

The Modern Social Contract between the Patient, the Healthcare Provider, and Digital Medicine

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Abstract

This article discusses the interplay of social media, digital technology, genomics, and personalized medicine and social policy and how the confluence of these fields impacts the future of healthcare, as well as the ethical fabric of a changed social structure.

Keywords: Social media; Public health; Healthcare; Social contract; Digital monitoring

Introduction

The practice of medicine is undergoing a transformational change in terms of science, technology, personalization, digitization, mobility and social media. At the vortex of these changes is data, generated analyzed and employed to develop, deliver, manage and predict aspects of health and disease. The fulcrum of change is the better resourced countries versus the less resourced countries grappling to stay in the fray. Global transformative medicine presents not only technical challenges to advancing medicine and targeting it to specific sub populations but ethical challenges as well. The greatest challenge, however, may well be how medicine and healthcare, both fundamentally reactive, will transform themselves to being proactive.

To quote Steve Jobs, "The people who think they are crazy enough to change the world are the ones who do so". We need to have that streak of insanity in us to swim into the world of change, or the tide will simply swallow us up. Medicine is necessary for the masses. Public health is a sociologic problem. The transformation from reactive to proactive requires both technology and public participation in equal measure. Conventional medicine comports a reactive approach, wherein diseases are treated after they arise. Similarly, the transformation to personalized, preventive, preemptive, and participatory medicine is demanding a huge unprecedented economic spend.

One size fits all medicine is no longer working. Applying a mass approach to therapy for individuals means that though some medicines in approved dosages work for some, they don't for others, implying that they may be ineffective, or even worse, unsafe, or both. Companion diagnostics (the joint use of a specific diagnostic to determine whether a targeted medicine is likely to be safe and effective) and molecular diagnostics that detect individual variants that drive decisions about the best treatment for an individual, illustrate the superiority of targeted medicine to effectively and safely treat specific diseases. The unstoppable soaring cost of healthcare and the enormous economic and social burden resulting from medicines that are unsafe or ineffective begs technology to transform medicine. Adverse side effects alone represent the fourth to the sixth biggest cause of death and hospitalization in the US [1]. Further, the cost burden to society, not only dollars spent but lost work days, and to individuals, who may have no choice but to spend their life's savings (especially in geographies such as India where they are not covered by health insurance) for therapies which are unsafe or ineffective, demands a solution. Hence, this calls for a personalized medicine approach, spawned by the technological capability of identifying and understanding the molecular basis of

disease and its individual pathophysiological expression over time. Social spend to address human ailing, in theory commendable, is basically a waste if the disease could have been prevented in the first place.

Key Health Drivers

One needs to factor in the influence of ethnicity, gender and age, as well as the socioeconomic status of the patient determining both access to and the quality of healthcare. Of the five determinants of population health, genes, biology and health behavior represent 25% of the factors impacting population health, whereas the social environment, physical environment/total ecology, and health services/medical care, represent the social determinants of health and these parameters directly impact health equity [2]. Technology is revolutionizing not only medicine but the context, namely the social environment, in which it is applied. Intimately and dynamically intertwined, targeted health requires ultimately the collaboration of the masses, the public.

With the substantive advances in technology has come the growing need for patients to make informed decisions, to be more in control of both their health records and of the treatment options they choose. Patients want to access information on the internet, learn from others, share experiences, and they want to be in charge of their own data. Technology, or the information highway, as the World Wide Web was once called, is enabling individuals to learn more about their conditions and health risks and use this information to question medical decision making and the care offered. The patient, in other words, is no longer the passive recipient of medical advice and treatment but is in the driver's seat choosing what they deem is best for them based on many factors including out of pocket costs of different therapeutic options. In other words, the individual has greater medical knowledge and power of decision-making than ever before and is leveraging that power not only for his/her health but to advance medical knowledge.

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Crowd sourced funding of medical research is but one example of how the patient is leveraging power not only for their own care but in the broader context by determining what research is funded.

Personal Health Records (PHRs)

To begin with, it is important to distinguish between Electronic Health Records (EHRs), Electronic Medical Records (EMRs) and PHRs, which are all too often used interchangeably, though they have distinct identities. EMRs are a digital version of the patient's case papers and include the medical and treatment history of the patient, limited to one practice. EHRs contain information from all the clinicians involved in the patient's care and also share information with other health care providers, such as laboratories and specialists and are accessible by all people involved in the patients care—including the patients as well. Thus, HIMSS Analytics reports that, "The EHR represents the ability to easily share medical information among stakeholders and to have a patient's information follow him or her through the various modalities of care engaged by that individual" [3].

A PHR can be generated by physicians, patients, hospitals, pharmacies, and other sources but is controlled by the patient, unlike the EHR is a computer record that originates with and is controlled by doctors [4]. 'Personalized' today is getting really personal. It's not only about therapies being oriented towards discrete strata of patients, but also towards the patient as an individual having access to his/her own PHRs which could be stored in a repository such as Google Health or Microsoft Vault or Dossia [5], as well as access to voluminous data through digital monitoring, healthcare apps and social media websites, which allow patients to share their personal experiences, exchange notes on what worked for others and what didn't, ask questions, comment and help them determine what may work for them as an individual.

International Data Corporation surveys have shown that users of PHR systems want three primary capabilities, the ability to access laboratory results, the ability to communicate with physicians' online and the ability to schedule appointments. While the survey indicated that the majority of patients had never used PHRs, less than 50% of those who had used them would continue to do so. Those who would use PHRs would do so upon the recommendation of their physician.

Arguably, one of the reasons that Google Health (the PHR repository) failed is that while it partnered with pharmacies, it did not partner with the healthcare community, thus ignoring a key stakeholder. In addition, it was not 'fun' – it was more of data storage set up, not social, not engaging THE END USER and did not market itself well [6]. With Dossia, Microsoft, on the other hand, went on a direct marketing approach to get the service closer to consumers. Dossia is an employer-backed service created and offered by Fortune 500 companies which offer the PHR service as part of their health insurance plans for a small fee, allowing employees to securely communicate their personal health information between patients, physician practices and hospitals and it also offers patient alerts. It is developing a direct, secure communication service, similar to the one which Microsoft's HealthVault has. Ensuring data privacy is critical as a patient's health records may have a direct impact on his employability and his insurance coverage. However, the question remains whether employees will trust a system developed and operated by their employers or insurers.

PHRs are still expected to take a couple of years to gain acceptance, but also because the demographic for whom the PHR is most meaningful, namely the middle aged and over those who have identified conditions requiring monitoring if not treatment as well, are not necessarily quick adopters. If the rate of adoption of online banking

can be considered as a model, then deep market penetration and with it a significant impact on care delivery is inevitable, but slow in the making. Online line banking took roughly a decade before it became main stream and real time.

Social Media, Analytics and Mobility: Making Healthcare Accessible

The vision for IBM Watson, IBM's supercomputer [7] is to deliver point of care data for medical decision making via cloud embedded big data cognitive analytics on a smart phone. After demonstrating its proof of concept by beating out previous Jeopardy winners and taking the first prize, Watson is currently providing natural language management support to oncologists treating lung cancer patients at Memorial-Kettering Cancer Center and help in diagnosing and treating patients. An important aspect to realizing its promise will be Watson's ability to process unstructured data, such as physicians' notes, published research, radiological images, device data, and data from online patient communities which themselves yield a lot of hidden information. Fulfilling this promise is monumental as 90% of the world's information has been created over the past 10 years, with 80% of it being unstructured data.

In a world of online patient communities and social media, more than 40% of Americans are using websites to check their symptoms and about a quarter of them are using them instead of visiting their doctor. Various free online and smart phone apps [8] have been developed including symptom checkers, such as Isabel Symptom Checker (recommended by Omaha Children's Hospital & Medical Center, wherein patients can type in their symptoms and it helps diagnose them), Symptom Checker, developed by Mayo Clinic (a symptom checker wherein users need to look up symptoms and then look at a list of possible causes), as well as the one developed by The American Academy of Pediatrics to help parents decide whether their child needs to see a physician. Similarly, insurer Aetna has developed the symptom checker iTriage which in addition helps the user find local medical facilities.

Social media has enabled the creation of a broad range of shared information networks. For example, The US Health Tap [9] is a social network that helps patients receive credible, relevant information online and has provided over 581 million answers to user questions. Similarly, Tumblr is an online platform that allows patients to share their experiences. Patients Like me (patientslikeme.com) allows patients to share their experiences and learn from one another while offering their experiences (evolving phenotypes) to researchers. Indian Patients Foundation is a similar online platform where patients can share experiences, recommend doctors and exchange notes [10]. The service *patientsknowbest.com* (PKB) allows healthcare professionals, with the patient's permission, to access and update their health records. Twenty UK hospitals have signed up, along with four international pharmaceutical companies and its presence now spans the US, Holland and Hong Kong [11]. *DocCom.me* is a cloud-based system that allows clinicians to find, share and collaborate with each other. *Dr.Thom.com* is an online General Practitioner service where patients can receive an online consultation and prescription medicines. This started as an online sexual health service, as patients were embarrassed to discuss these issues with doctors, and now includes contraception, cystitis treatments, medications for erectile dysfunction and hair loss, malarial drugs, travel vaccinations, and home tests for a variety of sexually transmitted infections Patient feedback is collected by an independent agency [12]. While physicians are becoming on-line guides for their patients, reimbursement for their time remains critical.

Over 150 US med schools are using Inking content on iPads to transform the way the new generation of doctors is learning. UC Irvine which was the first to offer its medical students a completely digital learning environment and an iPad-based curriculum also has a 'Mobile Technology Etiquette Checklist' to help students understand how to use technology during patient encounters [13]. Webicina, led by Bertaln Mesko, a medical futurist, is a website which curates (filters, segments, analyzes healthcare content, messages and signals in a meaningful way to provide answers to unique questions to address the needs of medicine), social media resources in medicine for both healthcare professionals and patients [14]. Thus, doctors and patients today are both thinking and behaving differently. Yes, large concerns prevail, including but not limited to data security, data privacy, whether online medical advice constitutes the practice of medicine, and whether these business will achieve a return on investment.

Point of Care Going Mobile

The ability to monitor conditions and get medical information the moment its wanted is increasing around the globe. Texts and mobile apps are providing information that previously was dispensed only in a formal clinic visit. For example, the FDA recently cleared the AliveCor iPhone ECG. Dr. Eric Topol, pioneer and leading expert in wireless medicine is currently working on a nanosensor in the bloodstream designed to identify artery lining shed cells, which is an early indicator of a heart attack, thus offering the ability to warn the patient of an ensuing myocardial infarction. Globally Mobile Alliance for Maternal Action (MAMA) provides mothers with helpful health information using simple SMS text messaging and includes a network of 253 organizations, across 59 countries and aims to reach 90 million women [15], making crucial health information accessible without the barriers of conventional care; scheduling, office waiting or costly clinic fees. Other wireless technologies are being developed every day, from calorie counters to sleep trackers, and we are not yet half way to the tip of the mobile health iceberg.

Video gaming is used both for the diagnosis and treatment of medical ailments, including alleviating and measuring chronic pain in children or virtual reality therapy (VRT) in the treatment of mental health disorders, wherein two conditions, namely immersion and presence are required [16].

Collaboration platforms are being used to bridge the gap between the globally rich and the pure and to provide expanded access to crucial medical information. iKure (a corporate social responsibility initiative in India) leverages iKure Techsoft, a platform that it has developed, called Wireless Health Incident Monitoring System (WHIMS) that enables effective communication, integration of data and contact between rural medical practitioners (RMPs) – the spokes and the city-based doctors – the hub. WHIMS have already received both national and global recognition in the field of healthcare innovation. Healthcare professionals in rural and urban West Bengal collaborate to provide quality healthcare to rural patients in West Bengal. Rural doctors function out of kiosks, and capture health information directly in the application; the application also interfaces with diagnostic devices. The rural doctors can then use the data captured in this database to consult with specialists based in urban Kolkata to outline the next level of care, thus expanding access of rural patients to sophisticated healthcare solutions. iKure won the first position at the "Technology for Impact Accelerator organized by CIIE, Indian Institute of Management, Ahmedabad. iKure was identified as one of the commercially scalable Indian start-ups that display a high level of social value in their tech-driven or tech-enabled offerings [17].

Medical Training Through Simulation

Airline pilots are trained to fly using simulators. This mode of training has existed for quite some time, in part due to the need to train emergency response skills. Military training and first responder training have relied on the need to simulate a specific scenario in order to ensure that specific skills are mastered. The idea of providing medical training via simulation took hold in the 90's morphing the standardized patients tool into more life-like, but nonetheless virtual, patient problem solving. Medical education began employing simulation with advanced cardiac life support simulators being one of the first types. Dr. Devi Shetty, thoracic surgeon and founder of Narayana Health City in India, uses a simulator to train nurses to put a central line, a wire that goes through an artery into the heart, a delicate job, requiring patience and skill. Simulation technology would help rapidly increase the numbers of 'augmented nurses' which could become mediators between the doctor and the patient [18].

The ability of technology to help providers and patients to track symptoms, identify patterns and problems, and analyse that data to develop solution strategies or simply support behavioural change, continues to grow. Buddy is one such virtual therapy app that allows users to respond to questions, record how they feel and then track patterns, receive tips on changing behaviour and setting up appointments. Buddy is meant to be a tool that is used "by and with" therapists [19] and is merely one in an exploding field of support tools. The FDA has released its final guidance on mobile medical apps on September 25th 2013 and has cleared about 100 mobile medical applications over the past decade, about 40 of which were cleared in the past two years [20].

Snap-on devices, with bluetooth-enabled sensors, supported by analytics and mobile apps to help patients visualize and understand their triggers and trends while receiving personalized feedback are being used extensively today, more often than not for fitness purposes, but by patients as well. Asthmapolis is a startup that has designed such a product that tracks how often people use their inhalers (along with the location and the time-of-day) [21]. ABI Research (Allied Business Intelligence, Inc.) has reported that the market for wearable gadgets (which help patients and clinicians monitor vital signs and symptoms) is projected to exceed \$2.9 b by 2016 [22]. Some examples include smart clothing that embed vital signs-monitoring systems, a headset and a patch to monitor brain and heart activity, or a chest sensor that transmits data, including ECG, heart rate, respiration rate and activity levels via a mobile phone. Similarly Toshiba has developed a smart healthcare Intelligent Monitor Engine & Ecosystem, Silmee, that simultaneously detects vital signs, ECGs, pulse, body temperature and movements, and sends that data to care provider's smartphones and tablet PCs with wireless technology [23]. Other biosensing digital monitoring gadgets are Vivonetics' LifesShirt, a machine washable shirt embedded with sensors to capture and store health data real time [24]. Similar products include HealthVest, HexoSkin, BioHarness, Respirationics, Equival, BioCapture, etc [25].

Technology is moving fast to replace the real clinic with a more perfect, albeit virtual, clinic. Walter De Brouwer, founder of the Scanadu Scout developed a medical tricorder a blue-tooth enabled device that measures an array of vital signs (ECG, heart rate, respiratory rate, blood oxygen levels, temperature by simply placing the device against your forehead) and sends them to your cell phone. It met its \$100,000 crowdfunding goal on Indiegogo in just one day thereby demonstrating the public's appetite for a point of care that is ever more precise, because of its basis in real time, and personal in the sense that

the data encompasses more of one's experience. These devices arguably represent the biggest innovation in home medicine since the invention of the thermometer" [26].

Virtual Clinical Trials: Are They for Real?

Even the pristine clinical trial is going virtual. Trials can now be run out of the privacy of one's home rather than in the clinics of major medical centers.

Technology is enabling the capture of real time data, thus a large-scale observational study is being conducted using nothing more than a smart phone [27]. 7Breaths, for example, is an app which counts respiratory rate using a mobile app (an accurate respiratory rate can be determined after counting only seven breaths). Sanofi Israel is collaborating with Camoni, an Israeli social networking for patients to crowdsource ideas for a new mobile app for diabetes [28].

Pfizer conducted 'Remote', the first virtual randomized clinical trial under an IND, to test the safety and efficacy of Detrol LA in the treatment of OAB (Over Active Bladder) using mobile and web based technology. Unique features included electronic informed consent conducted online using instructional videos/multimedia and online testing [29]. Blinded study medication was shipped to patients at home and researchers conducted the trial remotely, sharing the clinical trial data and results with the patients, enabling them to add them to their own PHRs. While the trial was discontinued because the stringent enrollment criteria for the target of around 600 patients across 10 states in the US, was not met, Craig Lipset, Head, Clinical Innovation at Pfizer, said that in principle, they could effectively manage the trial remotely and are likely to reinstate the same in 2013 [30]. Anthony Costello, co-founder and CEO of Mytrus (a California-based clinical technology and services company built on the idea that modern technologies can enable people to safely and effectively participate in clinical trials without requiring them to live near a study center) believes that up to 30% of studies run today could be done direct-to-patient.

Digital Drugs

Proteus Digital Health in collaboration with Novartis has pioneered the age of 'Digital Medicines' used its ingestible sensor technology, with a chip integrated in a pill that provides invaluable data about pharmacokinetics, absorption, distribution, metabolism and excretion [31]. The patient needs to have a bluetooth enabled mobile device, and wear a patch on his shoulder. When the patient consumes the pill, the Mg and Cu in the sensor react with the acid in the gastric juice creating a small electrical charge that enables it to communicate with the patch and thus the device. This smart pill approach would be of considerable value when IP compliance is critical, especially in cases such as transplants. Excess dosage can be harmful the patient, and not taking the right dose at the right time could result in the graft being rejected. Hence, the IEM helps ensure compliance and minimizes the risk of graft rejection. Challenges lie in ensuring data privacy and managing the huge volumes of data that are generated on-line. This Ingestible Event Marker (IEM) was approved by the FDA in 2012 [32].

Big Data Driving Personalized Medicine

Technology continues to generate enormous amounts of patient data, allowing trends and traits to be analyzed, all with the intent of improving detection, prevention and treatment. IBM is helping healthcare providers use data to see which other types of patients were similar to a given patient – in characteristics, treatments and outcomes – for the purpose of identifying the most appropriate physician and

treatment plan for a particular condition, through their platform and analytics offering (Patient Care and Insights). It can mine both structured and unstructured data [33].

Arguably equally important is the cultural shift that technology has created. The customization that technology has enabled us to create in many areas of our lives has extended itself to medicine where patients are looking for solutions tailored to meet their personalized needs. Though, personalized Medicine is not really about designing a separate drug or device for each individual, but rather about categorizing subpopulations based on their responsiveness or their sensitivity to the same. The individual's response will depend not only on his genotype, but on his evolving phenotypic profile as well.

Drivers for Personalized Medicine include diagnostics, high speed computing, big data and analytics. The key lies in the ability to link a specific genotype to a specific disease phenotype. This will be facilitated by linking genomic data with patient's health records. Insurance companies will inevitably be forced to pick up the tab. Various large payors have agreed to cover genetic screening costs including Wellpoint agreeing to cover Sequenom's MaterniT21 Plus fetal genetic screening tests and Anthem Blue Cross agreeing to cover AlloMap's genetic testing in Stable Heart Transplant Patients. LabCorp and Quest Diagnostics have also partnered with innovative genomics companies [34]. The promise of personalized medicine, improved care at lower cost, requires radical social and cultural change in the mindset of all stakeholders. Concerns range from the return of investment for the pharma company to data privacy, costs and healthcare coverage should some potential disorder be identified. It needs to be carefully managed to exploit the full potential of the same. Direct to Consumer (DTC) genetic testing involves genetic analysis being extended directly to patients bypassing, in some cases, doctors, and insurers. However, there have been some regulatory challenges of various types, not the least of which is whether physicians should be required to prescribe a test and if so whether the legal definition of a doctor-patient relationship applies to online encounters. Key companies that have been offering this service include Navigenics (recently acquired by Life Technologies), Pathway Genomics (which followed a similar route after receiving an advisory notice from the FDA), deCODEme (recently bought by Amgen), Lumingenix, DNA DTC (owned by Gene-by-Gene) [35] and DNA Direct, bought by Medco, now Caremark. 23andMe has patented a diagnostic test for a rare mutation used to diagnose risk of Parkinson's disease. This challenges the company's oft-championed position of providing individuals with "unfettered access to their genomes", as against its desire to commercialize the genomic information, while most if it has been provided by many individuals free of charge [36]. inVentiv Health Clinical recently partnered with PatientsLikeMe, whose 200,000 members share information and experiences on more than 1,500 different diseases and conditions. This will help accelerate patient recruitment [37].

Just as the speed of computing is increasing exponentially per Moore's Law, similarly the ability to interpret the human genome will have an equal impact on the practice of medicine.

The Social Impact

Does increased patient autonomy on the other hand result in reduced receptiveness of patients to a doctor's recommendations? Sixty per cent of U.S. adults are tracking various parameters including their weight, diet or exercise routine; one-third of adults are tracking some other indicator or symptom, such as blood sugar, blood pressure, headaches or sleep patterns; and one-third of caregivers are monitoring

health indicators for loved ones. About a third noted that their data collection had affected a health decision; 40 percent said they asked their doctors new questions or sought second opinions; and 46 percent reported that this had changed their overall approach to health [38]. Given the undersupply of physicians in the U.S. and the unabated rise in health care costs, the trend towards digitally driven self-care is only likely to grow. Whether this is ultimately a good or bad thing for one's health, and public health, remains to be seen.

Underlying Principle: Beneficence First, Access to All

There are good reasons to support the view that access to health care is a human right. Health is necessary for our general well-being and like education it is essential to promoting equality of opportunity. The Affordable Care Act is an important step in the direction of providing all Americans with access to excellent and affordable health care [39]. Yet challenging economic conditions deter a collective ability to drive equal access to healthcare.

Clinical knowledge is the foundation of our provision of healthcare. Healthcare providers need to be able to access, interpret, and share the most current medical information with patients. The for-profit nature of American healthcare, however, has created a culture in which knowledge creation is viewed as proprietary. We argue that this is at odds with medical professionalism and general principles of beneficence [40]. The for-profit motive of medicine is inhibiting our ability to provide all patients with access to the highest quality health care. Clinical knowledge that can benefit patients throughout the country should be widely shared, and we need to develop an infrastructure to support this goal.

Medicine as a profession is held to high moral standards. Society affords us many privileges and a great deal of autonomy in exchange for our commitment to clinical excellence, integrity, accountability, respect and compassion. A central tenet of medical professionalism is the Hippocratic Oath, to do no harm. Our commitment to the primacy of patient welfare is the basis for our patients' and society's trust in the medical profession. The professional obligations of therapeutic beneficence and non-maleficence are generally understood within the context of a particular physician-patient relationship, but in some cases there are compelling reasons to extend these obligations to society more broadly. For example, physicians have an obligation to report communicable diseases to public health departments where there is concern that a patient poses a risk to society. Similarly, we argue that physicians have a professional obligation to share clinical knowledge that may benefit patients for whom they do not provide direct care.

In addition to professional obligations to patients and society to share knowledge, we may also have an obligation to share anonymized clinical knowledge in a more general manner to meet the human obligation of beneficence. If we accept that we as individuals have an obligation to others less fortunate, to global benefit sharing, then the question of knowledge sharing is no longer a question but a moral imperative. There is an urgent need to change our approach to knowledge sharing. Reaping the benefits that digitized medicine offers requires knowledge sharing, not simply the choice to share personal data, whether identified, de-identified or anonymized, but also the sharing of infrastructure to permit structured and unstructured data to be exchanged and used. Knowledge is the basis of our ability to provide patients with high quality medical care. If healthcare organizations and professionals do not openly share knowledge we are not living up to our professional social contract with society and not fulfilling our general human duty of beneficence.

Conclusions

A commitment to sharing represents a new social contract based on a principal of solidarity and a duty to act for the common good. Arguments for knowledge sharing are frequently framed in terms of potential cost savings. However, the reasons to push in this direction are not just cost-savings but rather a moral obligation of society to its individuals. Such a duty is the source of a pressure against the businesses that are obligated to serve their self-interests. Historical factors may make a paradigm shift to greater knowledge sharing hard to achieve. Among them are considerations of what constitutes fair and appropriate benefit sharing. In light of the fact that companies may be asked to do things contrary to their best financial interests, one approach is to redistribute cost savings in such a way to financially incentivize sharing.

In its commitment to creating a healthier, and more productive society, The Affordable Health Care Act represents public affirmation of a paradigm shift, away from actuarial fairness which bases one's obligations only on one's needs, and declares that society embraces both the notion of an individual's right to healthcare but also a moral commitment to the common good, namely a healthier society. Ensuring accessibility of the best available clinical knowledge broadens and deepens our affirmation of the importance of the common good.

Growing evidence indicates societal, even global, environmental factors, influence one's medical risk. Epigenetic and environmental effects are linked to the explosion of non-communicable diseases, thus drive a wedge in the logic of actuarial fairness. Pollution, global warming, and radiation, for example, are adverse health impacts that affect all individuals and arguably, society bears the responsibility for both creating and remedying the same. In other words, medical risks are a function of not only our independence (our inborn risks and life style choices) but also our global interdependence.

In light of this interdependence, principles of a sustainable society are taking hold. The ethic of sustainability entails a duty to seek respect and care for the community of life as well as a duty to improve the quality of human life. Benefit sharing was developed as a strategy to achieve these goals. This framework has influenced global public health research and new knowledge distribution strategies.

The 2002 Budapest Open Access Initiative [41] is a good example of this strategy in practice. It established a moral imperative to advance knowledge through collaboration and enable its distribution equally to better and worse resourced entities. As such the initiative represents a paradigm shift to a notion of distributive justice based on the reality of interdependence and a principal of solidarity. In doing so, it defined the moral underpinnings of scientific information sharing and serves as a model for the potential of sociomics.

Fine moral fabric needs to drive principles of beneficence and both society and individuals need to leverage the changing dynamics to truly extend healthcare access to those in need.

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