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History, Technology of Internet and its Impact on Public Health

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Abstract

Like in so many other times in human history, technology in the 20th century was driven by war efforts. During the Second World War, Germans developed advanced cryptography and with their Enigma machines they were able to develop a new type of war that they called the Blitzkrieg strategy. On the other side the allies working at Bletchley Park, England, managed to crack the Enigma code and developed the sophisticated Colossus - the first electronic computer. Scientific discoveries during this period ranged from wireless communications to nuclear fusion and a suite of other technologies that shaped the way we live and interact with each other to the present day and its impact on human lives from public health point of view.

Keywords: Networking; Packets; Colossus; ARPANET;Public Health; Germany; England.

The history of the Internet is as old as formation of electronic computers in the 1950s. A great visionary thinking by people in the early 1960s brought internet to the floor who saw great potential value in allowing computers to share information on research and development in scientific and military fields. J.C.R. Licklider of MIT first proposed a global network of computers in 1962. He developed the theory of packet switching, which was to form the basis of Internet connections. The concepts of Internet was first introduced to public when a message was sent over the ARPANet from computer science Professor Leonard Kleinrock's laboratory at University of California, Los Angeles. It was the ARPANET in particular which resulted into the development of protocols for internetworking, in which multiple separate networks could be joined together into a network of networks. Internet has really revolutionized the lives of the people around the world. Social media has also become a powerful tool to share ideas and solutions in almost all spheres of daily life. An important research question however is: how can modern technology evolve out the cost effective health delivery for the common masses and the curtailment in the public health diseases? What are the challenges and opportunities that lie ahead?[1] Let us go to its history, technology, and final impact on human lives from public health point of view in chronological order:

First of all, we examine the networks that stepped up ultimately to Internet which included ARPANET; NPL; Merit Network; CYCLADES; X.25 and public data networks; UUCP and Usenet. The Advanced Research Projects Agency Network (ARPANET) pioneered world's operational packet switching network, the first network to implement TCP/IP leading to become the Global Internet. The network was initially funded by the Advanced Research Projects Agency (ARPA, later DARPA) within the U.S. Department of Defense for use by its projects at universities and research laboratories in the US. The packet switching of the ARPANET, together with TCP/IP, would form the backbone of how the Internet works. The packet switching was based on concepts and designs by engineer Paul Baran, British scientist Donald Davies[2,3] and Lawrence Roberts of the Lincoln Laboratory.[4] Prior to the advent of packet switching, both voice and data communications had been based on the idea of circuit switching. The TCP/IP set of communication protocols were developed for ARPANET by computer scientists Robert Kahn and Vinton Cerf. Donald Davies of the National Physical Laboratory (United Kingdom) by 1970 had designed and built the Mark I packet-switched network to meet the needs of the multidisciplinary laboratory.[5]

The Michigan Educational Research Information Triad formed the Merit Network[6] in 1966 as to explore computer networking between three of Michigan's public universities as a means to help the state's educational and economic development.[7] With initial support from the State of Michigan and the National Science Foundation (NSF), the packet-switched network was first demonstrated in December 1971 when an interactive host to host connection was made between the IBM mainframe computer systems at the University of Michigan in Ann Arbor and Wayne State University in Detroit.[7] The Merit Network, Inc. is an independent non-profit 501(c) (3) corporation governed by Michigan's public universities. Merit receives administrative services under an agreement with the University of Michigan. Louis Pouzin designed and directed French research network-The CYCLADES packet switching network who first demonstrated in 1973 to explore alternatives to the initial ARPANET design and to support network research generally. It was the first network to make the hosts responsible for the reliable delivery of data.[9,10] In 1979, two students at Duke University, Tom Truscott and Jim Ellis, came up with the idea of using simple Bourne shell scripts to transfer news and messages on a serial line UUCP connection with nearby University of North Carolina at Chapel Hill. Following public release of the software, the mesh of UUCP hosts forwarding on the Usenet news rapidly expanded. UUCP networks spread quickly due to the lower costs involved and ability to use existing leased lines, X.25 links or even ARPANET connections and sublink network, which progressed through popular diffusion.

On the other side of the fence, the Soviets were trying to keep up with the computer science development that was being made, especially on the United States. Clearly this was an area where they were not as successful as in the field of space science. Regarding the development of Soviet computer technology of the 60's and 70s', it is important to emphasize that much of their work "copied" the work being done on the West. The computers being built in the Soviet Union were copies of the Western ones, with a lower degree of quality. Seymour Goodman says in his 1979 article "Soviet Computing and Technology Transfer" that in 1966-67, the Soviets began working on another upward-compatible family. The M-1000, M-2000, AND M-3000 were developed under the Ministry of Instrument Construction, Means of Automation, and Control Systems (Minpribor)- The M-2000 and M-3000 used the IBM s/360 instruction set." According to Goodman, the M- series were designed to run the same programs under the same operating system that the IBM computer did. One other very interesting point to notice is the fact that the Soviet computer strategy was built around an idea to design a family of computers which could be scaled up as needed, a similar concept to what we see nowadays with cloud computing scalability. Following this strategy, a computer could be replaced by a new, more powerful one while the information and programs it had been using did not had to be replaced or obtained all over again. In April of 1991, Byte magazine published an article signed by Igor Agamirzian, a senior researcher from the Leningrad Institute of Informatics of the Soviet Academy of Sciences, telling us his views about the Soviet and Russian computing science environment.

In 1973–90 the networks were merged to create the Internet which were TCP/IP; ARPANET to the federal wide area networks: MILNET, NSI, ESNet, CSNET, and NSFNET and Transition towards the Internet. By 1973 Robert E. Kahn of DARPA and ARPANET worked out a fundamental reformulation, where the differences between network protocols were hidden by using a common internetwork protocol, and instead of the network being responsible for reliability, as in the ARPANET, the hosts became responsible.[11] Eventually, in July 1975, the network had been turned over to the Defense Communications Agency. In 1983, the U.S. military portion of the ARPANET was broken off as a separate network, the MILNET. The networks based on the ARPANET were government funded and therefore restricted to noncommercial uses such as research. This initially restricted connections to military sites and universities. During the 1980s, the connections expanded to more educational institutions. In the mid 1980s, National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF), and the Department of Energy (DOE) became heavily involved in Internet research and started development of a successor to ARPANET. As a high-speed, multiprotocol, international network, NSI provided connectivity to over 20,000 scientists across all seven continents. The NSFNET Project also provided support for the creation of regional research and education networks in the United States and for the connection of university and college campus networks to the regional networks.[12] The use of NSFNET and the regional networks was not limited to supercomputer users.

The term "internet" was adopted in the first RFC published on the TCP protocol -RFC 675[13]: It was around the time when ARPANET was interlinked with NSFNET in the late 1980s, that the term was used as the name of the network, Internet[12], being the large and global TCP/IP network. The Internet began to penetrate Asia in the late 1980s. Japan in 1984, connected to NSFNET in 1989. It hosted the annual meeting of the Internet Society, INET'92.[14] Between 1984 and 1988 CERN began installation and operation of TCP/IP to interconnect its major internal computer systems, work stations, PCs and an accelerator control system. CERN continued to operate a limited self-developed system (CERNET) internally and several incompatible network protocols externally. There was considerable resistance in Europe towards more widespread use of TCP/IP, and the CERN TCP/IP intranets remained isolated from the Internet until 1989. Astronaut T. J. Creamer posted the first live Internet link into low earth orbit on January 22, 2010 when he posted the first update to his Twitter account from the International Space Station.[15] As the early ARPANET grew, hosts were referred in the form of the Domain Name System .mil, .gov, .edu, .org, .net, .com and .us, root name server administration and Internet number assignments under a United States Department of Defense contract.[16] In November 2005, the World Summit on the Information Society, held in Tunis, called for an Internet Governance Forum (IGF) to be convened by United Nations Secretary General.[17] In public health, social media can be used to inform, educate, and empower people about health issues[18] to enhance the speed at which communication is sent and received during public health emergencies or outbreaks; to collect surveillance data and to understand public perceptions of issues. Mobile text messaging on new emerging or infectious cases of influenza as online surveillance; alerting the patients regarding their medicine intake for diabetes or cerebro vascular accidents; information sharing through video conferencing or teleconferencing thereby reducing the number of face to face meetings or profuse use of e-mails or social networking through face book/ twitter/yahoo groups etc can modernize health care and bring in efficiency and quality. Inspite of the improved access to such technologies public health and clinical health services are not dominant in their content and/or applications. There are concerns also that the rapid developments and penetration of technology is further causing a digital divide between "haves" and "have nots", causing further disparities in society and along the social gradient. But in the USA, at least, there are consistent "digital divides" in access to healthcare information. These include socioeconomic status, gender, race (Houston & Allison, 2002), health status, language (Berland *et al*, 2001, found Spanish-language sites suffered from even worse quality issues), age (Meischke *et al*, 2005) and physical disabilities such as elderly immobility (Katz & Aspden, 2001) or visual impairment (Davis, 2002). Most importantly, much data support claims that higher education levels corresponds with Internet use (Gimenez-Perez *et al*, 2002; Pandey *et al*, 2003; Licciardone *et al*, 2001). Kakai *et al* (2003) found that people of higher education levels prefer to get their health information through seemingly objective, scientific, and updated forms, such as the Internet, while those of lower educational levels prefer to have their information come from interpersonally communicated sauces. Perhaps one way to increase delivery to the "have-nots" may be to develop health kiosks in ways that appeal to the elderly and non-native language speakers; of course attention to location and usability would be paramount, as well as situated teaching campaigns to train local populations in their use. In conclusion, it is safely added that the technology needs to be used to strengthen health systems and improve efficiency, safety and quality of health. For accomplishment of this objective, internet has been observed to be the powerful tool and the investment in this modern technology is revolutionizing the public health system today and also for the future.

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