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"Risk Media in Medicine: The Rise of the Metaclinical Health App Ecosystem"

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Introduction

The convergence of digital information and communication technologies (ICTs) and medicine is creating a new field of risk media. Digital health apps linking patients' behavioral and environmental data with providers' assessment and triage tools are establishing digitally intermediated contexts for care. In these assemblages, we are seeing the emergence of personalized medicine delivered through ICTs as a form of stratified, data-driven healthcare. By feeding quantified data about users into apps whose algorithms manage access to resources, participants in this ecosystem cultivate new concepts of health, disease, privacy, surveillance, and care. Under these circumstances, almost any behavior or exposure that can be sensed and digitally quantified becomes reframed as a health behavior available for datafication, intervention, and optimization. These new conditions raise questions about how risk media technologies recalibrate our understanding of "the human" in medicine by converting experiences into quantified outcomes.

This chapter describes recent developments that are creating new forms of screen-based media interfaces to visualize ideas about managing the health risks of populations and the financial risks of corporate stakeholders that provide services to those populations. The first section of the chapter defines clinical and metaclinical spaces and describes the different

regulatory frameworks that govern risk media, particularly digital health apps, developed for use in these spaces. The second section describes the digital infrastructures that have enabled social, affective selves to become quantified as numerical representations of health and disease. Part three explains how technologies of quantification and metaclinical risk media are contributing to a shift in medicine from individual, reactive care to population-based, preventive care. Section four provides a case study of an exemplary digital health risk media program called Omada Health. As a metaclinical tool for managing users' risk of developing type two diabetes and heart disease, this platform demonstrates how data-driven concepts of risk address corporate stakeholders through the rhetoric of return on investment (ROI) while they engage patients through the language of science-based self-care. The conclusion describes how new forms of clinical and metaclinical risk media, such as EHRs and health surveillance apps, are redefining "the human" in quantitative terms that elide fundamental aspects of the experience of health and illness.

1. Defining clinical and metaclinical spaces and risk media

Under current conditions in medicine, risk media include many varied forms of computer interfaces that are present both within and beyond clinical spaces, operating in formerly distinct domains whose boundaries are now blurring, even as technologies, user behaviors, and regulatory policies seek to define more concretely the borders of these fields (Fiore-Gartland and Neff). I define "clinical" spaces as sites such as hospitals or physician offices where formal doctor-patient interaction is regulated by health law such as the Health Information Portability and Accountability Act of 1996 (HIPAA) and the U.S. Food and Drug Administration (FDA) premarket review process regulating the use of medical devices, including some digital health

technologies (Ostherr et al.). Apps that claim to diagnose or treat a disease or condition, which historically have been intended for use and integration into clinical spaces, are defined and regulated by the FDA as medical devices, and are therefore subject to complex, time-consuming, and expensive FDA review and approval processes (Cortez et al.; Elenko et al., "A Regulatory Framework"). Importantly for the purposes of this paper, the extent of FDA review is determined by the perceived level of risk posed to the patient by the medical device. As Elenko et al. have observed, "the key question is, what is the risk to the patient if this software fails?" (698). In this framing, the classification and regulation of health and medical apps is fundamentally defined in terms of risk media.

In contrast to highly regulated medical apps and spaces, I define "metaclinical" spaces as those sites constituting the vast ecosystem outside of traditional clinical settings where consumer-patients engage in behaviors that may be directly or indirectly related to self-management of health and disease, whose digital traces can be captured and incorporated into data-driven frameworks for health surveillance and intervention. Like "metadata" that provide context for other data, as in the metadata showing when and by whom a Wikipedia entry was updated (Riley), "metaclinical" data provide rich context for clinical data. Apps that are designed for use in metaclinical spaces may be promoted as "health and wellness" tools, but as long as they refrain from making medical claims in their marketing materials, they remain exempt from FDA review. Moreover, as long as these apps do not contain protected health information (PHI), they are not required to be HIPAA compliant (Office for Civil Rights). Many apps that capture and sell data to third-party companies for use in health profiling and marketing have no overt health function, capturing instead social interactions, consumption habits, geolocation, and other dimensions of daily life that are integrated into health risk media for the purpose of user

stratification (Zang et al.). Therefore, despite the very real, material consequences of social and behavioral determinants of health on patient morbidity, mortality, and quality of life, software that captures metaclinical data related to those domains is deemed inconsequential and therefore remains largely exempt from regulation, due to the narrow definition of biomedical risk to patients that governs app review.

Twenty-first century clinical and metaclinical spaces are filled with a wide range of screen-based risk media interfaces involved in the practices of "health datafication." This term refers to the process of "rendering into data aspects of the world not previously quantified" (Kennedy et al. 1) as well as transforming existing data into actionable forms that generate diverse and unevenly distributed forms of value for their producers and consumers (van Dijck). While all risk media are engaged in practices of health datafication, the threats that these media seek to contain are differentiated by responsible agent and target population. Risk media that extend into and permeate clinical spaces include medical simulations that facilitate the containment of risk in the cultivation of technical expertise in surgery, anesthesiology, and other fields of medicine. They include decision support systems, as well as artificial intelligence programs that mobilize algorithms to mitigate the risk of human error under the intensely affective circumstances of emergency medical care. They include the mundane electronic health record (EHR) screens that mediate almost every doctor-patient interaction in United States clinical settings. They also include the screens that proliferate in operating rooms, displaying everything from laparoscopic views of internal organs to three-dimensional brain scans in neurosurgery. These risk media work to contain the virtual threat of human error in medicine. That is, they work to contain threats posed to patients by doctors, nurses, clinical spaces, and the

practice of medicine itself. Clinical risk media work to contain iatrogenic threats to patients even as they function as vectors for the representation and transmission of those threats.

The metaclinical trajectory in medical risk media today extends beyond traditionally defined and regulated clinical spaces to include private homes, public recreation facilities, workplaces, schools, shopping areas, and the cloud hovering above and gathering up the data from all of these "real" spaces through the virtual network of the mobile web. In these metaclinical spaces, virtual risk media include smartphones, wearable technologies, mobile apps, global positioning systems (GPS), social media platforms, and environmental sensors. These risk media work to contain threats posed by environmental exposures—including self-induced exposures—related to the consumer-patient's behavior. The mediated threats that metaclinical risk media contain include physical activities; food, drug, and tobacco consumption; environmental contaminants; financial exchanges; social communications; and any other form of behavior that might be measurable and therefore quantifiable as a potential risk factor for negative health outcomes. Metaclinical risk media work to contain threats posed to clinical stakeholders (including providers and payers) by the personal behaviors of consumer-patients in the wild.

2. Digital infrastructures of quantified selves

The technological conditions of possibility for the emergence of digital health risk media have assembled over the past two decades and include the rise of the social web, the expansion of mobile internet connectivity, the rapid growth of smartphone use in the United States, and discoveries in nanotechnology and cognate fields of electrical engineering that have led to the availability of smaller, faster, cheaper, and more powerful mobile and environmental sensors.

Changes in health policy (discussed below) created market conditions for major venture capital investment in the development of risk media technologies for health. Finally, along with the technological affordances required for the rise of the health app economy, the social conditions for privileging quantification and data-driven habits of thought as norms are critical, emergent elements of the ecosystem.

Most of the technologies at play in the development of health risk media apps were not originally designed for healthcare applications. Instead, the mobile sensors and networks that provide the infrastructure for this field of health surveillance were developed as part of the broader set of strategic ICTs that transformed the internet into the mobile, social web (Rainie and Wellman). The opportunity that the health industry, startups and investors have recognized is that adapting these devices for use outside of clinical settings allows for deeper and wider data collection on the contextual risk factors for disease. Instead of capturing clinical data only when present in a doctor's office or hospital, patients can capture data through smartphones, accelerometers, and other devices twenty-four hours a day, seven days a week, thereby providing a richer picture of the variables at play in maintaining health. Under these circumstances, mobile devices can accrue large amounts of longitudinal health data, using methods not typically possible in a traditional clinic, study section, or analog self-tracking journal (Sarasohn-Kahn; Neff and Nafus; Neff).

These new conditions for capturing data create new concerns around how such data can and should be captured, interpreted, and shared (Wilbanks and Topol). The regulatory distinctions between clinical and metaclinical data play a significant role in determining data use practices. For instance, metaclinical health data from commercial devices are not easily integrated into clinical settings (Chung and Basch; Luxton et al.). Patients cannot simply bring

their FitBit data to their physician's office, or upload it to their EHR, and expect to receive recommendations based on their personal health data (Lobelo et al.). While a provider can recommend that a patient use a metaclinical health tracking device to monitor activity levels or other low-risk wellness indicators, integrating data from a device throughout the entire hospital would require HIPPA compliance and FDA approval—a lengthy and costly process. Moreover, without clinical support integration and human interpretive capability, mHealth interventions show little benefit for patients (Martin et al.). While some digital health technologies (such as the Apple watch's HealthKit) are working toward integration of metaclinical data into EHRs, the industry as a whole is far from reaching this goal (Gay and Leijdekkers). Meanwhile, metaclinical health-related devices that are not bound by HIPAA can do whatever they wish with a user's data, including selling the user's health data to third parties (Grundy et al.) once users agree to the app's terms of use.

3. Clinical risk media: from personal to population health

The rise of medical risk media has resulted in part from changes in health policy that have redefined the boundaries between medicine and public health. Historically, the practice of medicine has focused on reactive care of individual patients, once illness or injury has struck. Promoting the health of populations through preventive care has traditionally been the domain of public health. While medicine might diagnose and treat a patient for cancer by providing surgery, radiation treatment, and chemotherapy, public health conducts mass screenings, vaccination campaigns, and awareness programs to reduce the overall incidence and prevalence of cancer in the population as a whole. In general terms, public health focuses on causes, and medicine focuses on effects. Public health works to mitigate large scale risks, often deploying media to

increase public knowledge, change attitudes, and drive policy about existing health threats, such as smoking, sun exposure, or more recently, physical inactivity. In contrast, the practice of medicine is primarily predicated on individual exposure to risk, and provides highly specific interventions aimed at eradication of the current "complaint," without necessarily addressing the underlying or environmental cause of the problem. In terms of research, practice, funding, and prestige, medicine and public health have existed in siloes, rarely interacting despite their obviously overlapping areas of concern.

Health policy in the United States has exacerbated the artificial separation of medicine and public health through a structure of reimbursement for medical care that rewards procedures performed, rather than the outcomes of those procedures. The result has been a perverse incentive to provide unnecessary or overly invasive treatments that focus on disease states, not wellness. However, since the passage of the Patient Protection and Affordable Care Act (ACA) of 2010, and the follow-up legislation called Medicare Access and CHIP Reauthorization Act (MACRA) of 2015, health policy has reframed the historical isolation of medicine from public health by aligning healthcare payment with patient outcomes, not procedures performed (CMS). By legislating the transition to what the industry calls "value-based care," the ACA and MACRA also reframed the objective of medicine to improve population health, not just individual health. While this overhaul may be redirected due to political reconfigurations of health policy in the United States, the work to realign medical care with patient outcomes has prompted a long overdue shift toward "patient-centered care" that is unlikely to be eliminated without significant resistance on the part of patients and payers alike. The recent acquisition of health insurance provider Aetna by the pharmacy chain CVS exemplifies this reorientation toward "retail medicine" in the United States (de la Merced and Abelson).

These shifts in health policy shape the emergence of medical risk media through directives related to ICT development for healthcare contexts. A major component of healthcare reform in the United States in the past ten years has been the growth in adoption of electronic health record (EHR) systems by clinicians and patients. Early versions of EHRs had been in use since the late 1960s (Tripathi), but adoption was uneven, with many health systems using both electronic and paper records as clinicians adapted their practices to the uneven distribution of screens and access points across sites of care. A major turning point came from the landmark publication of the Institute of Medicine's (IOM) report, "To Err is Human—Building a Safer Health System," which concluded that 44,000 to 98,000 preventable deaths occur every year in the United States due to human medical errors. The IOM further concluded that these errors came at a cost of $17 to $29 billion per year, and the report urged policymakers to push for expanded use of EHRs and other automated computer systems that were expected to eradicate many of the human sources of error in healthcare.

Since that time, the use of EHRs has been associated with improving healthcare safety and quality by containing risk. From this perspective, EHRs appear as the first generation of risk media in medicine, as early instantiations of the big data mantra: more data equals more knowledge, equals lower risk, equals better health outcomes. Computer-based clinical health information technology (HIT) systems are framed by proponents as reducing the risk of human error by providing greater access to information when and where physicians need it most. This perspective was made into policy with the Health Information Technology for Economic and Clinical Health (HITECH) provisions of the American Recovery and Reinvestment Act of 2009, which incentivized clinicians to adopt EHR systems by offering payments of $50,000-100,000 per provider or group as implementation metrics were met (Hsiao and Hing).

Claims about the value of EHRs in improving safety in healthcare are complicated by their legacy as software originally designed for the purpose of billing patients for procedures performed. The perverse incentive that historically supported the reactive, procedure-based model of medicine was built into and perpetuated by EHR functionality. However, in the shift from individual to population, and from procedure- to outcome-based care, EHRs have been reframed as a new kind of risk media. These vast repositories of procedure codes and billing data are now seen as sources of big data that might shed large-scale insights when the entire patient population of a given health system is subjected to sophisticated data analytics. In the shift to reimbursement based on population health outcomes, individual patient records are compared to the population as a whole, assessed for relative risk, and triaged accordingly. Every keystroke made in a clinical setting adds or subtracts a risk variable relative to the total population, thereby creating the opportunity for digital health app developers—or in current terminology, digital therapeutics developers—to design a data-driven intervention for managing a target risk population (as exemplified by Omada Health, discussed in detail below).

While many doctors, nurses, and other users of EHRs complain about the poorly designed interfaces of these systems, another set of concerns around EHRs as medical risk media have grown in recent years. Research has shown that default settings can introduce errors into EHRs that proliferate throughout the patient's record with disastrous results, and that automated warning systems built into EHRs produce "alert fatigue" that makes physicians less likely to notice errors such as incorrect medication dosing (Sittig and Singh). EHRs have been shown to reduce the time and attention physicians pay to patients (Tai-Seale et al.). Comparative studies have shown how EHRs eliminate important contextual information about the patient's experience of illness by framing clinical narratives solely in terms of biomedical disease models

(Patel et al.). Finally, some doctors have argued that EHRs subvert the therapeutic power of human touch (Cochran), raising questions about whether EHRs and other computational interfaces in medicine might undermine the doctor-patient relationship more broadly.

From this perspective, instead of reducing the risks posed by medicine, EHRs introduce new risks related to the inhumanity of automated, algorithmic, and data-driven procedures that reduce human doctors and patients to binary variables incapable of accounting for aspects of human experience that resist quantification. Within the EHR, patients are reduced to preformulated categories typically accessed through drop-down menus. Doctors who use EHRs feel that they are reduced to functioning as robotic data-entry clerks, just as patients feel that their healthcare encounters and illness narratives are stripped of the social and experiential details that make them therapeutically meaningful. Recognizing that these critiques raise significant barriers to the adoption of digital therapeutics, developers are seeking new techniques for infusing digitally mediated medicine with features that approximate human connection.

4. Metaclinical risk media interfaces: digital health apps

As the critiques of EHRs attest, these risk media technologies redefine "the human" in medicine as binary code, determined by diagnostic and procedure codes selected from drop-down menus, occasionally augmented with minimalist narrative description. Like many popular, consumer-facing metaclinical risk media tools, EHRs quantify the self, redefining human experiences of health and illness as data. In an effort to counter the dehumanizing effects of EHR adoption, provisions within the HITECH Act mandated that providers create patient portals to ensure what policymakers termed "meaningful use" of EHRs for patient engagement (Trotter; CMS). Many health systems have met this requirement by opening up minimally functional patient portals that

allow communication of lab test results, secure one-way messaging from the clinic to the patient, appointment reminders, and other top-down transmissions of information. The capacity for dynamic, real-time, two-way, or patient-initiated dialogue is far less common, and consequently, the functionality that many users have come to expect from other sectors of their digitally connected lives, such as online appointment scheduling, instant messaging, video chat, and price comparison are rarely available. Few platforms allow patients to send questions to the doctor, though most allow patients to pay their medical bills online.

Yet, the opportunity that patient portals represent has not been lost on the healthcare stakeholders seeking to capitalize on the promise of savings and profits based on population health improvements through patient risk stratification. To achieve this goal, healthcare providers need access to their patients' metaclinical data, and the EHR patient portal seems an obvious site for data collection and storage. As new and better methods to gather and analyze large data sets are developed, health systems promise to leverage the big data generated by individual patients to determine more nuanced diagnoses and more effectively treat discrete illnesses. As a result, the same ICTs that generate population health gains may also enable doctors to increasingly individualize patient care, ushering in a new era of "personalized" and "precision" medicine (Chaussabel and Pulendran; Kostkova, et al.). The question that emerges from this shift is: who benefits from personalization based on risk stratification? What does "patient-centered care" mean in quantitative terms, and what happens to the interpretation of qualitative metaclinical data in this context?

While the iTunes and Android app stores overflow with tens of thousands of wellness apps, few have been clinically validated, and as of 2015, less than 2% had the capacity to connect to provider healthcare systems through EHRs (IMS). Apps that cannot feed their

metaclinical data back into legacy EHR systems fail to close the loop between patients and physicians, thereby undermining much of the potential efficacy of these interventions. Consumer-patients may find the self-contained, metaclinical feedback loop satisfying in mitigating affective risk in many ways, but when it comes to serious, life-threatening chronic conditions with expensive maintenance regimens, closing the clinical loop mitigates the financial threat of disease by creating the conditions of possibility for insurance coverage. Obtaining insurance coverage for app prescription might be seen as trading off one form of mediated risk—the risk of inadequate medical care—for another, namely, becoming part of an insurance company's risk pool. Closing that loop ensures a complete surveillance system that captures all of the patient data for the third-party app provider to improve their product and their marketing, for the medical care provider who integrates the data into the patient's EHR, and for the payer who now has access to a data-driven, real-time, adaptive and self-generated model for patient risk and payment stratification. But how does closing the metaclinical data loop benefit patients?

I will demonstrate how the digital health app economy brings together the quantified self (Neff and Nafus), risk media, and the rhetorics of self-care and ROI through a detailed discussion of Omada Health, a startup that is leading the nascent digital therapeutics industry (Natanson). After about a decade of experimentation and pilot testing of mHealth (mobile health) apps and devices, there is widespread consensus in the medical community that digital health technologies require rigorous clinical testing to provide real value to doctors and patients (Roess). Validation through randomized, controlled trials (RCTs) and other standardized methods for clinical research not only provides the necessary evidence to gain physicians' trust, it also paves a pathway to regulatory approval and insurance coverage. Omada Health based the design of its diabetes prevention program on the results of a high-impact National Institutes of

Health-funded study that demonstrated the efficacy of the behavior change methods employed on the app (Sepah et al., "Translating"; Sepah et al. "Long-Term Outcomes"). Notably, because the Omada interface operationalizes metaclinical social and behavioral determinants of health, and these data fall outside the narrow definition of biomedical risk that governs app review, the FDA classified Omada's app as subject only to "enforcement discretion," not premarket review (Elenko et al., "A Regulatory Framework"). This new category of regulation, developed in the wake of challenges to FDA review of digital health technologies, asserts that mobile medical devices in this class "may meet the definition of medical device," but are deemed to "pose lower risk to the public" and therefore are not regulated (FDA).

Since its founding in 2011, Omada Health has maintained that its app uses proven techniques to manage the financial and health risks associated with chronic illness (Empson). With a business model aimed at ROI for payers, Omada Health's target customers are the companies that purchase access to this program for clients or employees, not the patients who actually use the app. As a mobile, web-based interface that includes static and moving animated images, pre-recorded video lessons, live videochat, text, and graphical visualizations of user data, Omada Health is a paradigmatic example of medical risk media. Their promotional materials are explicit about the types of risk they aim to avert: for patients, their program reduces the risk of developing chronic disease including type 2 diabetes, stroke, and heart disease (Su et al.; Castro Sweet). For payers, namely employers, health systems, and health insurance providers, the risks are financial, and are explicitly enumerated in terms of ROI. As described in recent news coverage of the company, Omada has over 100,000 participants, and the company "work[s] with health plans and employers to find the highest-risk people. Omada claims health plans see a return on investment within two years, and they can save up to $2,190 per participant

after five years" (Siu). Despite this clear focus on ROI for enterprise clients, the marketing associated with health risk media requires dual payer/patient interfaces, and these distinct approaches to narrating the value of the app economy reveal the core concepts at work in contemporary industry-leading metaclinical risk media. Specifically, the app works to manage financial risks posed to clinical stakeholders (providers and payers) through therapeutic interfaces that engage patients to participate in self-surveillance as self-care.

A comparison of payer-facing and patient-facing communications is instructive. Insights on the payer-facing framework can be gleaned from a report available on the Omada Health website. The 2016 report, called "Value, Inc.," is billed as Omada's guide to the "Top Three Habits of Innovative Health Plans." Inside, Scott Honken (Vice President of Market Access and Payer Relations) describes the data-driven risk media practices underlying Omada's design interface. "Habit 1: Identify looming disease" is a primer in data-driven risk profiling for health. As the guide explains:

> Forward-thinking health plans use "Proactive Member Surveillance" or "Hot Spotting" to help protect their members' health and reduce spending. Basically, plans look at member health data and larger health trends to understand which conditions are most likely to impact their populations in the next three to five years. When health plans can predict how many—and precisely which—of their members are on the brink of costly but preventable conditions, they can invest in appropriate preventive treatments (3).

For health plans or employers that subscribe to Omada's program, risk management is financial; chronically ill employees or subscribers cost more money than healthy ones. Here, the goal of containing the latent risk of disease relies on past data (as in all probabilistic regression analyses) that cannot account for sudden or unprecedented changes that might occur in a patient's

environment, beyond individual control. New disease vulnerabilities from temperature or rainfall changes, or disruptions to the patient's circumstances such as job loss or family crisis that might adversely affect maintenance of adherence regimes cannot be incorporated into this framework. The selective inclusion of metaclinical data privileging quantifiable and predictable variables demonstrates how the algorithmic "quantified self" obscures features of human experience that are less amenable to risk modeling.

In "Habit 2: Scale with technology," Honken elaborates on the role of technology in healthcare, emphasizing data analytics, remote, virtual care delivery, and personalization (4). Here, the threat of depersonalization posed by clinical technologies such as EHRs is reframed in marketing terms that equate access to personal data with more persuasive technology-based rhetoric. The third habit, "Align incentives with providers," emphasizes the importance of reorientation toward population- and value-based care, as it benefits patients who stay healthy and doctors who will be financially rewarded for adhering to the new paradigm. A key benefit of the resulting model, Honken argues, is that "preventive medicine, done right, has the convenient effect of lowering health plans' long-term spending. So everybody wins" (5). The concept of rational actors in health care implicit in this quote suggests that medical doctors themselves should aspire to behave more like algorithms, and if they do, patients will behave accordingly. The consumer-facing app shares this model, implying that all of the steps it asks users to take are logical, fun, and simple to achieve. The notion of incentivizing providers through expectations of financial gain suggests that employers and payers can readily program patients to behave as though affective life with chronic illness is uncomplicated, patient experience is easily quantified, and self-care is easily equated with corporate ROI.

In contrast to the "Value, Inc." report, the consumer-facing video on the Omada website contains many of the common attributes of digital health startup promotional materials, framing the value of the app exclusively in terms of self-care, not ROI. The two-minute video presents the Omada user experience from the perspective of a white, female consumer named "Sandy," who logs onto the Omada website from home, launching a demonstration of the platform's approach to patient engagement for viewers. Several contextual cues signal Sandy's affluent status: the large diamond ring on her finger, the tidy, minimalist décor of her home, including a large, uncluttered white tabletop holding only her Apple laptop, a white coffee mug, and a wooden fruit bowl. The blurred-out background features shiny stainless steel kitchen appliances and neatly organized cooking accessories, a modernist wooden coffee table, an average-weight body wearing fashionable, understated athleisure attire. Nothing in the *mise-en-scène* suggests affective or experiential challenges such as poverty, familial caregiver burden, body weight struggles, mental health issues, systemic racism, or environmental stress. The setting, like the app's user experience, appears smooth and frictionless.

The voiceover narrator describes Omada as "a digital health program that uses a combination of proven behavioral science and rich data science to help build healthy habits that stick." The narrator proceeds to frame the program through the terminology of risk media, displaying a screenshot of the eligibility test for Omada users that asks, "What's your risk?" with choices of diabetes or heart disease. The video goes on to display the startup kit, including a wireless scale already linked to her account that Sandy receives in the mail once she is enrolled in the program. After she steps onto the scale, we see the various screens that begin to populate this user's virtual space, as the remainder of the user experience is presented through digitally intermediated interfaces. The screens include familiar digital design typographies with a small

profile shot of Sandy's face, questionnaires about her food intake, activity levels, personality, and so forth. Finally, a visualization of Sandy's strategically coordinated social network within the Omada program and her "dedicated health coach" appear onscreen. The coach is a young, white woman who provides "real time" feedback and personalized guidance delivered in videos and through a discussion board format similar to Facebook or WhatsApp. Sandy is depicted interacting with her social network as well, in a playful exchange of "friendly competition" featuring a multiracial group of community participants "a lot like you, for added support, accountability, and sometimes, a little healthy competition." Here, Sandy is shown engaging in light banter about favored baseball teams, a small detail meant to signal how much fun it is to participate in this form of collective self-surveillance.

The overall user experience is presented as friendly, encouraging, and reasonable, with an overarching rhetoric of data-driven efficiency and efficacy. A perky musical score featuring acoustic guitar and up-tempo drumming reinforce the cheerful mood. As the narrator notes in a lighthearted tone, "During the first four months, you track your food and activity," and all of the data generated by this activity adds up to a wealth of insights backed by data analytics. This process is visualized through an overhead shot of Sandy tapping her smartphone screen while seated at an orange table with a meal of a small sandwich, a glass of water, and an orange in front of her. The voiceover continues, "Within a few months, your thousands of data points paint a clear picture of what new habits are working best for you, and where you need to double down on effort." The video closes with an encouraging send-off that links personalization to data-driven behavior change, suggesting that, with this app, self-care is automated and self-cure is inevitable: "Omada provides personal support, powered by science, to inspire you to be your own cure, in lots of tiny, totally doable steps."

Analysis of the Omada app and business model demonstrates the complexity of answering the question of who benefits from metaclinical risk media. On one hand it is evident that the app is a money-saving tool for subscribing companies, based on surveillance of employees who may not be fully aware of the risk exposure entailed in participation. On the other hand, the app design is based on evidence from a study that found reduction in the incidence of chronic disease, a result that is in itself an unambiguous benefit to patients, in addition to benefitting the insurance underwriters. The conditions that give rise to chronic disease vulnerabilities, surveillance vulnerabilities, and the conversion of human experiences of health and disease into virtual, datafied algorithms of health and disease, however, raise questions that remain to be answered.

Conclusion: Redefining "the Human" through Metaclinical Risk Media

Self-care in the twenty-first century is characterized by the ubiquitous presence of digitally intermediated screens linking varied forms of clinical and metaclinical data. These new forms of risk media, including EHRs and health surveillance apps, are quantifying the self, and thereby redefining the human, through data that elide fundamental aspects of the human experience of health and illness. While the rhetoric of medicine emphasizes the value of "patient-centered care," the business of medicine operationalizes this concept through a risk-stratified, data-driven form of "personalized medicine" derived through probabilities based on population-based aggregates, not individual history. In this context, the patient is the center of a digital surveillance network dedicated to sensing environmental and behavioral exposures that shape future risk profiles. The Omada Health app exemplifies this logic by targeting users at risk of developing type 2 diabetes or heart disease. These patients are presently healthy, but their future,

data-projected selves are chronically ill. In this scenario, the human and the virtual are collapsed, as both are defined by predictive, aggregative, and numerical algorithms that frame datafication as the only method for understanding health and disease. As the boundaries between clinical and metaclinical contexts for data collection dissolve, the boundaries between the computational and the human dissolve. In the current trajectory of risk media, patients are reduced to data points without history, context, or affect. Alternatives to metaclinical risk media are needed to preserve the messiness of human experience, and to resist the further automation of clinical exchange.

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