



www.pwc.com/sg

Digital health

Challenges and solutions to measuring
Return on Investment (ROI)



Saw Swee Hock
School of Public Health

Centre for Health Services and
Policy Research

Foreword

A collaborative, data-driven and evidence-based study

We now live in one of the most transformational times in human history and are in the middle of a digital revolution, particularly in healthcare. Not only is the paradigm shift from healthcare to health, from hospital to home, and from quality and volume to value-based care evident, it is reflective of today's fast-evolving healthcare landscape at all local, regional, and global levels. While patient-centricity and empowerment are at the heart of this healthcare transformation, the paradigm shift is nevertheless propelled by digital disruption faced by the industry. With more than three billion people worldwide connected to the internet, harnessing the power of digital connectivity will be key to solving healthcare access challenges. This leads us to the next question, “**At what cost will it take to achieve this?**” Leveraging the data provided by the Singapore-based, digital healthcare start-up, MyDoc, and analysed by the National University of Singapore's Centre for Health Services Policy Research, our collective answer to this question is, “**A reducing one.**”

Building on our study last year, *The digital healthcare leap* (which discussed how emerging markets are able to leapfrog developed economies, enabled by new digital health business models), this year's study illustrates the imperative of getting the ROI measurements right for digital health investments; something which all economies, both emerging and developed, should bear in mind. That being said, understanding the costs and benefits of investments in digital health solutions will be essential for informed decision-making, and for driving positive outcomes in providing what we refer to as the 3 As in healthcare: **Affordable, Accessible and A+** quality care.

Finally I'd like to thank MyDoc and the National University of Singapore for this collaborative opportunity, which brought together insights from industry practitioners and academics in producing this study.

Dr. Zubin J Daruwalla

Healthcare Consulting Director
South East Asia, PwC

Disclosure: While a Healthcare Consulting Director at PwC, Dr. Zubin J Daruwalla remains a practicing clinician and independent advisor to a number of start-ups in the digital health and medical education spaces, including MyDoc for which he has no equity share to declare.

Working together to achieve impact

As digital technology becomes an integral part of healthcare systems around the world, ensuring the successful and scalable translation of innovative thinking into public health outcomes requires productive collaborations and partnerships between academia, policymakers and entrepreneurs. As our understanding of emerging new technologies is continually evolving, any one partner may not have all the answers – making open, transparent and critically-minded dialogue about the benefits and costs to various different stakeholders more crucial than ever. In providing input to this report, the **Centre for Health Services and Policy Research** is happy to contribute to the process by which we as a community of practice create and sustain learning healthcare systems in the face of new technological progress.

A/Prof. Joanne Yoong

Director, Centre for Health Services and Policy Research
National University of Singapore

Table of Contents

Executive summary	05
Propelling Southeast Asia's digital health revolution	06
Investing in digital health: Defining and measuring ROI	08
• <i>Getting to the root of the problem</i>	08
• <i>ROI measurements re-imagined</i>	12
• <i>Case Study: ROI from virtual consults in a health screening initiative</i>	14
Conclusion	18
Our authors	19

Methodology

Our comments and analyses are based on data obtained from industry recognised sources. We also built on PwC's research and findings drawn from previous publications, such as *The digital healthcare leap* (2016).

In partnership with the National University of Singapore's Centre for Health Services and Policy Research, this paper also presents a case study that supplements our findings. The primary data of the case study was provided by MyDoc, a Singapore-based digital health platform, and analysed by the National University of Singapore's Centre for Health Services and Policy Research.



Executive summary

Healthcare stakeholders – patients, providers and payers – in Asia are now in a juncture of a system burdened with ageing populations and rising costs, and the digital revolution that is rapidly reshaping the world we live in.

With that in mind, the astounding speed of digital transformation is quickly re-defining consumer expectations, including their demands from healthcare services. This creates a window for new entrants to compete in the space with their innovative solutions. More than ever, industry incumbents are in a race against time to either invest in digital technology or risk falling behind the curve.

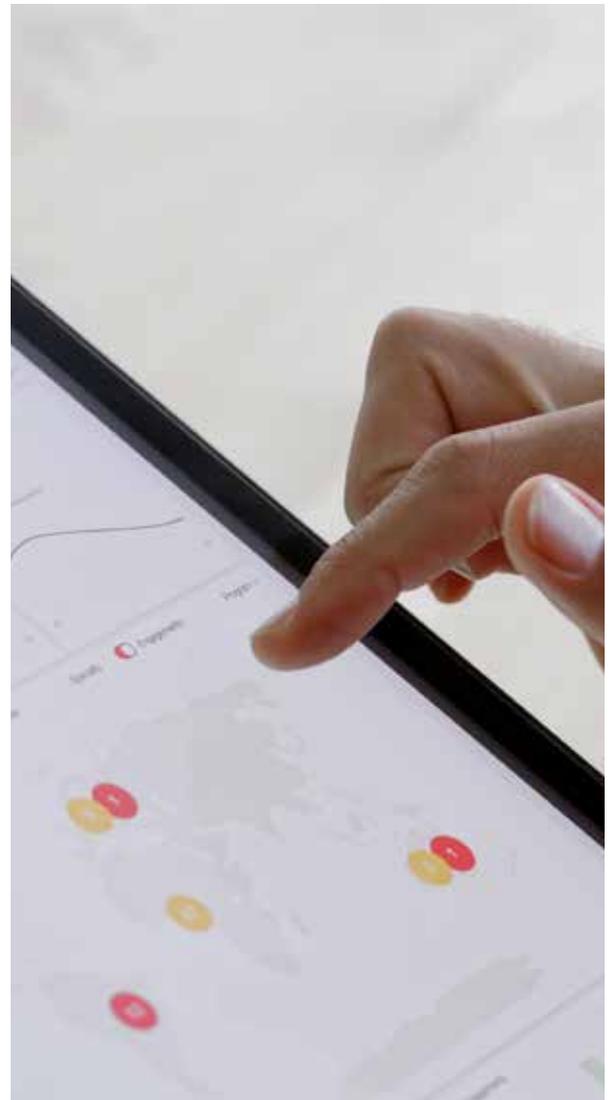
Despite the apparent benefits of digital solutions coupled with mounting pressures to level-up their service offerings, the healthcare industry incumbents have been relatively slow in their digital adoption compared to other sectors (e.g. financial services and retail). What's hindering them from making the digital health leap? We believe that core to the problem are:

- Complexities in defining and demonstrating the value from digital health investments
- Conflicting perspectives in determining the return on investment (ROI) and how it should be measured

The solution: A well-thought-out approach that addresses the holistic benefits of digital health investments. To realise positive returns, healthcare organisations must prioritise both monetary and non-monetary benefits that drive value to their business and customers. In addition, they need to establish the right metrics to measure these benefits. If implemented successfully, digital health solutions can generate sustainable value by:

- Efficiently catalysing wider participation of multiple stakeholders
- Enabling deeper engagement between patients and providers

In partnership with the National University of Singapore's Centre for Health Services and Policy Research, this thought leadership paper also presents a case study on a community-based diabetes screening initiative. The analysis of the primary data gathered shows a higher follow-up rate for teleconsultations than physical consults, which can translate to approximately five times greater savings for healthcare payers over the long term as a result of averted future in-patient admissions.



Propelling Southeast Asia's digital health revolution

As economies and socio-demographics alter, ageing populations and chronic diseases are becoming a prominent feature in both developed and developing economies. In combination with a growing middle class awareness of healthcare, these sociodemographic trends have led to an unprecedented demand for healthcare services. By 2040, worldwide spending on healthcare is predicted to increase to \$18.28 trillion^{1,2}. The healthcare market in 2017 was predicted to account for 30% of global revenues³, and is expected to grow by 12.8% annually⁴.

At the same time, technology penetration in Southeast Asia has experienced an unparalleled upsurge, and connectivity is at its fastest growth. In Indonesia and Philippines, for example, individuals on average have more than one mobile phone⁵. In addition, the fourth industrial revolution (Industry 4.0) is also gaining momentum in the region. Already, we are seeing technological advancements, such as the internet of things and artificial intelligence, automating/replacing manual tasks, and redefining business operations⁶ as well as competition.

The issue at hand however, as outlined in our earlier study, *The Digital Healthcare Leap*⁷, is that the supply of services is unable to keep up with rising demand. As seen in Figure 1, where out of the six Southeast Asian economies that have mobile phone penetration rates of above 50%, access to healthcare - benchmarked against the World Health Organization's designated threshold - remains limited/challenging in three of them⁸.

Today, the Southeast Asia region faces a persistent gap in care delivery. Adding further pressure to its already constrained healthcare system are poor access and affordability, which stem from underdeveloped physical infrastructures and shortage of resources.



¹ Dieleman et al. National spending on health by source for 184 countries between 2013 and 2040. *The Lancet*, Volume 387, Issue 10037, 2521 - 2535

² Institute for Health Metrics and Evaluation. "Global spending on health is expected to increase to \$18.28 trillion worldwide by 2040 but many countries will miss important health benchmarks". 2017.

³ Enterprise Innovation. "Frost & Sullivan sees increased healthcare spending across APAC". 2017. <https://www.enterpriseinnovation.net/article/frost-sullivan-sees-increased-healthcare-spending-across-apac-1530917047>

⁴ DBS Bank. "Healthcare Opportunities in Asia". 2016.

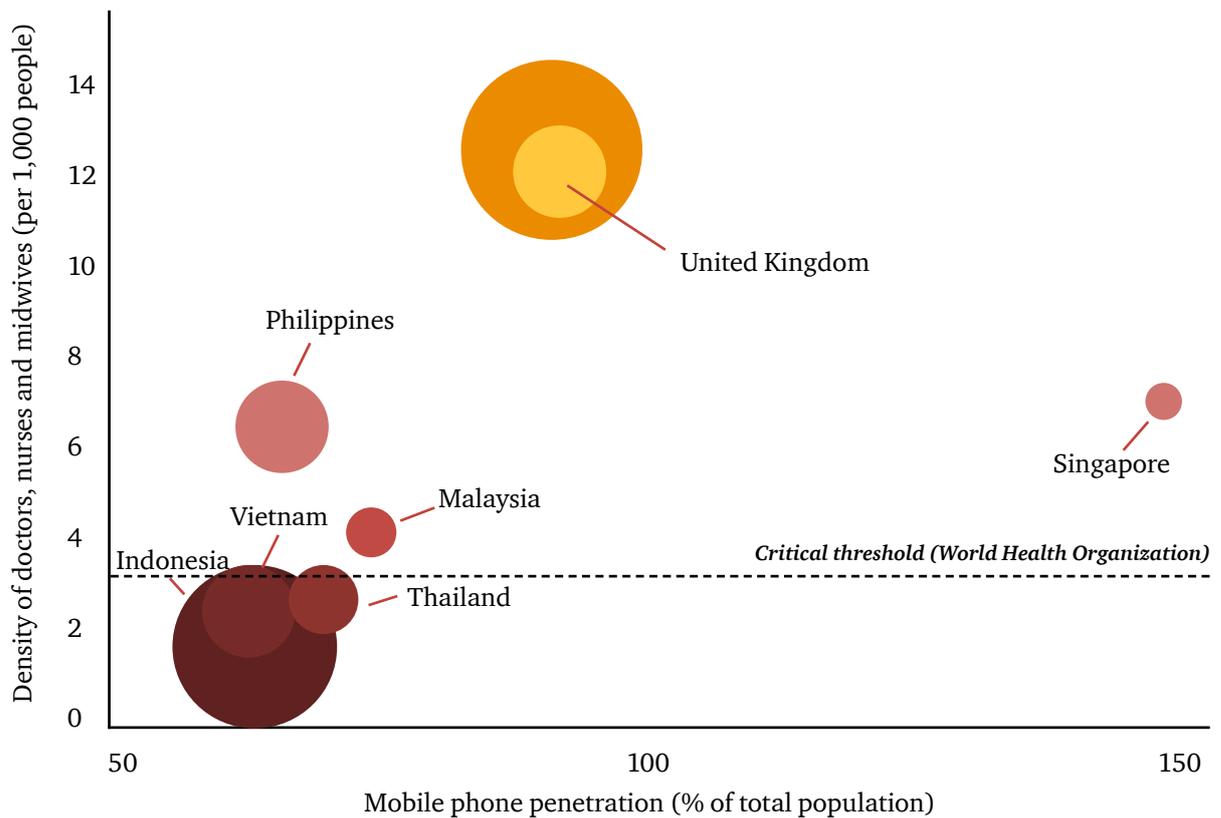
⁵ World Bank. Mobile cellular subscriptions (per 100 people). <http://data.worldbank.org/indicator/IT.CEL.SETS.P2>

⁶ World Economic Forum. The Fourth Industrial Revolution: what it means, how to respond. <https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/>

⁷ PwC. *The Digital Healthcare Leap*, 2016

⁸ eMarketer. Digital Usage in Southeast Asia, 2016; WHO Global Health Observatory Data Repository; UN Population Division; Gov of Singapore

Figure 1: Access to healthcare remains limited despite increasing technology penetration



Note: Mobile phone penetration refers to (mobile phone users/total population)*100
 Source: WHO Global Health Observatory Data Repository, UN Population Division, eMarketer, Gov of Singapore

Meanwhile, the digital revolution is challenging the status quo. The influx of technology is evolving traditional stakeholder-patient relationships across the care continuum. New entrants are disrupting conventional models by enabling the delivery of care over digital health platforms such as mobile health, wearable devices, telehealth, telemedicine and personalised medicine⁹. Greater connectivity has also generated a more informed and empowered customer base, while mobile phones are now used as a channel for accessing health information, consultations, and managing payments, even in remote and/or rural areas. Harnessing the power of digital technology will be key to helping Southeast Asia’s health industry bridge the gap between access to and the affordability of care, as well as catalyse the proliferation of quality care delivery in the region.

⁹ Food and Drug Administration. Digital Health. <https://www.fda.gov/MedicalDevices/DigitalHealth/>

Investing in digital health: Defining and measuring ROI

Getting to the root of the problem

Healthcare organisations have much to benefit from a developed digital health market. To name a few, it empowers patients, improves client engagement, reduces human error (which contributes to safer care), as well as optimises operations and cost efficiency as a result of the elimination of redundant processes. Despite the benefits, the healthcare industry has been slow in adopting digital solutions in comparison to other sectors. Although digital investment is becoming an increasingly attractive option for healthcare organisations seeking both internal financial and quality improvement while optimising delivery of care, PwC's 2016 Global CEO survey revealed that only 51% of global CEOs have prioritised digital transformation to better connect with their customers¹⁰.

The reasons for this slow adoption in the healthcare industry are complex. High upfront and maintenance costs for digital transformation, coupled with a difficulty in defining and measuring value from investments in healthcare often have organisations questioning their ROI in digital health.

High upfront costs

Traditions of medical practice have been passed down through centuries orally or on paper, and the human touch and patient interaction have always been a part of the medical practitioner's role. A transition to paperless records and virtual consults signals a paradigm shift in these traditions. However, adoption of new technology often comes with a new set of issues or risks that drive up the upfront cost and inertia to change. Big data, for example, has revolutionised the healthcare practice by enabling new ways of understanding patients. However, in addition to acquiring the new technology, healthcare organisations also need to invest in employee training, create governance and compliance strategies, and implement security measures to manage data, ownership and privacy risks. That is not all. Ongoing costs stemming from system maintenance, integration, and cybersecurity (among other functions) add further pressure on the budget. Furthermore, particularly in the emerging markets where organisations may not have a digital infrastructure in place, or have yet to embark on their digital journey, significant investments will have to be made in resources and building organisation-wide capabilities to see through the development of their digital strategy to execution, and ensure sustainability.



¹⁰ PwC. Global CEO Survey 2016. <http://www.pwc.com/gx/en/ceo-agenda/ceosurvey/2016/transformation.html>

Defining value and returns in healthcare

Economic uncertainty coupled with rising demand for healthcare – driven by ageing, co-morbid populations – are putting pressure on the healthcare industry to deliver optimal patient outcomes at minimum costs. This has made it crucial for technological innovations to deliver a value proposition based on a risk vs benefit impact to decision-makers – whether it is a hospital provider considering transformation to electronic record systems, or a physician’s practice integrating teleconsulting into its service offerings, or a health ministry considering investing in telehealth services for remote areas of its regions. In countries such as South Korea, Health-Technology Assessments (HTAs) have proven to be an effective mechanism to launch more cost-effective medications¹¹.

What makes it so difficult to demonstrate value from digital investments in healthcare practice?

Different stakeholders see “value” differently

The definition of what “value” entails in healthcare has traditionally been challenging as cost-benefit perspectives differ between stakeholders, and are subject to individuals’ preferences and objectives. Value for healthcare providers, for example, may be derived from improvements in their revenue and reductions in operating costs. However, that may not be the case for patients who may equate the value of a wearable device with improvements in their health outcomes, convenience of a personal data tracker and care consults over the cloud, and affordability¹².



¹¹ <https://www.ncbi.nlm.nih.gov/pubmed/27086557>

¹² Cutler, Henry. The value of health technology. Macquarie University.

Taking into account the positive externalities of a healthcare investment

Any healthcare investment can have positive externalities or spillovers, benefiting more than just the targeted individual. For example, the benefits of a vaccination programme are not limited to those who receive that vaccination. It extends to the larger population as the disease cannot spread effectively if only a few individuals are susceptible to it¹³. With that in mind, the ROI from healthcare investments, including digital health, and how it is measured cannot be constrained or biased to a specific value system. Its wider impact to the patients, the society and the entire ecosystem needs to be taken into consideration, which leads us to a key question: How can value or impact be holistically captured or quantified?

Future outlook shrouded in uncertainty

The adoption and expansion of digital health technologies are complex undertakings, and are resource and capital intensive. Faced with an environment marked with prolonged uncertainty, measuring returns – which often requires long term projections – becomes difficult.



Lack of consensus over methodology for ROI measurement and metrics in healthcare

From a financial-tangibility perspective, ROI is commonly measured as the **percentage of net profit over the total cost of investments**. Meanwhile, financial metrics, such as increased revenue and reduced costs, are used to evaluate an impact.

With that in mind, within any given organisation, different stakeholders and processes are concurrently at play in creating impact, making it difficult to isolate and weigh the value contributed by individual agents. Take for example, how does one isolate and attribute profits to a newly implemented electronic health record (EHR) system, which helped improve workflow efficiency, from the profits attributable to the implementation of an improved benefits programme, which helped drive greater staff motivation¹⁴?

Studies that examine only the financial or budgetary implications of investments tend to measure ROI based on the amount of revenue incurred and costs reduced – as a result of the investment – over a specific period of time¹⁵. Meanwhile, some studies use more indirect approaches, such as cost-savings derived from improvements in organizational workflow and reductions in adverse events when clinical decision making systems were installed^{16,17}. Additional outcomes captured for measurement in other studies include changes in clinical endpoints, patient engagement and quality of care from health interventions, and quantified indirect cost-savings from avoided medical expenditure due to improved health outcomes from the intervention.^{18,19,20}

Despite the above efforts, uncertainty and a lack of consensus remain over selecting an appropriate time horizon for evaluations²¹.

¹³ World Health Organisation. http://www.who.int/influenza_vaccines_plan/resources/session_2_kaddar.pdf?ua=1

¹⁴ Brousselle, Astrid et al. "What are the benefits and risks of using return on investment to defend public health programs?" *Prev Med Rep.* 2016 Jun; 3: 135–138

¹⁵ Jang, Yeona et al. "Return on Investment in Electronic Health Records in Primary Care Practices: A Mixed Methods Study." *JMIR Med Inform.* 2014 Jul-Dec; 2(2): e25.

¹⁶ Grieger DL, et al. "A pilot study to document the return on investment for implementing an ambulatory electronic health record at an academic medical center." *J Am Coll Surg.* 2007 Jul;205(1):89-96.

¹⁷ Kaushal R, et al. "Return on investment for a computerized physician order entry system." *J Am Med Inform Assoc.* 2006 May-Jun;13(3):261-6. Epub 2006 Feb 24.

¹⁸ Goetzel, Ron, et al. "Estimating the Return on Investment From a Health Risk Management Program Offered to Small Colorado-Based Employers." *J Occup Environ Med.* Author manuscript; available in PMC 2015 Jun 16.

¹⁹ Su et al. "Return on Investment for Digital Behavioral Counseling in Patients With Prediabetes and Cardiovascular Disease". *Prev Chronic Dis* 2016;13:150357

²⁰ Morpew T, et al. "Mobile health care operations and return on investment in predominantly underserved children with asthma: the breathmobile program." *Popul Health Manag.* 2013 Aug;16(4):261-9.

²¹ Food and Drug Administration. Digital Health. <https://www.fda.gov/MedicalDevices/DigitalHealth/>

Broad impact of technology

The impact of technology extends vertically and laterally across organisations. As such, isolated improvement in a certain function is difficult to be extricated from cross-functional operations for measurement purposes.

Differing healthcare system characteristics

As healthcare systems in Southeast Asia become increasingly robust and formalised, a “one size fits all” approach to measuring digital health ROI is not feasible. Measurements will have to be put within context, with one of the likely challenges to be faced in this undertaking being the lack of data availability.



ROI measurements re-imagined

With the astounding speed of digital transformation occurring across industries, new entrants disrupting the healthcare industry and patients fast becoming empowered consumers, healthcare stakeholders are in a race against time to go digital or risk falling behind the curve.

Bottom line: The definition of value must be reconsidered. Currently, literature on measuring ROI from healthcare investments appears

fragmented with various methodologies measuring monetary benefits using both direct and indirect approaches. What is needed is a holistic measurement framework that not only addresses immediate, monetary benefits, but also the non-monetary benefits arising out of quality care delivery. Take patient experience, for example, where improved satisfaction and greater quality of life are important components of quality care provision that preserve the human touch in care delivery outcomes.

Figure 2: ROI from digital health investments – a holistic measurement framework

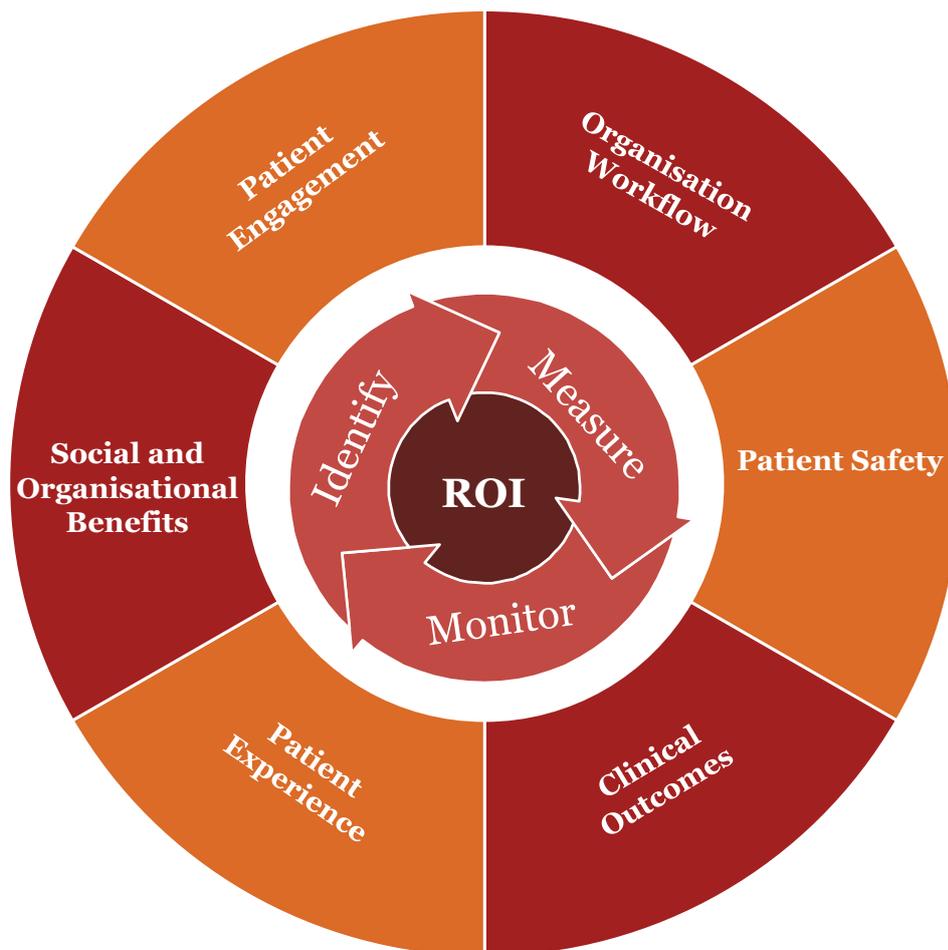


Figure 3: ROI from digital health investments – measurement dimensions or the holistic framework

Benefit	Dimensions	ROI measurements / metrics
Monetary	Patient engagement	<ul style="list-style-type: none"> • Increased patient footfall • Increased patient interaction with organisation (e.g. measured by social media behaviour, usage of apps)
	Organisation workflow	<ul style="list-style-type: none"> • Reduced/improved service time in the following area: <ul style="list-style-type: none"> - Patient wait times - Average length of stay • Increased active patients to clinical staff ratio • Improved staff utilisation rates
	Patient safety	<ul style="list-style-type: none"> • Increased compliance with best-in-class clinical data reporting guidelines and metrics • Reduced data entry and transmission errors • Reduced near-miss and adverse events • Lowered medication error and prescription error rates • Lowered cybersecurity threat events
	Clinical outcomes and quality of care	<ul style="list-style-type: none"> • Reduced complication rates • Improved surgical success rates • Lowered readmission rates • Lowered morbidity and mortality rates • Reduced hospital-acquired infections (HAIs)
Non-Monetary	Patient experience	<ul style="list-style-type: none"> • Increased patient satisfaction • Improved quality of life (i.e. quality-adjusted life year, and disability-adjusted life year)
	Social and organisational benefits	<ul style="list-style-type: none"> • Improved quality of working environment • Enhanced trust • Increased flexibility

Case study: ROI from virtual consults in a health screening initiative

The primary data from a community-based health screening initiative – studied by the National University of Singapore’s Centre for Health Services and Policy Research, and PwC – showed that patients with abnormal post-screening results were nearly six times more likely to follow up via virtual consults with a physician (using MyDoc, a Singapore-based digital health platform), than via in-person consults with a general practitioner. With that in mind, administering virtual consults can potentially translate to about five times greater savings for patients and their payers over long term as a result of averted future in-patient admissions for diabetes. (See Figure 4 and Figure 5).

Figure 4. Follow-up rates for virtual consults are nearly 6x higher, generating nearly 5x greater saving

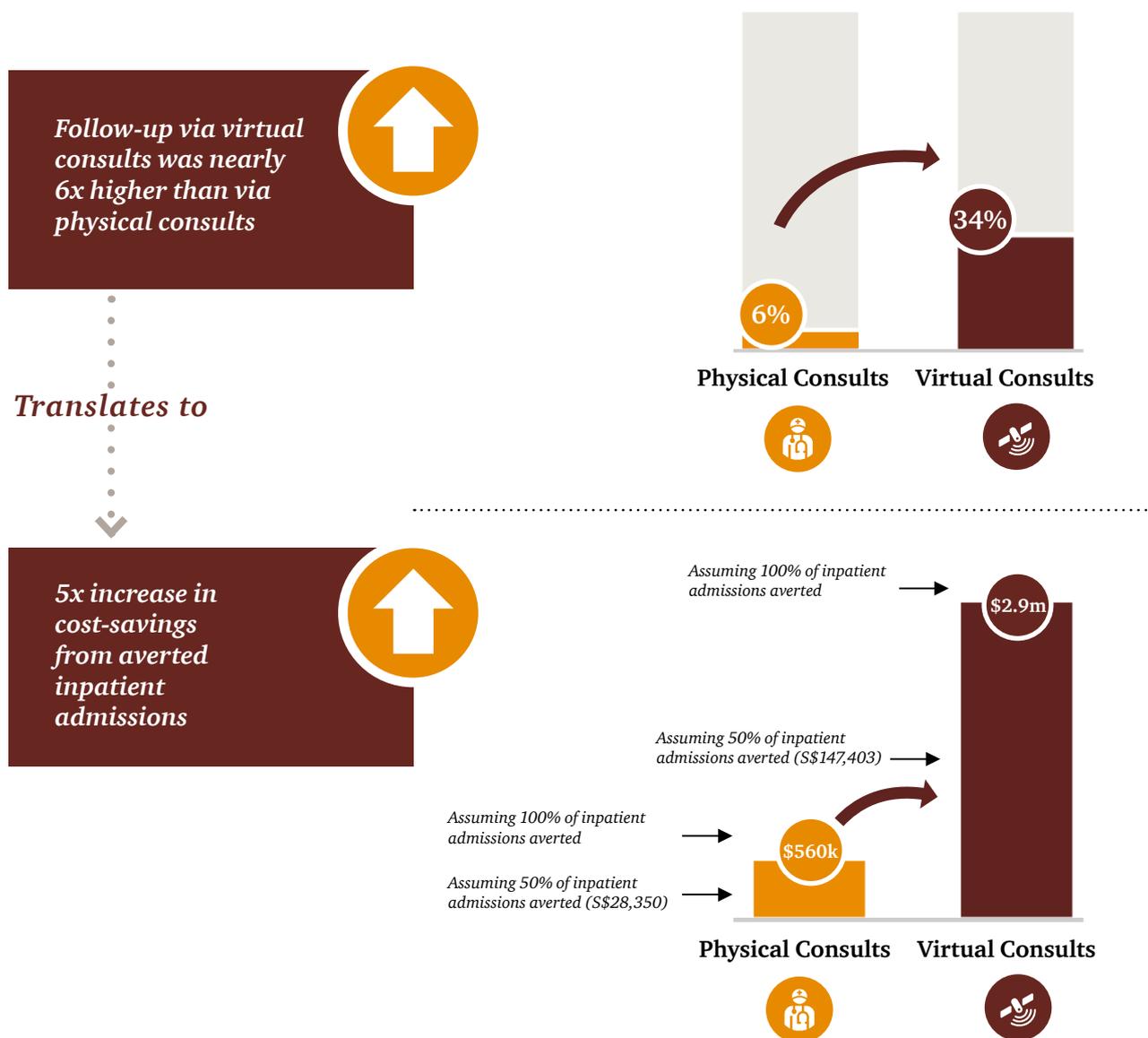


Figure 5: Cost-savings opportunity from averted diabetes admissions generated by patient follow-up – virtual consults versus in-person consults

	Virtual consult		Physical consult		Assumptions
Total participants in cohort population	100,000		100,000		
Number of patients with abnormal results	70,000	70%	70,000	70%	Assumed 70% for closest to identical populations in both cohorts
Number of follow-up patients with abnormal results	23,481	34%	4,516	6%	
Virtual Consultation Benefit Factor				5.2	
Diabetes specific					
Diabetes prevalence in SG population	11.3%		11.3%		Ministry of Health, Singapore²²
Diabetes patients in cohort population	11,300		11,300		
Prevalence of diabetes in patients with abnormal results (corrected prevalence)	16.1%		16.1%		Assumed all diabetics are detected to be abnormal during screening
Number of follow-up patients with abnormal results	23,481		4,516		
Number of diabetic follow-up patients	3,791		729		At 16.1% prevalence of diabetes in patients with abnormal results, assumed all diabetics are detected to be abnormal during screening

²² Ministry of Health (Singapore). Prevalence of diabetes in adults aged 18-69 years in 2010. Diabetes is defined as 2-hour plasma glucose during an oral glucose tolerance test ≥ 11.1 mmol/l. https://www.moh.gov.sg/content/moh_web/home/statistics/Health_Facts_Singapore/Disease_Burden.html

	Virtual consult	Physical consult	Assumptions
Expected number of inpatient admissions amongst the diabetic follow-up patients	629	121	At a 17.1% rate of inpatient admissions amongst diabetic patients in Singapore (Ng et al, 2015 ²³)
Mean cost of inpatient admission per diabetic patient in Singapore	S\$8,787.8	S\$8,787.8	Ng et al, 2015 ²⁴
Mean cost-savings due to averted inpatient admissions amongst the diabetic follow-up patients	S\$5,529,495	S\$1,063,494	Assuming 100% of inpatient admissions averted due to detection from screening and follow-up
Mean annual cost of outpatient treatment per diabetic patient in Singapore	S\$690.5	S\$690.5	Ng et al, 2015 ²⁵
Net mean cost-savings due to averted inpatient admissions amongst the diabetic follow-up patients	S\$2,912,150	S\$560,097	Assuming 100% of inpatient admissions averted due to detection from screening and follow-up

Notes:

- The study's patient population is based on response rates extrapolated from actual data.
- Virtual consult refers to a text-follow up with a GP on a telehealth application platform once the patient has viewed an abnormal blood test result.
- Costs are presented in Singapore Dollars (SGD).
- Study based on cross-sectional data collected during two Health Promotion Board Healthy Workplace Screening Programme days in the following locations – Harbourfront (June 2016) and Viva (May 2016) in Singapore.

Source:

- The data for physical consults and virtual consults were provided by MyDoc.
- Analysis conducted by the NUS Centre for Health Services and Policy Research

²³ Ng et al. "Direct Medical Cost of Type 2 Diabetes in Singapore". PLoS One. 2015; 10(3): e0122795.

²⁴ Ibid.

²⁵ Ibid.



Conclusion

Pressed with the burden of glaring gaps in care delivery, the fast pace of healthcare reform and rising patient empowerment, adoption of digital solutions in Southeast Asia is likely to become more the norm than exception. In such a scenario, digital complacency for healthcare organizations – particularly payers and providers could lead them to losing market share and falling behind the curve.

The future is digital, and it's already here. Industry incumbents cannot afford to be complacent with the status quo or they risk becoming irrelevant. We have identified that among the main issues obstructing traditional players from moving forward is that there isn't a clear-cut approach to defining the value of digital health investments and measuring its ROI. In order to make meaningful progress, there is an urgent need for industry-wide collaboration to arrive at a consensus in this matter.

There is no doubt that implementation costs of digital health solutions will be high, and that monetary returns on investment will not be immediate. However, defining its value and prioritising its ROI metrics holistically – both as a collective effort, and customised to each stakeholder in the value chain – will help pave way for effective decision-making and drive positive health outcomes, benefiting the entire healthcare ecosystem.

Our authors



David McKeering
Public Sector and Health
Industries Leader
South East Asia, PwC



A/Prof Joanne Yoong
Director
Centre for Health Services and Policy
Research, National University of Singapore



Dr. Zubin J Daruwalla
Healthcare Consulting Director
South East Asia, PwC



Natasha Chainani
Associate
South East Asia, PwC

Contributing Authors

Sumanth Kambhammettu
Senior Manager
South East Asia, PwC

Gracielynn E Flores
Manager
South East Asia, PwC

Emmi Hokiana
Manager
South East Asia, PwC

Cindy XY Chan
Senior Associate
South East Asia, PwC

