

# Digital Technologies and Disease Prevention



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In the last 3 decades or so, digital technologies have penetrated into a vast array of human activities; smartphones, computers, Internet, social media, and the rest have not only reached into many domains of everyday life but also spread globally and very rapidly—at a speed that technologies from previous eras had not done. In this special themed issue of the *American Journal of Preventive Medicine*, a series of papers explore some of the implications of digital technologies for disease prevention and public health. Presently, the potential for such interventions appears to be extensive, including surveillance of population information, continuous self-monitoring of bodily signs, symptoms, and measures, through prompts to assist and support behavior changes to provision of advice and guidance about lifestyle and health risks. There are a number of questions that deserve detailed scientific attention, and the papers in this volume contribute to that consideration.

First, unintended consequences: The inventors, pioneers, innovators, and advocates of earlier technical revolutions did not foresee with too much accuracy the direction that their new technologies would take. The printing press, the steam engine, canals, the electric motor, the postage stamp, TV, and railways were not originally devised with anything like full knowledge of all the many diverse ways in which these technologies would eventually develop and subsequently shape society. The technologies went in directions of their own. So it seems likely, given that it is comparatively early days in respect of digital technologies applied to disease prevention, that some of the uses we imagine for digital technologies now will appear to succeeding generations to be quaintly misguided. We have yet to see the way these technologies eventually get used on a regular and sustained basis. That these technologies will have uses and effects for good or ill is clear; what we don't know is what those benefits and

dis-benefits are likely to be. This collection of papers shows that the science of understanding the impacts and mechanisms of action of these technologies is as yet largely underdeveloped.

Second, it is easy, but misguided, to talk about digital technologies as if they were one thing. They are computer based and digital and they sit on electronic platforms and can be used on devices that share a common information technology (IT) heritage. But obviously that does not mean that they are the same or will work in the same way. Just because these things are IT based it does not mean that the psychological or social response to the devices and any interventions that they carry will be similar. The ways that people engage with the technologies, the mechanism of action, the human responses, and the outcomes will be heterogeneous. Of course, there will be classes of devices and stimuli emanating from them that may share characteristics, but it is not clear what those classes of devices or actions or outcomes are. Conceptually, we are far from precise about the things called digital technologies.

Third, as these papers show, it is not yet clear what the optimal scientific way is that we should study these objects and their effects. As evidence-based medicine has become established, a series of tried and trusted methods have been refined to assess effectiveness, efficacy, and the cost effectiveness of new drugs, devices, or new interventions to prevent disease. The RCT is the cornerstone of this approach and we have learned much over the last several decades about the strengths and the limitations of this method and associated approaches like systematic reviewing and evidence synthesis. What emerges in this collection of papers is that these methods will need to be revisited with respect to digital technologies. One of the core problems is the speed of evolution of the technologies compared with the conventional pace of scientific research, development, and evaluation in medical science. The pace of change of the technologies is much faster than conventional research designs can keep up with—and yet it is vital to continue to provide users and policymakers with high-quality evidence about the cost effectiveness of digitally delivered health care. It is clear that new research designs will have to be developed; otherwise we are likely to be rather like astronomers gazing through an optical telescope in the hope of picking

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up signals from invisible distant galaxies. The scientific method will need to reflect the nature of the phenomena we are studying rather than the principles of past scientific successes. This also applies to the way the cost effectiveness of the new technologies is assessed and evaluated. A set of methods has been developed to permit the reliable and consistent comparison of the cost effectiveness of technologies and of conducting preventive activities. The need to extend these methods to capture the particular issues arising in digital technologies will be an emerging area in health economics in ways that remain to be explored.

Fourth, there are implications for the traditional doctor–patient relationship and public health experts and the populations they serve. This relationship is conventionally grounded in notions of expertise and the closure of knowledge along with patient or public dependence on that professional expertise. The availability of masses of information to anyone with a device about anything that may be wrong with them, or the many risks attaching to being alive, has certainly ended the strictly demarcated social closure of medical knowledge. But of course information isn't knowledge, and information doesn't equate to expertise. It is easy to glibly talk about expert patients and about the availability of information transforming the doctor–patient relationship, but precisely how? Does traditional clinical advice on, for example, the perils of smoking, alcohol misuse, or being overweight become redundant as the patient can themselves access the epidemiologic sources describing risks? Or are the messages diluted because of the availability of junk information vying for attention amid the peer-reviewed science? Undoubtedly, the presence of mega information has the capacity to change things, but it is not at all clear how.

Fifth, new ethical issues emerge as a consequence of the use of these technologies. The degree to which the opportunities for surveillance offered by the digital traces left by our engagement with technologies and the continuous monitoring of biological signs and symptoms that can be collected from populations is unprecedented. Current legislation on data protection and informed consent lags well behind the potential that these new technologies offer and the ethical principles raised remain relatively under-discussed—the issue is not raised in this set of papers, for example. Whether one sees this as the Foucauldian nightmare of the Benthamite panopticon about to come to pass or an amazing opportunity to observe population health is not just an interesting debate. Quite possibly, we are on the verge of something analogous to the invention of x-ray imaging, but for populations. The new technologies will allow us to “see inside” the population in ways that have never before

been possible. The linkage of digital data with our knowledge of the metabolome might yet prove to be the most significant development in medicine of the last 50 years. But how to regulate all this and what the challenge to our ethical principles might be remain pressing questions.

Finally, the methods we use as scientists are premised on a set of, usually implicit, epistemic assumptions. These are the assumptions that determine what is and isn't considered to be admissible knowledge for our models, theories, and evidence. As the papers in this volume demonstrate, as new methods evolve, new epistemic assumptions will also need to evolve and professionally we need to be keenly aware of their implications for our science and our practice. One critical example of this is the relations between individual and population health. As you read through the papers in this volume, it will become clear that most of the working assumptions about the engagement, mechanisms of action, and outcomes of digital technologies are located at the level of the individual. The putative devices and interventions are aimed at discrete individuals often in highly personalized ways. The assumption that follows is that population health effects will be the consequence of the aggregation of all the individual effects.

Although this will of course be true, we will need to be mindful of the fact that public health also uses another epistemic assumption, which is that populations are not just the statistical aggregation of millions of individuals, populations have a reality and analytic level of their own. Here, phenomena that manifest themselves at population level such as the patterning of health inequalities or the actions of the wider determinants of health like poverty, disadvantage, and economic and political processes operate. If our starting assumption is that the current epidemics of non-communicable disease only originate in the lifestyle behaviors of individuals, that the solution is more and better ways of changing these lifestyle behaviors, and that digital technologies offer a more effective way of doing this than our erstwhile methods of health education and behavior change, we might not make very much progress.

The epidemics of non-communicable disease are the product of the actions of often global agents selling populations large quantities of energy-dense, fatty, salty, sugary products of non-optimal nutritional value and cheap and easily available alcohol. The epidemics are also the product of environments where it is difficult to walk or exercise, with the tobacco industry forever hovering in the background ready to seize the commercial initiative given half a chance. Digital technologies have and will become intrinsic to these environments. So, it is not so much that we should not think about new

ways in which digital technologies may help people individually take more exercise, monitor their blood sugar, or drink less alcohol. Rather, we must also reflect on the nature of digital technologies working at the distinct population level. The papers in this collection show that this is conceptually quite difficult. We also have to be savvy about our enthusiasm for the new. Anti-health forces would be delighted if we switched all our preventive attention to individually based digital behavior change technologies because it lets them right off the hook. Both the individual and social levels of analysis intrinsic to public health with their different epistemic assumptions must be uppermost in our collective research minds as we think about the digital landscape as it might look in 10, 20, or even 30 years' time.

We hope that this crossdisciplinary and interdisciplinary collection of papers from scholars around the world will help not just elucidate some of the issues but prompt debate and discussion about this exciting field

and perhaps move some of the scientific questions forward.

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