Inclusive innovations in services: leveraging digital technologies for inclusive innovations in healthcare services

Rajan Varadarajan
Department of Marketing, Texas A&M University, College Station, Texas, USA

Received 3 February 2023
Revised 27 January 2024
22 April 2024
Accepted 6 May 2024

Abstract

Purpose – This paper aims to provide insights into the potential of digital technologies-based innovations for more inclusive healthcare by alleviating the affordability, accessibility and availability barriers to utilization of healthcare services. Also, it aims to provide insights into the potential of digital technologies-based innovations for more inclusive services, broadly.

Design/methodology/approach – A conceptual framework is inductively developed by analyzing real-world examples of digital technologies-based innovations for more inclusive healthcare through the lenses of economics of information in digital form and certain characteristics of services.

Findings – Concurrent implementation of digital technologies-based healthcare innovations with innovations and/or modifications in service processes can enable greater inclusivity by alleviating the affordability, accessibility and availability barriers to utilization of healthcare services.

Research limitations/implications – Issues relating to inequities in healthcare, as a social problem, are the focus of research at multiple levels (e.g. global, national, regional and local) in several academic disciplines. In relation to the scope of the problems and challenges pertaining to providing quality healthcare to the unserved and underserved segments of society, worldwide, the contribution of the proposed framework to practice is modest. However, by highlighting the promise and potential of digital technologies-based innovations as solutions for alleviating barriers to affordability, accessibility and availability of healthcare services during various stages (prevention, detection, diagnosis, treatment and post-treatment follow-up) with illustrative vignettes and developing a framework, the article offers insights for future research. For instance, in reference to mission-driven social enterprises that operate in the product-market space for inclusive innovations under resource constraints, a resourcefulness-based view of the social enterprise constitutes a potential avenue for theory development and research.

Practical implications – Given the conceptual nature of the article, the implications for practice are limited to cognitive implications. Action implications (instrumental implications or implications for practice) are outside of the scope of the article.

Social implications – Innovations that are economically viable, environmentally sustainable and socially impactful is one of the important issues of our times.

Funding: The author received no financial support for the research, authorship and/or publication of this article.

Declaration of conflicting interests: The author declares no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

European Journal of Marketing
Vol. 58 No. 13, 2024
pp. 107-129
Emerald Publishing Limited
0309-0566
DOI 10.1108/EJM-02-2023-0080

Originality/value – The proposed framework provides insights into the potential of digital technologies-based innovations for more inclusive healthcare by alleviating the affordability, accessibility and availability barriers in the context of emerging and less developed country markets and base of the pyramid segments of society in these markets.

Keywords Healthcare, Sustainable development goals, Inclusive innovation, Innovation for the greater good, Digital technologies, Base of the pyramid, Digital technologies based innovations

Paper type Conceptual paper

Introduction

"Unlocking Health Technology's Potential for All" (Mazzucato, 2023).

"AI Could Impact Health on A 'Planetary Scale.' Here's How" (Wen, 2023b).

"How Digital Tools Could Boost Efficiency in African Health Systems" (Jousset *et al.*, 2023).

"U.S. HealthCare from a Global Perspective, 2022: Accelerating Spending, Worsening Outcomes" (Gunja *et al.*, 2023).

"How Do We Fix the Scandal That Is American HealthCare?" (Kristof, 2023).

"You Don't Have to Be a Doctor to Know How Much Trouble the N.H.S. Is In" (Pollock and Roderick, 2023).

The titles of first three of the above articles are suggestive of the promise and potential of digital technologies-based innovations for alleviating the affordability, accessibility and availability barriers to healthcare services faced by a large cross-section of humanity, numbering in the billions. However, the titles of next three article highlighting the state of healthcare in the USA and the UK are indicative of major structural shortcomings even in nations with a healthcare safety net that cover all or a large majority of its residents. Healthcare is a *need service* for which the quality of the core service (e.g. a cardiovascular surgery or a cataract surgery) is the same for all of humanity. At the risk of stating the obvious, when people forego availing certain healthcare services due to affordability, accessibility and/or availability barriers (a fact of life in many parts of the world), it is at peril to their life (e.g. foregoing treatment for cardiovascular diseases) or the quality of their life (e.g. foregoing cataract surgery or being fitted with prosthetics).

In recent years, innovations aligned with the social problems highlighted in United Nations (UN) sustainable development goals (SDGs) for 2030 (United Nations, 2015) such as poverty (SDG # 1), hunger and malnutrition (SDG # 2), gender related inequities (SDG # 5) and inequities in access to healthcare (SDG # 3), education (SDG # 4), water and sanitation (SDG #6), energy (SDG # 7) and justice (SDG # 16) have emerged as a major focus of a growing number of firms. An indicator of the importance of specific SDGs, from the standpoint of betterment of the human condition, is the billions of people worldwide faced with a multiplicity of social problems that are the focus of the SDGs. For instance, the size of the unserved and underserved segments of society for healthcare is estimated to be over five billion people globally (Lancet Commission, 2015). Based on an analysis of 2,701 public hospitals located in 48 sub-Saharan countries and islands for which full or partial information about their geographical coordinates were available, Ouma *et al.* (2018) reported that only 16 countries reached the international benchmark of more than 80% of their populations living within a two-hour travel time of the nearest hospital.

In recent years, digital technologies-based innovations have been a transformational force in healthcare, as evidenced by innovations such as tele-healthcare, wearable devices for healthcare, mobile apps for healthcare, artificial intelligence (AI) algorithms for diagnosis and robotics enabled surgery. The economics of information products in digital form that are embedded in other products (e.g. a 3D printing software embedded in a 3D printer for making custom prosthetics; an AI algorithm embedded in an eye scanning device for diagnosing diabetic retinopathy) point to the potential of digital technologies-based innovations for achieving a steep reduction in cost, and thereby alleviate the affordability barrier to healthcare faced by humanity at the base of the economic/market pyramid (BOP). The economics of information products in digital form undergirding their transformative potential in the healthcare sector include low marginal cost (approaching zero) and low cost of processing, storing, retrieving, reproducing, reusing and transmitting information (e.g. X-ray in digital form compared to in analog form).

Intangibility, heterogeneity, inseparability and perishability (IHIP) are highlighted in the services literature as characteristics that distinguish services from goods (Berry, 1980). Although authors have pointed out that the IHIP characteristics do not generalize to all services (Vargo and Lusch, 2004; Lovelock and Gummesson, 2004), several healthcare services evidence the characteristics of:

- heterogeneity (variability in quality within and between providers of a specific healthcare service);
- inseparability (simultaneity of provision and consumption of the healthcare service); and
- perishability (perishability of available service capacity that is not used – an issue of major concern in the current environment of demand for healthcare far exceeding supply capacity).

Against this backdrop, this article presents a framework that provides insights into the potential of digital technologies-based innovations for achieving greater inclusiveness of healthcare services by alleviating the affordability, accessibility, and/or availability barriers to utilization. The framework is inductively developed by analyzing real-world examples of digital technologies-based innovations in healthcare services for BOP markets through the lenses of economics of information in digital form and certain characteristics of services.

The focus of the article aligns with calls for research in marketing on substantive issues at the nexus of healthcare, marketing and technology. For instance, in a recent editorial essay, Moorman *et al.* (2024) noted that the marketing discipline has an opportunity to contribute toward enhancing our understanding the complexities of healthcare in a changing environment. Anderson *et al.* (2019) noted that marketing is uniquely positioned to address future challenges facing healthcare service systems. They note that a preferred future in healthcare can be achieved by implementing a three-pronged approach that includes health promotion and prevention, appropriate use of technology in healthcare and value co-creation. Ostrom *et al.* (2021) highlighted leveraging technology for service provision and consumption as a key research priority for the services discipline. Agarwal *et al.* (2020) highlighted the need for research on how technology and analytics-enabled healthcare services can be designed for inclusivity and the benefit of vulnerable population segments. In literature on transformative service research, Anderson and Ostrom (2015) enumerated health are offerings, service models and service designs for reducing inequities in healthcare as healthcare related substantive issues that are important to the field.

The remainder of the article is organized as follows. First, an overview of relevant literature is presented. Second, definitions of innovation, innovations for the greater good (IGGs) and inclusive innovations are proposed. Third, a conceptual framework that provides insights into the potential of digital technologies-based innovations for greater inclusiveness of healthcare services by alleviating the affordability, accessibility and availability barriers is presented. The article concludes with a discussion on implications for practice, theory and future research.

Literature overview

Innovations for the greater good

In common parlance, the phrase "for the greater good," is used to mean, for the benefit or well-being of society or a broad cross-section of society. However, the term, "innovations for the greater good," is generally used in business literature to refer to innovations that create value for both the innovating firm and society. IGGs refer to innovations that are economically viable, environmentally sustainable and socially impactful. An IGG creates value for the shared benefit of the innovating organization and society. An IGG creates economic value benefitting the innovating organization by generating a rate of return greater than the cost of capital. It benefits society by creating environmental value through alleviation of harm to the environment and/or social value through alleviation of social problems. IGGs are conceptually distinct from social innovations, whose purpose is value creation primarily for the benefit of society. For instance, Phills *et al.* (2008, p. 39) defined *social innovation* as "a novel solution to a social problem that is more effective, efficient, sustainable, or just than existing solutions and for which the value created accrues primarily to society as a whole rather than private individuals." Issues relating to IGGs have been explored in several literature streams including:

- innovations for base of the pyramid markets (Prahalad, 2006; Prahalad, 2012);
- inclusive innovations (George *et al.*, 2012; Mashelkar, 2012); and
- responsible innovations and responsible innovations in healthcare (Lehoux *et al.*, 2021; Silva *et al.*, 2018).

Innovations for base of the pyramid markets. The term, "base of the economic pyramid" is commonly used in literature to refer to population groups with the lowest levels of income in any given society (e.g. in a country). From an exchange perspective, the term, "base of the pyramid market," (BOP market) is commonly used in literature to refer to customer groups or market segments with the lowest levels of income in any given society. A major focus of literature on BOP markets is barriers to consumption or use of specific products by people at the BOP. The impediments highlighted in the literature include:

- *affordability* (i.e. BOP customers lacking the financial means to buy specific products at prevailing prices);
- *accessibility* (e.g. inability of people at the BOP residing in rural areas to avail healthcare services that are available only in major urban locations, due to nonexistent or deficient transportation infrastructure such as road and rail connectivity);
- *availability* (e.g. number of physicians caring for patients at public hospitals relative to the number of BOP patients in need of specific healthcare services; demand far exceeding supply or service capacity);
- awareness (e.g. lack of awareness among segments of society residing in media dark markets about healthcare services that they can avail at no cost); and
- *usability* (e.g. inability of households which are not connected to the electric grid to use products such as household electrical appliances; inability of people with low literacy levels to use financial services delivery technologies such as ATMs) (See:

Anderson and Markides, 2007; Prahalad, 2004; Sheth and Sisodia, 2012; Kolk *et al.*, 2014).

Prahalad (Prahalad, 2004; Prahalad, 2006; Prahalad, 2012) enumerated four criteria that innovations for BOP markets must meet to be economically viable and socially impactful.

Affordable: The innovation should achieve a steep reduction in cost as a precursor for a steep reduction in price – a price that BOP customers can afford. The affordability criterion implies that the new product development process should be guided by the "Price – Profit = Cost" approach (i.e. price affordable by BOP customers) rather than the traditional "Cost + Profit = Price" approach.

Accessible: The innovation should result in a significant increase in the accessibility of the product by customers in the BOP market segments.

Available: The innovation should be scalable to significantly increase supply to meet the demand for the product by customers in the BOP market segments.

Comparable: The innovation should achieve a level of product quality that is comparable to the quality of products used or consumed by customers in developed country markets, and the affluent segments of society in emerging and less developed country markets.

In reference to products in general, Prahalad (2006) specified *comparable quality* as innovations for BOP markets offering a quality level in the range of 80%–90% compared to the quality of products marketed to customers in developed country markets, and the affluent segments of society in emerging and less developed country markets. However, as noted earlier, for healthcare, a need service, the quality of the *core service* is the same for all of humanity.

Inclusive innovations. George *et al.* (2012) conceptualize *inclusive innovations* (innovations for inclusive growth) as the development and implementation of new ideas that create or enhance opportunities for improving the social and economic wellbeing of disenfranchised members of society, such as those at the base of the economic pyramid. They construe inclusive innovations as encompassing innovations in goods, services, business models, processes, institutions, etc. They note that when economic, geographic, social and/or other structural barriers prevent certain sections of society from achieving social and economic wellbeing, innovations can foster inclusiveness by eliminating the structural barriers. Mashelkar (n.d., p. 99) defined inclusive innovations as "any innovation that leads to affordable access of quality goods and services creating livelihood opportunities for the excluded population, primarily at the base of the economic pyramid and on a long-term sustainable basis with a significant outreach." He further notes that true inclusive innovations create extremely affordable goods and services, rather than creating just affordable goods and services. Mashelkar characterizes innovations for inclusive growth – achieving more performance by using less resources for more people – as the *MLM paradigm*.

Based on an in-depth analysis of the inclusive healthcare initiatives of six organizations based in India, Angeli and Jaiswal (2016) noted that their actions evidence eight areas of emphasis:

(1) *Co-creation of patient needs*: Ensuring that patients are aware of their health needs and recognize the health-enhancing potential of the proposed solutions.

(2) *Community engagement*: A stronger focus on communities of patients.

(3) *Interactions with customers*: Extensive interactions for gaining customer insights.

(4) *Technology-enabled innovations*: Telemedicine.

(5) *Human resources*: Use of the same human resources at lower costs or the use of less costly human resources.
(6) *Strategic partnerships*: With an extensive network of strategic partners.
(7) *Economies of scale*: Through specialization.
(8) *Cross-subsidization*: Through differential pricing of services for affluent versus less affluent patients.

Using a policy intervention (a program launched by the Vietnamese government in 2005 for providing free universal health insurance for children under the age of six) as a natural experiment, Aiyar and Venugopal (2020) evaluated the effect of inclusion in the healthcare market by comparing the outcomes for eligible children with older children who were ineligible based on three measures – healthcare utilization, healthcare expenditure and demand for complementary services. Based on data from two surveys (2005 and 2008), the authors report that the levels of utilization of healthcare services, out-of-pocket spending on healthcare and utilization of complementary healthcare services were higher for the group covered by the policy intervention compared to the group excluded from the policy intervention.

Responsible innovations and responsible innovations in health. Synthesizing extant literature on responsible research in innovation (RRI), Silva *et al.* (2018) enumerated four core principles of RRI: (1) Address societal needs and challenges. (2) Engage a range of stakeholders with the aim of improving decision-making and mutual learning. (3) Anticipate potential problems, assess available alternatives and reflect on underlying values, assumptions and beliefs. (4) Provide guidance on ways to act in accordance with the previous principles. Drawing on the core principles of RRI, Silva, *et al.* conceptualize *responsible innovation in health* (RIH) as a collaborative endeavor by stakeholders who commit to meeting a specific set of economic, environmental, ethical and social principles, values and requirements in the design, financing, production, distribution, use and disposal of sociotechnical solutions for addressing the needs and challenges of health systems in a sustainable manner.

Silva *et al.* (2018) presented a five value domains-based framework for fostering responsible innovations in health (RIHs) and assessing the potential of RIHs. (1) *Population health value*: The extent to which the innovation increases the ability to address society's collective need to tackle inequities in healthcare. (2) *Health system value*: The extent to which the innovation provides an appropriate response to contemporary challenges of health systems. (3) *Economic value*: The extent to which the innovation delivers both a high-performing and affordable product to support healthcare equity and sustainability. (4) *Organizational value*: The extent to which the innovating organization through the business model it employs seeks to provide more value to users, purchasers and society. (5) *Environmental value*: The extent to which the innovation reduces negative environmental impacts of health innovations over their lifecycles.

Digital Technologies-Based innovations

Digital: Information (data, text, images, sound, etc.) that is stored, transmitted, manipulated or reproduced by a process using groups of electronic bits represented as ones and zeros (Collins Dictionary, n.d.).

Technology: Methods, systems and devices which are the result of scientific knowledge used for practical purposes (Collins Dictionary, n.d.).

Digital Technologies: Methods, systems and devices in which information is represented, manipulated, processed, reproduced, retrieved, stored and transmitted in digital form.

The proposed definition of digital technologies is based on above stated dictionary definitions of "digital" and "technology."

Digital technologies-based innovations, by fostering greater inclusiveness, have been a transformational force in various industries. Goldfarb and Tucker (2019), in their review of literature on digital economics, provided insights into how standard economic models change as certain costs (search costs, replication costs, transportation costs, tracking costs and verification costs) fall substantially, approaching zero. Weiss *et al.* (2018), in a review of literature, broadly classify *innovations in health-related technologies* as (1) direct end-user technologies (e.g. health portals, internet sites, apps and wearable consumer technologies), (2) direct-use gatekeeper technologies (e.g. metered-dose inhalers) and (3) indirect-use gatekeeper technologies (e.g. angiography, defibrillators and magnetic resonance imaging). Jousset *et al.* (2023) enumerated 24 digital health tools for efficiency gains and classify them into six broad categories: (1) *Virtual interactions* (e.g. live audio and video consultations; remote monitoring). (2) *Paperless data* (e.g. AI virtual assistant; e-prescribing). (3) *Patient self-care* (e.g. digital diagnostics; patient support network). (4) *Patient self-service* (e-scheduling). (5) *Decision intelligence systems* (e.g. clinical decision support; patient flow management). (6) *Workflow automation* (e.g. e-referral; nurse mobile connectivity). Based on their study on the potential financial impact of adoption of digital health tools in Kenya, Nigeria and South Africa, they note that by expanding use of digital health tools, health systems in these countries could realize up to 15% efficiency gains by 2030 and reinvest the savings to improve access and outcomes.

In a study focusing on digital service innovations capabilities for value creation for BOP customers, Sunder and Modukuri (2024) identify persuasion, co-creation, adaptation and self-sustainability as essential capabilities. That is, capabilities for creating value along the dimensions of awareness, acceptability, availability and affordability for BOP customers. The authors inductively derive the above capabilities based on an in-depth analysis of three firms offering three different essential services (healthcare, education and finance) and using different digital service innovation paths: (1) *Innovative service delivery system* – a new way of interacting with customers. (2) *Innovative service interface* – a highly personalized interface designed to cater to the needs of individual customers. (3) *Innovative service concept* – using a problem-solving approach to become more relevant to the beneficiaries.

In a study focusing on barriers to adoption of digital health tools by consumers, Iyanna *et al.* (2022) classify healthcare providers' perceptions of major barriers to adoption of e-health by users into three broad categories. (1) *Functional barriers* – (a) usage barriers – task-related and usability related barriers, (b) value barriers – infrastructure and resource related barriers and (c) risk barriers – perceived threat. (2) *Psychological barriers* – tradition and image related barriers. (3) *Context-specific barriers* – patient care, system and self-efficacy related barriers.

Pearl and Wayling (2022) noted that virtual healthcare (aka: telemedicine or telehealth) can improve patient health, reduce costs and make healthcare more equitable and accessible to anyone with a smartphone – to the 89% of USA adults and 78% of adults globally who own a smartphone, including those in medically underserved communities. However, in view of the *market focus* of this article (humanity at the base of the pyramid in emerging and less developed country markets), the *product focus* is on digital technology-based products for use by healthcare providers to provide in-person service. Virtual healthcare that requires patients to own and use digital technology-based products (e.g. desktop or laptop computer, smartphone and smartphone apps and wearable devices such as the smartwatch) are outside the scope of the article.

Innovation, innovation for greater good and inclusive innovation: definitions [1]

Innovation: The development and implementation of a novel idea for a new product, process or practice or significant improvement of an existing product, process or practice that creates value for the stakeholders (Varadarajan, 2024).

Innovation for the greater good (IGG): The development and implementation of a novel idea for a new product, process or practice, or significant improvement of an existing product, process, or practice that creates economic value for the innovating firm, environmental value for society by alleviating harm to the environment and/or social value for society by alleviating a social problem (Varadarajan, 2024).

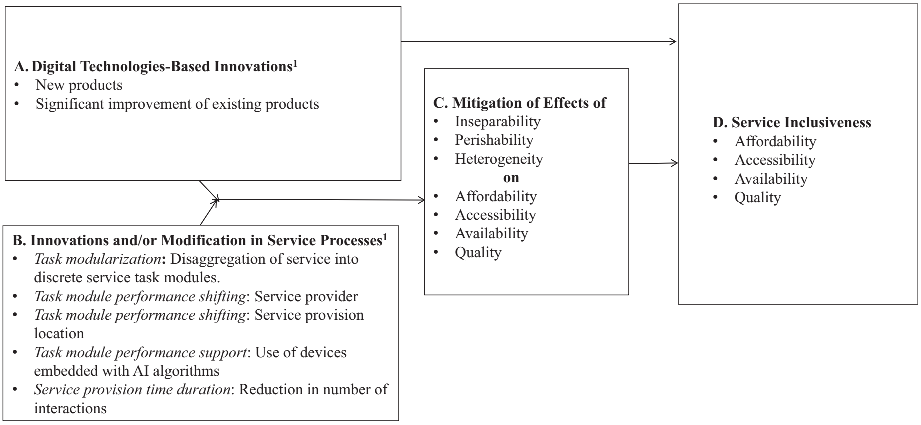
Inclusive product innovation: The development and implementation of a novel idea into a new product or significant improvement of an existing product that enables one or more segments of society who are currently nonusers of the product to become users, creates economic value for the innovating firm, utilitarian value for users of the product and social value for society (Varadarajan, 2024).

In the above definitions, the term, "products" encompasses goods, services, hybrids of good and services, experiences, places, etc. The offering of a service as a product to customers generally entails the use of one or more goods. In certain instances, innovations in goods spur innovations in services (e.g. the use of drones to deliver medicines and medical supplies to hospitals located in places with poor road and rail connectivity). In other instances, market opportunities for services spur innovations in goods (e.g. the market for nonstop international flights between far apart cities spurring innovation in commercial aircraft manufacturing). The literature underpinnings of the above definitions are discussed in Varadarajan (2024).

Digital technologies-based innovations for more inclusive healthcare: a conceptual framework

Figure 1 presents a conceptual framework that provides insights into the potential of digital technologies-based innovations for greater inclusiveness of services broadly, and healthcare services specifically. The framework is inductively developed based on real-world examples of digital technologies-based innovations for greater inclusiveness in healthcare services. Specifically, by analyzing the innovations through the lenses of economics of information in digital form (marginal cost approaching zero; low cost of access, processing, retrieval, reproduction, reuse, storage and transmission) and certain characteristics of services (simultaneity, perishability and variability) for insights into how they alleviate barriers to the affordability, accessibility and availability of healthcare services. Although the framework is inductively developed based on real-world examples of digital technologies-based innovations for greater inclusiveness in healthcare services, it generalizes to a broader class of services that exhibit the characteristics of inseparability, perishability and heterogeneity.

Figure 2 presents a conceptual framework (an elaboration of Figure 1) that provides insights into the potential of digital technologies-based innovations for greater inclusiveness in healthcare services. In Box A of Figure 2, digital technologies-based innovations are broadly distinguished as new products and significant improvement of existing products. Connectivity and interactivity enabled by information and communication technologies (ICTs) and information products embedded in the core product (goods, services and hybrids of goods and services) are among the characteristics of digital technologies-based products that facilitate greater inclusiveness. Illustrative of an information product embedded in a core product are (1) a 3D printing software



Notes: [1]The arrows from Boxes A and B to Box C denote the joint effect of digital technology-based innovation (Box A), and innovations and/or modifications in service processes (Box B) in ameliorating the effects of the inseparability (simultaneity of service production and consumption), perishability (non-inventoriable) and heterogeneity (variability in service quality within and between providers of a specific service) characteristics of services on the affordability, accessibility, availability and quality of the service
Source: Author's own work

Figure 1. Digital technologies-based innovations for greater inclusiveness of services: a conceptual framework

embedded in a 3D printer, and (2) an AI algorithm for detecting diabetic retinopathy embedded in an eye scanning device.

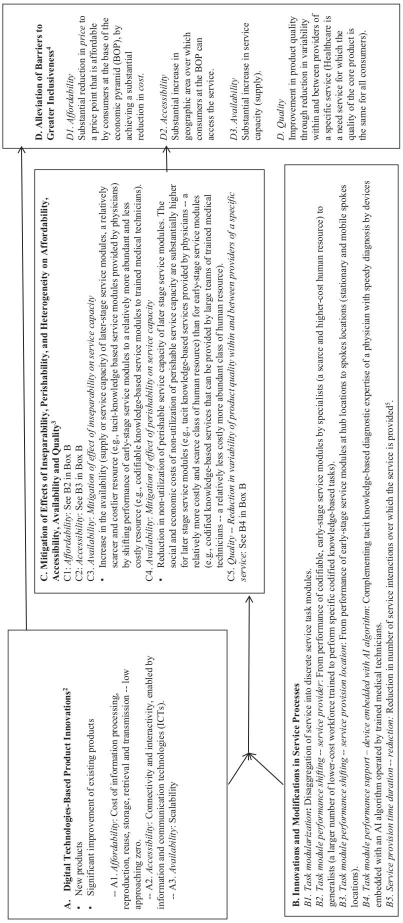
In Box B of Figure 2, the following are highlighted as innovations and/or modifications in service processes, when implemented concurrently with specific digital innovations can alleviate the affordability, accessibility and availability barriers. (1) *Task modularization*: disaggregation of a service into discrete task modules. (2) *Task module performance shifting*: service provider. (3) *Task module performance shifting*: service provision location. (4) *Task module performance support*: AI algorithms embedded as apps in devices. (5) *Task performance time duration*: reduction in number of interactions over which a service is provided.

In Box C of Figure 2, the joint effects of the digital technologies-based innovations and concurrent innovations and/or modifications in service processes in the alleviation of affordability, accessibility and availability barriers through their effects on the following characteristics of the services are highlighted: (1) *Simultaneity*: Inseparability of service provision and consumption. (2) *Perishability*: Economic and social costs of non-utilization of service capacity (supply) of specific service task modules. (3) *Heterogeneity*: Variability in product quality within and between providers of a specific service. The potential outcomes of the innovations (affordability, accessibility, availability and quality) are shown in Box D of the figure.

A discussion on the framework follows and is organized around the following links shown in Figure 2.

Link A → D: Alleviation of affordability, accessibility and availability barriers to healthcare through digital technology-based innovations.

Link A, B → C → D: Alleviation of affordability, accessibility and availability barriers to healthcare through digital technology-based innovations (Box A) and concurrent



Notes: [1]Figure 1 presents a conceptual framework on the potential for leveraging digital technologies for more inclusive innovations in services, broadly. The conceptual framework presented in Figure 2, an elaboration of Figure 1, provides a focused perspective on the potential of digital technologies-based innovations for greater inclusiveness in healthcare services, specifically. Vignettes of representative digital technologies-based inclusive innovations that the framework is based on are discussed in the text. [2]The term product encompasses goods, services, experiences, places, etc. Most service products entail the use of goods to provide the service. For example, the use of drones to deliver medicines and medical supplies to hospitals located in places with poor road and rail connectivity. [3]The arrows from Boxes A and B to Box C denote the joint effect of digital technology-based innovation (Box A) and service process innovations or modifications (Box B) in ameliorating the effects of the inseparability, perishability and variability characteristics of services on service affordability, accessibility, availability and quality. [4]Crucial for a service innovation for the greater good to be socially impactful through greater inclusiveness is achieving a steep or substantial reduction in cost (for the service provider to be able to offer the service at a price that is affordable by BOP customers), a substantial increase in accessibility and a substantial increase in availability, relative to existing offerings. [5]Effect on Availability: Increase in service capacity through reduction in the number of service interactions required to provide a service

Source: Author's own work

Figure 2. Digital technologies-based innovations for greater inclusiveness of healthcare services: a conceptual framework[1]

innovations or modifications in service processes (Box B) that mitigate the effects of inseparability, perishability and heterogeneity characteristics of services on affordability, accessibility, and availability barriers to healthcare (Box C).

First, vignettes of real-world examples of the following types of innovations for greater inclusiveness in healthcare services are presented. The proposed labels are an attempt to succinctly capture the defining characteristics of the innovations discussed (and, by extension, potential innovation opportunities). Next, in reference to the linkages delineated in the framework, a discussion on the following innovations is presented at a conceptual level:

- ICTs based, hub and spokes model for healthcare services.
- Drones-based, hub and spokes model for distribution of goods for healthcare provision.
- 3D printing technology-based retail factory model for hybrid healthcare products (hybrids of goods and services).

- AI algorithm powered, on-site equipment-based model for diagnostic healthcare services.
- AI algorithm powered, portable devices-based, asset light off-site model for diagnostic healthcare services.
- Mobile app enabled portable devices-based, asset light off-site model for diagnostic healthcare services.
- Adaptation of off-the-shelf, low-cost digital devices for providing healthcare services, on-site and off-site.

Information and communication technologies based hub and spokes model for greater inclusiveness in healthcare

Vignette: In certain emerging country markets, a few healthcare service providers have achieved considerable success in alleviating the affordability, accessibility and availability barriers related to serving humanity at the BOP by implementing ICTs enabled hub and spokes service delivery models. As opposed to providing all modules of a healthcare service at either a central location or at multiple locations, early-stage modules of a service are performed at multiple spokes locations by trained medical technicians. For example, preliminary eye examinations are performed at spokes locations and corrective eyeglasses are dispensed to some of the patients and follow-up examinations of other patients are performed by specialist physicians based at a hub location, facilitated by ICT enabled connectivity and interactivity (i.e. information transmission and interaction between patients and medical technicians at spokes locations and physicians based at the hub location in real-time). For patients who are diagnosed as needing later stage modules of the service (e.g. cataract surgery), they are provided by physicians at the hub location. [See Case studies on the Aravind Eye Hospital: Rangan (1993); Chaudhary *et al.* (2012)].

A prerequisite for offering a service at a *price* that BOP customers can afford is innovating to achieve a steep reduction in *cost* (to an amount that is lower than the price that BOP customers can afford). For certain services, a viable mechanism for achieving a significant cost reduction is disaggregating the service into discrete task modules (B1 in Figure 2) and shifting the performance of certain modules (i.e. codifiable knowledge-based task modules) to a lower cost category of service providers (B2 in Figure 2). Shifting of the performance of early-stage codifiable knowledge-based task modules to a lower cost and more abundantly available type of service provider (medical technicians) also increases the availability (service capacity/service supply: D3 in Figure 2) of a relatively scarcer and higher cost type of service provider (e.g. providers of tacit knowledge-based task modules).

Geographic proximity of households to the physical locations of service providers and service provider density (number of providers within a defined radius) are among the measures of accessibility that have been used in prior research (see: Suri and Jack, 2016). For certain services, a viable mechanism for alleviating the accessibility gap is delivering early-stage modules of the service at multiple stationary spokes locations (e.g. small towns and cities) and/or mobile spokes locations (e.g. mobile clinics on wheels) and facilitating connectivity and interactivity between patients and service providers based at spokes locations and specialist service providers based at the hub location by using ICTs (see A2 and B3 in Figure 2). ICTs refer to technologies for capturing, processing, storing and communicating information. ICTs provide access to information through communication networks that encompass the Internet, computer hardware and software, mobile phones, communication satellites, etc. (Heeks, 1999; Zuppo, 2012).

Given the inseparability characteristic of certain services (simultaneity of production and consumption), task shifting of early-stage service modules (codifiable knowledge-based tasks) to a more abundantly available and lower cost category of service providers increases the availability (service capacity/service supply) of a relatively scarcer category of service providers (providers of later-stage, tacit knowledge-based service modules). For example, the number of cataract surgeries that a physician can perform during an eight-hour period. That is, in the face of the simultaneity constraint, a mechanism for increasing availability (service capacity or supply) at a significantly lower cost is disaggregating the service into discrete task modules, and task-shifting of performance of specific modules to a team of lower cost category of trained service providers.

For certain services such as healthcare, the social and economic costs of non-utilization of perishable service capacity are substantially higher for later stage service modules (e.g. tacit knowledge-based services provided by specialists using specialized equipment and facilities such as an operating theater) than for earlier-stage service modules (e.g. codified knowledge-based services that can be provided by a medical technician). As shown in Figure 3, for certain services, a viable mechanism for increasing the availability (service capacity or supply) of the full service is disaggregating the service into discrete task modules, and using an ICT enabled hub and spokes service delivery model to minimize non-utilization of perishable service capacity of later stage service modules.

Drones-based hub and spokes model for distribution of goods for healthcare provision

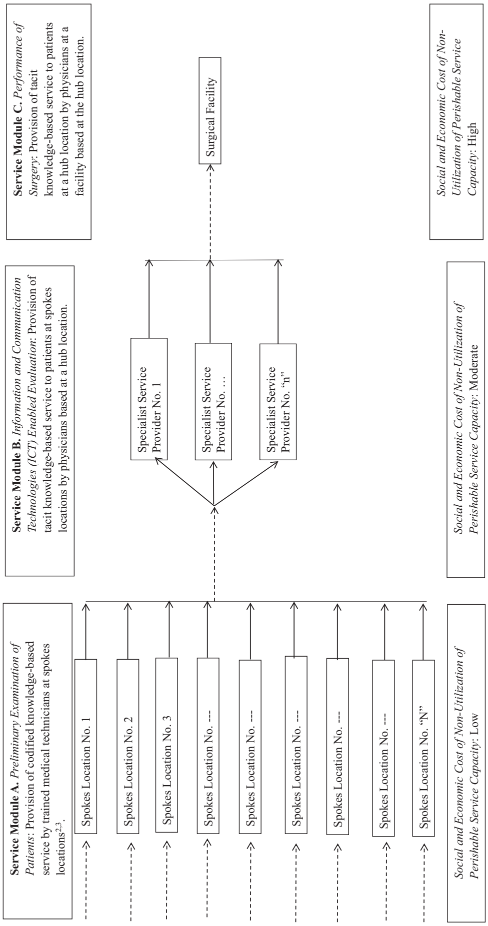
Vignette: An innovation that some start-up enterprises have used to circumvent the lack of infrastructure or deficient infrastructure in less developed country markets is a hub and spokes model for delivery of medicines and medical supplies using drones. Specifically, delivering medicines and medical supplies to hospitals (1) located in remote areas with poor road and/or rail connectivity, (2) that lack refrigerators to store medicine, (3) face the risk of spoilage of medicines which require refrigerated storage due to frequent power outages and/or (4) lack the financial resources to stock infrequently used, high-priced medicines and medical supplies (see: Baker, 2017).

A mechanism for alleviating the availability barrier under conditions of major deficiencies in infrastructure (e.g. transportation infrastructure – rail and road connectivity; electric power infrastructure) is innovating to circumvent dependence on the infrastructure to provide the service. Case in point is the use of drones and a hub and spokes delivery model for distribution of medicines and medical supplies to hospitals. The affordability gap is also partially alleviated through a reduction in the inventory carrying costs (i.e. reduction in inventory carrying cost by stocking infrequently used and/or costly medicines at a single central location versus at multiple locations).

3-D Printing technology-based retail factory model for hybrid healthcare products

Vignette: Compared to a prosthetic leg made with multiple materials by using traditional means of manufacturing, a Japanese firm demonstrated that a prosthetic leg can be made at a substantially lower cost (e.g. $4,200 versus $100 in Japan) by using 3D-printing technology using elastic polymer that is soft to the touch (Fujikawa, 2016).

Hybrid product innovations refer to innovations that encompass both a good (a tangibles-dominant product) and a service (an intangibles-dominant product). As opposed to the traditional model (e.g. production of a good such as prosthetics at a central hub location and performance of the related service, namely, fitting of prosthetics, at multiple geographic locations), a significant reduction in affordability, accessibility and availability barriers can



Notes: 1An exposition in the context of healthcare services that can be disaggregated into discrete modules and different modules performed at different locations. 2Dotted arrows denotes patient queue. 3Spokes denote fixed spokes (e.g. physical locations), mobile spokes (e.g. clinics on wheels), or a combination of both
Source: Author's own work

Figure 3. Increasing overall service capacity by increasing utilization of knowledge and resource intensive service modules[1]

be achieved by using a 3D printing technology-based retail factory model (i.e. production of both the good and performance of the related service at multiple locations). The retail factory model is conducive to the establishment of small business enterprises that can afford to invest in a 3D printer, 3D printing software and supplies sourced from businesses based at hub locations to produce the good and perform the service at spokes locations. Particularly, in communities in which large numbers of customers may need the product, such as regions where landmines were placed during conflicts. Small businesses (retail factories) that produce and fit prosthetics can also stimulate economic development at the local level (in small towns and cities). Diffusion of the 3D printing technology-based factory model has the potential to enable tens of thousands of people worldwide who may be unemployed due to physical disabilities, to be gainfully employed.

While the above vignette is illustrative of an innovation for the greater good (value creation for both the innovating firm and society), a similar recent innovation for the social good (value creation primarily for the benefit of society) is offering customized 3D-printed prostheses created and printed by a global community of volunteers to those in need of upper limb assistive devices (hands and arms) at no cost. The designs for the prostheses are open-sourced and are available at no cost on a website dedicated to the sharing of the digital design files (see Silva *et al.*, 2018). Under the broader umbrella of innovations for the social good, the above example is illustrative of *open-sourced digital innovation for the social good* (*crowd-sourced digital innovation for the social good*). Tomašev *et al.* (2020) noted that advances in AI and machine learning present opportunities for building better tools and solutions for addressing the social problems outlined in UN's SDGs [2].

AI algorithm powered, equipment-based, on-site and off-site models for diagnostic healthcare services

The potential of AI for transforming healthcare are the focus of books (Topol, 2019), journal articles (Davenport and Kalakota, 2019) and articles in the business press and popular press (Wen, 2023a; Wen, 2023b). They provide insights into the potential of AI for enhancing efficiency (e.g. reduction in treatment costs) and effectiveness (e.g. improvement in health outcomes) broadly and in specific domains such as drug discovery, clinical trials, early detection of diseases, diagnosis, treatment, preventive care and patient wellness, to list a few. The following vignettes provide insights into digital technologies-based products embedded with diagnosis focused AI algorithms for fostering greater inclusiveness in healthcare.

Vignette: *AI algorithm aided diagnosis of diabetic retinopathy*. According to the World Health Organization, nearly 70 million people in India are diabetic and at risk of blindness. According to the International Council of Ophthalmology, for every million people in India, there are about 11 ophthalmologists. Currently, diagnosis of diabetic retinopathy is mostly done by trained physicians examining patients to identify tiny lesions, hemorrhages and discoloration in their eyes. A recent innovation for diagnosing diabetic retinopathy is an AI algorithm embedded desktop device for scanning the eyes of patients and displaying the results of the test on a computer screen within seconds. By analyzing millions of retinal scans showing signs of diabetic blindness, AI algorithm aided screening methods learn to identify the condition (Metz, 2019). Metz notes that according to the findings of a research study (Gulshan *et al.*, 2016), while the system performs on par with trained ophthalmologists, it is far from completely replacing them for diagnosis.

Vignette: *AI algorithm aided diagnosis of tuberculosis*. In 2019, tuberculosis (TB) is reported to have claimed nearly 1.4 million lives worldwide. A recent innovation for screening and diagnosing TB is an AI algorithm app installed on a smartphone or a computer for scanning lung X-rays for signs of TB. In less than a minute, the app scans an X-ray for signs of TB and assigns a patient a risk score if it finds evidence of TB. Physicians perform confirmatory tests on patients with the highest risk. Thus, rather than replacing physicians, the AI-based algorithm complements them. In emerging and less developed economies, the innovation is viewed as particularly crucial for flagging the disease among people residing in remote regions with poor and road rail connectivity. It is envisioned that the innovation can help flag the disease early, and used on a large scale, aid in identifying locations that are emerging clusters of the disease (Mandavilli, 2020).

Vignette: *AI algorithm aided interpretation of ultrasound images*. It is estimated that in 2020, worldwide, about 800 women died every day during pregnancy or childbirth due to causes that are preventable (World Health Organization, 2023). Although the World Health Organization recommends performing prenatal ultrasounds for all pregnant women, it has been noted that about 50% in developing countries do not for various reasons. For an ultrasound to be performed, first, the patient must be able to travel to a facility staffed with a trained technician. Next, the sonographic images must be transmitted to a radiologist or specially trained obstetrician for interpretation. In some countries, poor transportation infrastructure and shortage of trained medical technicians are barriers to expectant mothers receiving an ultrasound. An innovation that is currently being tested is a low-cost, battery-operated handheld ultrasound device that community health workers can be trained to operate with a few hours of training. The images, uploaded onto a smartphone are interpreted by an AI algorithm app. The innovation, by enabling earlier and more frequent screenings, facilitates referring patients to timely higher-level care when needed (Wen, 2023a). Wen draws attention to a study by Gomes *et al.* (2022) that found the level of accuracy of the AI algorithm to be comparable to prevailing clinical standards.

In the articles that the above vignettes are based on (Metz, 2019; Mandavilli, 2020; Wen, 2023a), an AI algorithm is construed as "an algorithm that learns from a large volume of past data to interpret new data and improves its interpretation performance over time with exposure to additional data." (e.g. an algorithm that learns from analyzing millions of retinal scans that show signs of diabetic blindness to interpret the retinal scans of new patients for signs of diabetic blindness) [3]. The vignettes provide insights into the potential of digital technologies-based innovations to foster greater inclusiveness in healthcare provision (Links A → D and A, B → C → D in Figure 2). (1) *Affordability*: The substantially lower cost of devices, relative to products for which they are substitutes, enable provision of specific healthcare services at prices that BOP customers can afford. (2) *Accessibility*: Device portability enables offering specific healthcare services at spokes locations that are proximate to where patients live, rather than only at hub locations that may require patients to travel long distances under conditions of poor road and rail connectivity. (3) *Availability*: A substantial increase in availability (service capacity) enabled by hiring a team of medical technicians trained to operate low-cost diagnostic devices, and diagnosis enabled by AI algorithm apps.

All else being equal (e.g. absent algorithmic bias), a reduction in heterogeneity or variability in product quality (between and within providers of a specific service) can be achieved by complementing the expertise of the service provider with AI-based algorithms (see B4 and C5 in Figure 2). In the context of the inseparability of service delivery and consumption, through low-cost, mass screenings for specific ailments at the community level (e.g. AI algorithm aided diagnosis of tuberculosis), the affordability, availability and accessibility of early-stage service modules (preliminary screening for specific ailments), as well as availability (supply or capacity) of providers of later-stage service modules (physicians) can be increased.

Mobile app enabled portable devices-based, asset light off-site model for diagnostic healthcare services

Vignette: *Mobile app enabled portable device for screening and detecting breast cancer*. By some estimates, more than 90% of women in the developing world lack access to early detection of breast cancer due to factors such as the high cost of mammograms, limited availability of trained radiologists (e.g. while the USA has 12 radiologists for every 100,000 people, India has one radiologist for every 100,000 people) and nonexistent or deficient infrastructure (e.g. transportation and electric power infrastructure). In the face of such constraints, the following were among the specifications that guided development of a device for screening and detecting breast cancer. A device that (1) can be used to screen and detect breast cancer without performing costly mammograms, (2) can be operated by community healthcare workers, the backbone of healthcare systems in most developing countries, to screen patients, (3) is portable and can be operated with batteries, (4) is painless during screening and (5) can be produced at a cost that would allow for breast screening to be provided at a price affordable by people at the BOP. The iBreastExam is a wireless hand-held device that enables painless, radiation free screening by trained healthcare workers in about five minutes. After a healthcare worker scans the four quadrants of each breast with the device, based on recordings of variations in breast elasticity, the device diagnoses and communicates wirelessly with a smartphone to store and display the findings in real time – green indicating normal breast tissue and red the detection of a lesion and the need for further testing at a nearby hospital (Cousins, 2018).

As noted earlier, crucial to the affordability of innovations by the BOP market is achieving a steep reduction in cost, compared to products currently available in the marketplace. A potential innovation avenue for achieving a substantial reduction in cost is developing low-cost substitutes for specific high-cost service modules of an existing service product (e.g. mammography machine and services of a radiologist).

Adaptation of off-the-shelf, low-cost digital devices for providing healthcare services, on-site and off-site

Vignette: *Screening for detection of cervical cancer*. As opposed to the current practice of sending a cervical tissue sample to a lab for examination under a microscope, a recent innovation brings the microscope to the tissue, eliminating the need for biopsies. A compact, high-resolution micro-endoscope connected to a tablet computer has been proven to be effective in clinical trials across the globe for diagnosing cervical cancer. The innovation also eliminates the need for the services of a pathologist to examine the tissue sample. Following analysis of an image of the tissue, the screen of the tablet computer transforms to red color if the cells are cancerous. Rather than having to wait for a few days for the biopsy results from the lab, treatment can be initiated, immediately following diagnosis (Hixenbaugh, 2016).

Vignette: *Minimally invasive surgery*. According to a report on the state of surgical care worldwide (Lancet Commission, 2015), about five billion people (about two-thirds of the world population) lack access to safe, affordable surgical and anesthesia care when needed. The report further notes that in low-income and lower-middle-income countries, nine out of ten people lack access to basic surgical care. A focus of innovations for ameliorating this situation is digital technologies-based ultra-low-cost devices, such as a laparoscope using cell phone parts for performing minimally invasive surgery virtually anywhere in the world (even without a hospital or reliable electricity). A laparoscope, a thin tube with a tiny camera on the end, enables performing surgery inside a patient's belly by making a few small incisions rather than a large incision. The attending surgeon views a magnified image of the abdominal cavity as well as the surgery being performed on an external video screen. In place of the expensive image processor and high-resolution video screen, the surgeon views the video feed from the laparoscope on a laptop screen or smartphone screen, which also powers the laparoscope for up to eight hours. Compared to the cost of a laparoscope (over $20,000) and related equipment (image processor and high-definition video screen) that may add up to a capital investment in the range of $700,000 and an annual service contract for the system of a few thousands of dollars, the target price for the innovation is in the range of $300 to $500 (Beck, 2016).

In general, affordability of tangible goods refers to whether the price of a product is within the financial means of a potential buyer. However, in the context of healthcare, in addition to the price of the core product, affordability is also impacted by factors such as cost of travel to a healthcare facility and wages foregone for the time taken off from work to avail a healthcare service. The affordability problem is further compounded when delivery of a healthcare service is spread over multiple service interactions, over several days.

Viewed from the vantage point of the simultaneity characteristic of certain services, a mechanism for increasing availability (supply or service capacity) is reducing the number of service interactions needed to provide the service (e.g. an innovation that enables real time diagnosis of cervical cancer and initiation of treatment immediately following diagnosis as opposed to a after few days – elapsed time between performing a biopsy and transmission of the biopsy results by a pathologist to the attending physician).

Discussion

As pointed out by Samuelsson (2023), healthcare provision is a complex service characterized by patients with diverse needs that entails coordinating the efforts of multiple actors to deliver the service to individual patients. He further notes that healthcare provision presents the dual challenge of balancing external effectiveness (i.e. providing better and integrated service to patients) and internal efficiency (i.e. achieving cost savings). Relative to the scope of healthcare provision broadly construed, the conceptual framework presented in Figure 2 is limited in its scope. The focus of the framework is inclusive innovations for specific healthcare services such as fitting of prosthetics, and diagnosis for early detection of ailments such as breast cancer, diabetic retinopathy and tuberculosis. However, given the imbalance between supply and demand for these services in emerging and less developed country markets, inclusive innovations with the potential to alleviate affordability, accessibility and availability barriers for specific healthcare needs highlight their importance.

Some of the specific real-world examples of innovations for greater inclusiveness in healthcare discussed in the previous section may not diffuse and be widely adopted for reasons such as new research evidence on their efficacy, safety and reliability (issues that belong in the realm of scholarship and research in health sciences), or the emergence of innovations that perform even better in alleviating the affordability, accessibility and/or availability barriers (e.g. ability to detect specific types of cancers based on blood tests). However, they do not negate the conceptual underpinnings of the framework – the potential of digital technologies-based innovations, implemented concurrently with innovations or modifications in service processes to alleviate the affordability, accessibility and availability barriers faced by BOP customers to use (consume) specific healthcare services.

In relation to the enormity of inequities in healthcare as a global social problem, the scope of the proposed framework is modest. However, in relation to the size of the unserved and underserved segments of society for healthcare [over five billion globally; the Lancet Commission (2015)], the potential of digital technologies-based inclusive innovations to alleviate inequities in healthcare are nontrivial. Alleviating inequities in healthcare in specific realms can significantly lower cost to both society and individuals. For example, use of digital technologies-based innovations for low-cost mass screening for specific ailments (e.g. breast cancer, cervical cancer, diabetic retinopathy and tuberculosis) for early detection and timely initiation of treatment for those in need. With the above caveats and qualifications, a discussion on implications for practice and future research follows. Given the conceptual nature of the article, the discussion on implications for practice are in the vein of cognitive implications (issues that merit further thought) and not instrumental (i.e. action implications).

Inclusiveness potential of innovations

A measure of the *inclusiveness potential* of an innovation is the percentage of current nonusers of a product (good or service) due to barriers such as affordability, accessibility and availability who can become users of the product and benefit from it. Certain digital technologies-based innovations such as mobile phones-based financial services (e.g. banking services for the unbanked) have enabled a very high percentage of erstwhile nonusers to become users. In comparison, the inclusiveness potential of digital technologies-based innovations for greater inclusiveness in healthcare will be lower. On the one hand, the economics of information in digital form highlights the potential of digital technologies-based innovations for greater inclusiveness in healthcare. For example, as elaborated in the previous section, (1) the near zero cost of transmission of X-rays in digital form from hospitals located in remote rural areas to a healthcare facility located in a large city for screening for tuberculosis; and (2) the near zero cost of reuse of an AI algorithm embedded in a device for screening for diabetic retinopathy. On the other hand, certain other costs relating to provisioning of healthcare such as the cost of facilities and equipment (i.e. physical infrastructure for healthcare) and human resources are nontrivial.

Interdependencies between social problems

In the broader context healthcare, the focus of UN's Sustainable Development Goal # 3, the article focuses on the potential for leveraging digital technologies for inclusive innovations in healthcare. Although outside the scope of the article, of major importance is the interdependencies between the SDGs (e.g. SDGs # 1 and # 3: Poverty and health. SDGs # 2 and # 3: Malnutrition and health. SDGs # 6 and # 3: Sanitation and health). The following excerpts from tributes in memory of Dr Paul Farmer (1959–2022), a physician who was globally acclaimed for delivering high-quality healthcare to some of the world's poorest people, are instructive in this regard.

> He was a practitioner of 'social medicine', arguing there was no point in treating patients for diseases only to send them back into the desperate circumstances that contributed to them in the first place. Illness, he said, has social roots and must be addressed through social structures. (Barry and Traub, 2022)

> Medical providers must break down the structures that prevent impoverished people from accessing care. As PIH explains itself: 'A mother cannot undergo cancer care and lose work without receiving economic support. A tuberculosis patient cannot endure strong medications on an empty stomach. And a patient showing symptoms of covid-19 cannot take public transportation to her local testing site'. A patient might need food, money, child care and a car ride before medicine or surgery can be of any value. (Drehle, 2022) [4].

Implications for theory and future research

A conceptual model of antecedents and outcomes of inclusive innovations in services: The *conceptual framework* proposed in Figure 1 (and Figure 2, an elaboration of Figure 1) is a *process framework* that provides insights into the potential of digital technologies-based innovations and concurrent innovations or modifications in service processes for alleviating affordability, accessibility and availability barriers to consumption of need services. A potential avenue for future research is developing an empirically testable *conceptual model* delineating the antecedents and outcomes of a firm's extent of emphasis on inclusive innovations.

Resourcefulness-based view of the social enterprise. Many of the real-world examples (vignettes) of digital technologies-based healthcare innovations presented in the earlier sections are by legacy social enterprises and start-up social enterprises. In a review article on social entrepreneurship (SE) research, Saebi *et al.* (2019) noted that SE is a contested concept. They note that although there is neither a consensus on a definition of SE nor the dimensions of the SE construct, the numerous definitions of SE advanced in literature are suggestive of social and economic value creation as the core characteristics of SE (see Table A.1 to A.3 in the online supplement to their article for a summary of definitions of SE that have been advanced in literature). Di Domenico *et al.* (2010) noted that although like traditional business enterprises, social enterprises also focus on both economic and social value creation, they are less focused on profit. Mission-driven social enterprises generally innovate for greater inclusiveness under resource constraints. A potential avenue for theory development is a *resourcefulness-based view of the social enterprise* that builds on literature spanning bricolage, innovation, market inclusion and social entrepreneurship (see: Desa and Basu, 2013; Halme *et al.*, 2012; Mateus and Sarkar, 2024; Senyard *et al.*, 2014; Witell *et al.*, 2017).

Reverse innovations for the greater inclusiveness. Although most major social problems transcend national borders, a larger percentage of the population in middle and low-income countries (emerging and less-developed country markets) experience specific social problems than in high-income countries (developed country markets). Hence, a major focus of inclusive IGGs is the alleviation of social problems in the context of emerging and less developed country markets. *Reverse innovations* refer to the introduction in industrialized country markets products that were developed and introduced in emerging and/or less developed country markets in response to the needs and wants of these markets (Govindarajan and Trimble, 2013; Govindarajan and Ramamurthi, 2018). The lower environmental impact of reverse innovations (due to their focus on efficiency/frugality in resource utilization) and the prevalence of BOP segments in high-income countries as well, suggests *reverse innovations for greater inclusiveness* as an avenue for future research.

Conclusion

Issues relating to inequities in healthcare at various levels (global, national, regional and local), as a social problem, are the focus of research in several academic disciplines. *Equity* is "the absence of unfair, avoidable, or remediable differences among groups of people, whether those groups are defined socially, economically, demographically, or geographically or by other dimensions of inequality" (World Health Organization, 2024). Against this backdrop, this article presents an inductively developed framework that provides insights into the potential for alleviating inequities in access to certain healthcare services. In relation to the scope of the problems and challenges pertaining to providing quality healthcare to the unserved and underserved segments of society, worldwide, the incremental contribution of the proposed framework to practice is modest. However, by highlighting the promise and potential of digital technologies-based innovations with concurrent innovations and/or modifications in service delivery processes as solutions for alleviating barriers to affordability, accessibility and availability of healthcare services during various stages (prevention, detection, diagnosis, treatment and post-treatment follow-up) with illustrative vignettes and developing a framework, the article offers insights for future research.

Notes

1. The definitions presented here are minor revisions of the definitions presented in Varadarajan (2024).
2. The *AI for Social Good (AI4SG)* movement aims to establish interdisciplinary partnerships centered around AI applications toward SDGs. Under its auspices, Tomašev *et al.* (2020) proposed guidelines for establishing collaborations between AI researchers and application-domain experts, highlight existing AI4SG projects and identify new AI4SG application opportunities.
3. See Manis and Madhavaram (2023, Table 1) for a summary of 22 definitions of AI that have been advanced in literature as well as the definition of AI proposed by the authors.
4. PIH = Partners in Health.

References

Agarwal, R., Dugas, M., Gao, G. and Kannan, P.K. (2020), "Emerging technologies and analytics for a new era of value-centered marketing in healthcare", *Journal of the Academy of Marketing Science*, Vol. 48 No. 1, pp. 9-23.

Aiyar, A. and Venugopal, S. (2020), "Addressing the ethical challenge of market inclusion in base-of-the-pyramid markets: a macromarketing approach", *Journal of Business Ethics*, Vol. 164 No. 2, pp. 243-260.

Anderson, J. and Markides, C. (2007), "Strategic innovation at the base of the pyramid", *MIT Sloan Management Review*, Vol. 49 No. 1, pp. 83-88.

Anderson, L. and Ostrom, A.L. (2015), "Transformative service research: advancing our knowledge about service and well-being", *Journal of Service Research*, Vol. 18 No. 3, pp. 243-249.

Anderson, S., Rayburn, S.W. and Sierra, J.J. (2019), "Future thinking: the role of marketing in healthcare", *European Journal of Marketing*, Vol. 53 No. 8, pp. 1521-1545.

Angeli, F. and Jaiswal, A.K. (2016), "Business model innovation for inclusive health care delivery at the bottom of the pyramid", *Organization and Environment*, Vol. 29 No. 4, pp. 486-507.

Baker, A. (2017), "The American drones saving lives in Rwanda", TIME, November 29, available at: https://time.com/rwanda-drones-zipline/

Barry, E. and Traub, A. (2022), "Dr. Paul farmer, who traveled the globe to aid the poor, dies at 62", The New York Times, February 22, Section A, p. 19.

Beck, M. (2016), "New low-cost surgical tool could help patients in third world", The Wall Street Journal, September 23, available at: www.wsj.com/articles/new-low-cost-surgical-tool-could-help-patients-in-third-world-1474855620

Berry, L.L. (1980), "Services marketing is different", *Business*, Vol. 30 No. 3, pp. 24-29.

Chaudhary, B., Modi, A.G. and Reddy, K. (2012), "Right to sight: a management case study on Aravind eye hospitals", *International Journal of Multidisciplinary Research*, Vol. 2 No. 1, ISSN 2231 5780, available at: www.zenithresearch.org.in

Collins Dictionary (n.d.), available at: www.collinsdictionary.com/dictionary/english

Cousins, S. (2018), "A new way to detect breast cancer", The New York Times, August 28, available at: www.nytimes.com/2018/08/28/opinion/detect-breast-cancer-developing-countries-asia.html?action=click&module=Opinion&pgtype=Homepage

Davenport, T. and Kalakota, R. (2019), "The potential for artificial intelligence in healthcare", *Future Healthcare Journal*, Vol. 6 No. 2, pp. 94-98.

Desa, G. and Basu, S. (2013), "Optimization or bricolage? Overcoming resource constraints in global social entrepreneurship", *Strategic Entrepreneurship Journal*, Vol. 7 No. 1, pp. 26-49.

Di Domenico, M., Haugh, H. and Tracey, P. (2010), "Social bricolage: theorizing social value creation in social enterprises", *Entrepreneurship Theory and Practice*, Vol. 34 No. 4, pp. 681-703, doi: 10.1111/j.1540-6520.2010.00370.x.

Drehle, D.V. (2022), "To Paul farmer, healing the poor meant meeting their basic human needs", The Washington Post, March 4, available at: www.washingtonpost.com/opinions/2022/03/04/paul-farmer-partners-in-health-treating-the-poor-first/

Fujikawa, M. (2016), "3-D printing startup seeks niche in low-cost prosthetic legs", *Wall Street Journal*, September 13, p. B4.

George, G., McGahan, A.M. and Prabhu, J. (2012), "Innovation for inclusive growth: towards a theoretical framework and a research agenda", *Journal of Management Studies*, Vol. 49 No. 4, pp. 661-683.

Goldfarb, A. and Tucker, C. (2019), "Digital economics", *Journal of Economic Literature*, Vol. 57 No. 1, pp. 3-43.

Gomes, R.G., Vwalika, B., Lee, C., Willis, A., Sieniek, M., Price, J.T., *et al.* (2022), "A mobile-optimized artificial intelligence system for gestational age and fetal malpresentation assessment", *Communications Medicine*, Vol. 2 Article No. 128, doi: 10.1038/s43856-022-00194-5.

Govindarajan, V. and Trimble, C. (2013), *Reverse Innovation: Create Far from Home, Win Everywhere*, Harvard Business Review Press.

Govindarajan, V. and Ramamurthi, R. (2018), *Reverse Innovation in Health Care: How to Make Value-Based Delivery Work*, Harvard Business Review Press.

Gulshan, V., Peng, L., Coram, M., *et al.* (2016), "Development and validation of a deep learning algorithm for detection of diabetic retinopathy in retinal fundus photographs", *Journal of the American Medical Association*, Vol. 316 No. 22, pp. 2402-2410.

Gunja, M.Z., Gumas, E.D. and Williams, R.D. II (2023), "U.S. health care from a global perspective, 2022: accelerating spending, worsening outcomes", The Commonwealth Fund, January 31, available at: www.commonwealthfund.org/publications/issue-briefs/2023/jan/us-health-care-global-perspective-2022

Halme, M., Lindeman, S. and Linna, P. (2012), "Innovation for inclusive business: intrapreneurial bricolage in multinational corporations", *Journal of Management Studies*, Vol. 49 No. 4, pp. 743-784.

Heeks, R. (1999), "Information and communication technologies, poverty and development", Institute for Development Policy and Management. June, available at: www.man.ac.uk/idpm/idpm_dp.htm#devinf_wp

Hixenbaugh, M. (2016), "A mission to save valley's women", Houston Chronicle, November 30, pp. A1-A15.

Iyanna, S., Kaur, P., Ractham, P., Talwar, S. and Najmul Isla, A.K.M. (2022), "Digital transformation of healthcare sector. What is impeding adoption and continued usage of technology-driven innovations by end-users?", *Journal of Business Research*, Vol. 153, pp. 150-161.

Jousset, O., Kimeu, M., Müller, T., Sforza, G., Sun, Y.S., Ustun, A., *et al.* (2023), "How digital tools could boost efficiency in African health systems", McKinsey and Company, March 10, available at: www.mckinsey.com/industries/healthcare/our-insights/how-digital-tools-could-boost-efficiency-in-african-health-systems?

Kolk, A., Rivera-Santon, M. and Rufin, C. (2014), "Reviewing a decade of research on the 'base/bottom of the pyramid' (BOP) concept", *Business and Society*, Vol. 53 No. 3, pp. 338-377.

Kristof, N. (2023), "How do we fix the scandal that is American health care?", The New York Times, August 16, available at: www.nytimes.com/2023/08/16/opinion/health-care-life-expectancy-poverty.html

Lancet Commission (2015), "Global surgery 2030: evidence and solutions for achieving health, welfare, and economic development", *The Lancet*, Vol. 386, pp. 569-624, doi: 10.1016/S0140-6736(15)60160-X.

Lehoux, P., Silva, H.P., Denis, J.-L., Miller, F.A., Sabio, R.P. and Mendell, M. (2021), "Moving toward responsible value creation: business model challenges faced by organizations producing responsible health innovations", *Journal of Product Innovation Management*, Vol. 38 No. 5, pp. 548-573.

Lovelock, C. and Gummesson, E. (2004), "Whither services marketing? In search of a new paradigm and fresh perspectives", *Journal of Service Research*, Vol. 7 No. 1, pp. 20-41.

Mandavilli, A. (2020), "These algorithms could bring an end to the world's deadliest killer", The New York Times, November 20, available at: www.nytimes.com/2020/11/20/health/tuberculosis-ai-apps.html

Manis, K.T. and Madhavaram, S. (2023), "AI-Enabled marketing capabilities and the hierarchy of capabilities: conceptualization, proposition development, and research avenues", *Journal of Business Research*, Vol. 157, p. 113485.

Mashelkar, R.A. (2012), "On building an inclusive innovation ecosystem", *Conference on Innovation for Inclusive Development, Organization for Economic Cooperation and Development (OECD)*, Cape Town, November 21, available at: www.oecd.org/sti/inno/K_Mashelkar.pdf

Mashelkar, R.A. (n.d.), "Saving humanity: more from less for more people", available at: https://mashelkar.com/articles/saving-humanitymore-from-less-for-more-people/

Mateus, S. and Sarkar, S. (2024), "Bricolage – a systematic review, conceptualization, and research agenda", *Entrepreneurship and Regional Development*, doi: 10.1080/08985626.2024.2303426.

Mazzucato, M. (2023), "Unlocking health technology's potential for all", Project Syndicate, October 24, available at: www.project-syndicate.org/commentary/health-technology-mrna-governance-conditions-to-serve-common-good-by-mariana-mazzucato-2023-10?

Metz, C. (2019), "India fights diabetic blindness with help from A.I", The New York Times, March 10, New York edition, p. B1.

Moorman, C., van Heerde, H.J., Moreau, C.P. and Palmatier, R.W. (2024), "Marketing in the health care sector: disrupted exchanges and new research directions", *Journal of Marketing*, Vol. 88 No. 1, pp. 1-14.

Ostrom, A.L., Field, J.M., Fotheringham, D., Subramony, M., Gustafsson, A., Lemon, K.N., *et al.* (2021), "Service research priorities: managing and delivering service in turbulent times", *Journal of Service Research*, Vol. 24 No. 3, pp. 329-353.

Ouma, P.O., Maina, J., Thuranira, P.N., Macharia, P., Alegana, V.A., English, M., *et al.* (2018), "Access to emergency hospital care provided by the public sector in Sub-Saharan Africa in 2015: a geocoded inventory and spatial analysis", *The Lancet Global Health*, Vol. 6 No. 3, pp. E342-E350.

Pearl, R. and Wayling, B. (2022), "The telehealth era is just beginning", Harvard Business Review, May-June.

Phills, J.A., Deiglmeier, K. and Miller, D.T. (2008), "Rediscovering social innovation", *Stanford Social Innovation Review*, Vol. 6 No. 4, pp. 34-43.

Pollock, A. and Roderick, P. (2023), "You don't have to be a doctor to know how much trouble the N.H.S. is in", The New York Times, March 17, available at: www.nytimes.com/2023/03/17/opinion/nhs-britain-privatization.html?smid=em-share

Prahalad, C.K. (2004), *The Fortune at the Bottom of the Pyramid: Eradicating Poverty through Profit*, Wharton School Publishing.

Prahalad, C.K. (2006), "The innovation sandbox", *Strategy+Business*, Vol. 44 No. Autumn, pp. 1-10. available at: www.strategy-business.com/article/06306?gko=0eab4

Prahalad, C.K. (2012), "Bottom of the pyramid as a source of breakthrough innovations", *Journal of Product Innovation Management*, Vol. 29 No. 1, pp. 6-12.

Rangan, V.K. (1993), "Aravind eye hospital, Madurai, India: in service for sight", Harvard Business School Case 593-098. April (Revised May 2009).

Saebi, T., Foss, N.J. and Linder, S. (2019), "Social entrepreneurship research: past achievements and future promises", *Journal of Management*, Vol. 45 No. 1, pp. 70-95.

Samuelsson, P. (2023), "The effects of innovation types and customer participation on organizational performance in complex services", *European Journal of Marketing*, Vol. 57 No. 13, pp. 27-55.

Senyard, J., Baker, T., Steffens, P. and Davidsson, P. (2014), "Bricolage as a path to innovativeness for resource-constrained new firms", *Journal of Product Innovation Management*, Vol. 31 No. 2, pp. 211-230.

Sheth, J.N. and Sisodia, R. (2012), *The 4 A's of Marketing: Creating Value for Customer, Company and Society*, Routledge, New York, NY.

Silva, H.P., Lehoux, P., Miller, F.A. and Denis, J.-L. (2018), "Introducing responsible innovation in health: a policy-oriented framework", *Health Research Policy and Systems*, Vol. 16 No. 1, pp. 1-13.

Sunder, V. and Moduri, S. (2024), "Essential capabilities for successful digital service innovation at the bottom of the pyramid", *California Management Review*, Vol. 66 No. 3, pp. 69-92.

Suri, T. and Jack, W. (2016), "The long-run poverty and gender impacts of mobile money", *Science*, Vol. 354 No. 6317, pp. 1288-1202.

Tomašev, N., Cornebise, J., Hutter, F., Mohamed, S., Picciarilleo, A., Connelly, B., *et al.* (2020), "AI for social good: unlocking the opportunity for positive impact", *Nature Communications*, Vol. 11 No. 1, p. 2468, doi: 10.1038/s41467-020-15871-z.

Topol, E. (2019), *Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again*, Basic.

United Nations (2015), “Transforming our world: the 2030 agenda for sustainable development”, October 21, available at: https://sdgs.un.org/2030agenda

Varadarajan, R. (2024), “Mitigating the definitional quagmire in innovation research: an inclusive definition of innovation as a template for defining various types of innovations uniformly”, *Journal of Product Innovation Management*, Vol. 41 No. 4, pp. 703-723, available at: https://onlinelibrary.wiley.com/doi/10.1111/jpim.12729

Vargo, S.L. and Lusch, R.F. (2004), “The four service marketing myths: remnants of a goods-based, manufacturing model”, *Journal of Service Research*, Vol. 6 No. 4, pp. 324-335.

Weiss, D., Rydland, H.T., Oversveen, E., Jensen, M.R., Solhaug, S. and Krokstad, S. (2018), “Innovative technologies and social inequalities in health: a scoping review of the literature”, *Plos One*, Vol. 13 No. 4, p. e0195447, doi: 10.1371/journal.pone.0195447.

Wen, L.S. (2023a), “The AI revolution in health care is already here”, The Washington Post, July 11, available at: www.washingtonpost.com/opinions/2023/07/11/ai-health-care-revolution/

Wen, L.S. (2023b), “AI could impact health on a ‘planetary scale.‘here’s how”, The Washington Post, August 29, available at: www.washingtonpost.com/opinions/2023/08/29/ai-health-care-global-ultrasounds-tuberculosis/

Witell, L., Gebauer, H., Jaakkola, E., Hammedi, W., Patricio, L. and Perks, H. (2017), “A bricolage perspective on service innovation”, *Journal of Business Research*, Vol. 79, pp. 290-298.

World Health Organization (2023), “Maternal mortality”, World Health Organization, available at: www.who.int/news-room/fact-sheets/detail/maternal-mortality

World Health Organization (2024), “Health equity”, World Health Organization, available at: www.who.int/health-topics/health-equity#tab=tab_1

Zuppo, C.M. (2012), “Defining ICT in a boundaryless world: the development of a working hierarchy”, *International Journal of Managing Information Technology*, Vol. 4 No. 3, p. 13, doi: 10.5121/ijmit.2012.4302.

About the author

Rajan Varadarajan is University Distinguished Professor and Distinguished Professor of Marketing, Regents Professor and Brandon C. Coleman, Jr. ’78 Endowed Chair in Marketing in the Mays Business School at Texas A&M University. His primary teaching and research interests are in the areas of marketing strategy, innovation and sustainability. He has published over 100 journal articles and made over 200 presentations at major national and international conferences, doctoral and faculty consortia, universities and other forums. His research has been published in the *Journal of Marketing, European Journal of Marketing, Journal of the Academy of Marketing Science, Academy of Management Journal, Strategic Management Journal, Management Science*, *Journal of Business Research* and other journals. Rajan Varadarajan can be contacted at: varadarajan@tamu.edu