4%
Hispanic/Latino	88.5%	77.5%	81.8%	16.7%	14.3%	15.4%
Asian/Pacific Islander	86.7%	80.0%	85.0%	100.0%	0.0%	66.7%
Other/mixed ethnicity	90.9%	94.1%	92.3%	0.0%	0.0%	0.0%

^aNo statistically significant differences in pump users by insurance type, chi-square p -value=0.12.^bPercentages of pump users differs slightly from Table 1 because analyses exclude individuals with missing race/ethnicity.^cStatistically significant differences in pump users by insurance type, chi-square p -value < 0.001.^dNo statistically significant differences in pump users by race/ethnicity, chi-square p -value = 0.67.^eStatistically significant differences in pump users by insurance type in South Clinic, chi-square p -value < 0.001.

Table 3

Clinic staff demographics.

	West Clinic	South Clinic
Administrative staff & medical assistants	5: All women 2 Latina 2 Asian 1 African American	10: 9 women, 1 man 9 African American 1 Latina
Nurses/CDEs/Social workers/Psychologists/Nutritionists	9: All women 6 White 2 Latina 1 Asian	20: All women 8 White 7 African American 3 Asian 2 Latina
Endocrinologists	14: 9 women, 5 men 8 White 6 Asian	17: 14 women, 3 men 8 White 4 African American 4 Asian 1 Latina

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