

Patient Engagement

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[AP3-E2-1-01] OHIDAS Toolkit, the PHC, and *Tanya Pakar*: A Multi-level, Vertically Integrated Digital Health Promotion, Primary Prevention and Telemedicine Provision Programme

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Keywords: OHIDAS, Wellness, Telemedicine, Smart Health, PHC

Multiple challenges abound in Malaysian healthcare delivery, including a high prevalence of non-communicable disease associated with poorly reinforced lifestyle practices, service delivery challenges in primary care, and difficulty in adapting English-language evidence-based research to Kadazan culture-specific health beliefs. University Malaysia Sabah (UMS) University Hospital (HUMS) conceptualized a three-pronged, vertically integrated digital health system to address these shortfalls intelligently. Firstly, a mobile application called OHIDAS (“health” or “wellness” in the local Kadazan language) was built to serve two major objectives namely promoting healthy lifestyle practices among the community and advocating for health screening prior to illness to maintain health and well-being in our communities and prevent illness caused through NCDs. There are four stages of OHIDAS; health promotion and primary prevention, telemedicine, capturing of patients’ bioinformatics, and full integration of clinical care with mobile application. Secondly, a proprietary telemedicine system called *Tanya Pakar* was developed and expedited in view of the Covid-19 pandemic. Thirdly, HUMS collaborated with Kyushu University to develop a Malaysian Portable Health Clinic which heightens rural access to tertiary level healthcare through a synergy of telemedicine, trained human capital, and portable health devices. In conclusion, OHIDAS has the potential to become a highly effective tool for health promotion and primary prevention.

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Abstract

Multiple challenges abound in Malaysian healthcare delivery, including a high prevalence of non-communicable disease associated with poorly reinforced lifestyle practices, service delivery challenges in primary care, and difficulty in adapting English-language evidence-based research to Kadazan culture-specific health beliefs. University Malaysia Sabah (UMS) University Hospital (HUMS) conceptualized a three-pronged, vertically integrated digital health system to address these shortfalls intelligently. Firstly, a mobile application called OHIDAS (“health” or “wellness” in the local Kadazan language) was built to serve two major objectives namely promoting healthy lifestyle practices among the community and advocating for health screening prior to illness to maintain health and well-being in our communities and prevent illness caused through NCDs. There are four stages of OHIDAS; health promotion and primary prevention, telemedicine, capturing of patients’ bioinformatics, and full integration of clinical care with mobile application. Secondly, a proprietary telemedicine system called *Tanya Pakar* was developed and expedited in view of the COVID-19 pandemic. Thirdly, HUMS collaborated with Kyushu University to develop a Malaysian Portable Health Clinic which heightens rural access to tertiary level healthcare through a synergy of telemedicine, trained human capital, and portable health devices. In conclusion, OHIDAS has the potential to become a highly effective tool for health promotion and primary prevention.

Keywords:

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Introduction

Digital health has become an increasingly salient point in today’s ever-changing healthcare landscape. With the advent of personalised Information and Communication Technology in everyone’s pocket via the advent of smartphones, healthcare is becoming ubiquitous and not trapped behind the cloistered walls of hospitals. Modern smartphone processing power and capacities, including simple cameras and motion sensors, are sufficient to fulfil the role of many proprietary devices, potentially providing a valuable Internet of Things (IoT) solution [1]. There are many reasons that uptake of such facilities might be lesser in lower and middle income countries. This includes but is not limited to: the high cost of producing

comprehensive healthcare related applications and the limited potential of revenue without a large-scale subscription model and pool of potential customers; the lack of backing from a large-scale hospital, be it a private or ministry of health-related facility; and the lack of ethics or medicolegal guidelines regarding such applications [2].

Moreover, Internet information bases may be convenient but they remain generic. Each illness presents in each unique individual with specific illness profiles, including but not limited to unique symptoms, functional impairments, specific side effects to treatments, and very different subjective illness experiences and psychological sequelae.

Hence, there is high importance in providing targeted illness health advice and personalised treatment plans, as it will increase adherence levels [3].

In this day and age, a hospital needs to diverge from the traditional model of hospital providership, where patients come to hospitals to seek care on a one-off or as needed basis, then have a long hiatus till the next encounter. This is paternalistic and does not serve to reinforce health-promoting behaviours and reduces the sense of collaboration and partnership with hospitals. Also this model is not suitable for chronic illnesses e.g. hypertension and diabetes, which rely on patients making incremental steps for behavior change and adoption of medication adherence behaviours and healthy lifestyles in the long run, rather than single interventions in hospitals that can excise or limit the illness [4]. Much of this can be countered by creating a mobile application. Instead of putting patients in hospitals, we are essentially able to put hospitals into patients’ pockets. There will be continuous care provided in both directions envisioned: from hospital to patient (via health promotion and primary prevention information), from patient to hospital (via bioinformatics), and most importantly, collaboratively with patient and hospital (through personalized care plans and their implementation via direct contact with clinical care teams in-app). As part of implementation of HUMS as a smart hospital, an app was conceptualized called OHIDAS (“health” or “wellness” in the local Kadazan language). OHIDAS is a revolutionary idea in the creation of a SMART HUMS, as it will be a ground-breaking mobile application that will serve two major objectives, namely to promote healthy lifestyle practices among the community, and to advocate for health screening prior to illness to maintain health and well-being in our communities and prevent illness caused through NCDs.

In the “new normal” espoused by COVID-19 and its multiple ramifications on social distancing, transformation of healthcare norms, and decongestion of hospitals and healthcare facilities, OHIDAS has an even more integral role. By uberising healthcare and transforming primary prevention and healthcare promotion from a face-to-face activity performed in mass gatherings or in classroom settings, all heavily proscribed under current lockdowns and new norms, into an activity

easily performed in the comfort of one’s home, village or location with the aid of one’s smartphone, it allows healthcare to proceed relentlessly. Moreover, as OHIDAS includes in its mid-level implementations telemedicine facilities, it will allow people with chronic health issues who are hampered from movement and health-seeking behaviours due to lockdowns equitable access to tertiary healthcare providers via telemedicine software, remote dispensing, and judicious use of online monitoring systems.

Theoretical Framework for OHIDAS

OHIDAS is strategically poised to directly affect the way patients think, feel and behave in terms of their health, thus its foundations have to be established with firm support. To that length OHIDAS is not a flight of fancy but is grounded in theories of health behaviour – self-determination theory [5]. Ryan et al describe 3 basic psychological needs that are central to the model of self-determination: autonomy (feeling of being the origin of one’s behaviours), competence (feeling effective), and relatedness (feeling understood and cared for by others) [6]. These three needs represent “psychological nutrients that are essential for ongoing psychological growth, integrity, and well-being” [6]. Support and subsequent satisfaction of these needs provides a higher quality of psychological energy that is predicted to, and has been empirically confirmed to, motivate the initiation and long-term maintenance of health behaviors [5]. This leads to better mental and physical health [7]. Meta-analytic level evidence suggests statistically significant positive relationships between the two pillars: psychological need satisfaction and autonomous motivation to beneficial health outcomes [5]. Hence the activities and tools that propose to be made available in the OHIDAS toolkit will ideally be able to incorporate principles and aspects of SDT on top of the values HUMS espouses.

Focus on Primary rather than Tertiary Prevention

One paradigm shift in terms of healthcare behaviours is a move away from tertiary prevention and towards primary prevention [8]. Provision of tertiary prevention, i.e. reduction of symptoms or morbidity when illness has already begun, is expensive, usually intractable with difficult symptoms to treat, and causes high level of risk, side effects and morbidity [9]. Primary prevention on the other hand, where we take active steps to prevent illness from beginning by promoting wellness behaviours, e.g. diet, lifestyle, exercise, provision of good mental health, and tackling burnout and stress management is more cost-effective from a public health point of view, and has minimal or manageable risk and side effect profiles [10]. This is because staying “in wellness” involves sustainable behaviours of eating, living, and exercising well. Hence, they are easier to maintain as a “lifestyle” rather than tertiary interventions which are “firefighting” in nature. This increases self-determinism in terms of relatedness and competence. Patients who feel they have mastery about their own health behaviours and feel more related to primary teams when they provide higher levels of primary prevention advice, are more likely to then behave self-deterministically.

One major obstacle to delivering healthcare, that afflicts both

low and middle-income countries (LMICs) and developed nations alike is continuity of care [11]. Due to increasing consumerization of healthcare, mobility of individuals for employment in a globalised world, and lack of a continuous general practitioner to attend, populations falling ill tend to doctor-shop and attend multiple practitioners [12]. Hence many people do not have a centralised file in one place, have multiple records in multiple centres, and do not know what illness they have, what medications they are on, or what treatments they have undergone. Hence different centres are forced to repeat different investigations unnecessarily, at great cost and potential risk to the patients. OHIDAS increases self-determination in terms of autonomy. By patients knowing they have control over storage, transmission, and communication to other parties of their own health information, rather than waiting for a doctor or a centralised filing system to do so, people start behaving in more self-deterministic ways with regards their healthcare.

Another issue is the lack of reliable healthcare information provided to the patient [13]. Patients frequently use Google but may yield non-evidence-based or circumstantial literature. Moreover, medicine is an inexact science; scientifically based healthcare advice that is relevant to a “textbook presentation” of asthma may not be relevant to the vast majority of individuals who have presentations dissimilar to the norm. Targeted healthcare related advice that is directly relevant to patients’ presentations and illness patterns is far more useful than delivering generic healthcare advice.

In an unreleased report commissioned by HUMS for the value proposition of its new hospital, 14.4% of Sabahan hospital readmissions have been found to be avoidable for NCDs e.g., diabetes. In an ideal world, 24-hour home-based nurses tending to post-discharge patients with home-care teams would perform necessary monitoring, deliver relevant healthcare advice, and provide essential preventative care that would reduce readmission. However, due to logistics, transport availability, and shortage of staff, this is not feasible without huge structural changes at national level to healthcare HR budgets. Part of this can be delegated to the Internet via both healthcare applications and telemedicine facilities.

Methods

The implantation of the overall multi-level digital health framework for Hospital UMS and Sabah state in general is as follows: the OHIDAS digital application, the Tanya Pakar telemedicine system, and the Portable Health Clinic (PHC) community based healthcare solution.

OHIDAS Digital Application

The implementation of this application was planned to be carried out in multiple stages. This is because of various reasons. Firstly, there are few medicolegal guidelines on how to implement an application that collects patient data, and this has implications in both emergencies and in terms of improper use of big data with regards research ethics. The only recent guidelines from the WHO mainly target digital interventions, but mainly focusing on child, maternal, and reproductive health interventions [14]. Secondly, it is envisioned the project will be sustainable and organic as per HUMS’s five key core values, and instead of implementing an application straight up without any process of self-correction through negative feedback, it would be better to allow an app to evolve from simple to complex levels, while taking into account user feedback along the way on what works and what does not. The first stage was an OHIDAS mobile app focusing predominantly on health promotion and primary prevention. The second stage featured telemedicine

functionality, the third stage added bioinformatics directly linked to the OHIDAS application, whereas the fourth and final stage involved direct communication both verbally and bioinformatically with live clinical teams.

In the first stage, the OHIDAS app aims to promote healthy lifestyle practices among the community, and advocate for health screening prior to illness to maintain health and well-being in our communities and prevent illness caused through non-communicable diseases (NCDs). Medications, diagnoses, previous procedures, or imaging done were recorded directly in the OHIDAS. If this information is from HUMS, it was planned to be directly downloaded from the existing Total Hospital Information System. For non-HUMS information, e.g., patient visits to private GPs or district hospital, a mechanism was developed to capture the encounter. A simple drop-down form with typing capabilities allowed doctors out of HUMS to capture the basic information as above. For imaging or complex information like blood result panels, we created a simple camera-phone “scrapbook” which took pictures of that information and appended it to the drop-down form as an attachment.

Also, adherence to medications and treatments is one of the most difficult parts of healthcare delivery; studies estimate that between 60% of patients with chronic illness are unable to adhere to the complex schedules available [15]. This especially concerns the individuals on polypharmacy and individuals on mixed oral and injectable schedules. Hence medication aid systems are an integral part of OHIDAS. A “virtual” Dosette box screen with information about medications due and doses, and a reminder was integrated into the app, both through Google Calendar and via a propriety app reminder. This reminder was both text-based and also pictorial, to cater for less educated or those with more visual intelligence. This also reinforced names of medications.

To aid knowledge retention, gamification was incorporated. The app featured simple computer games e.g., identifying symptoms, quizzes, which will facilitate learning about targeted disease. Research has shown gamification to facilitate learning and expedite retention of information compared to didactic methods or in-hospital lectures or psychoeducation [17]. Emergency linkages were also available in-app via a GPS tracker which alerts users to nearest healthcare facilities. OHIDAS incorporated as well virtual worksheets targeted to illness and severity, e.g., depression worksheets focusing on CBT or mindfulness, and incorporated aspects of gamification. Also, electronic mood diaries, which are useful for both mental health disorders and general stress management, allowed users to record mood changes and immediate stressors, to see patterns and determine modifiable factors if recorded in diary repeatedly.

To cater for the wide cultural landscape of Sabah, English and Malay/Kadazandusun resources were available from the onset depending on patient’s preferred language setting, providing relevant language resources. Also, for a lot of these locally available materials, they were curated by app content creators rather than downloaded or syndicated from other sources, with appropriate citations provided where necessary.

Tanya Pakar Telemedicine

Initially, it was anticipated that the OHIDAS platform would need to be carefully curated and would need extensive levels of ethical clearance before proceeding, as there are still no telemedicine guidelines that have been clearly drawn up in this region other than Malaysian Medical Council preliminary guidelines. However, due to the necessity to expedite provision of telemedicine during the unanticipated and sudden Covid-19 societal lockdown and restriction of movement, a system called

Tanya Pakar HUMS (Ask the Specialist, HUMS) was developed.

This system was set up to provide telemedicine consults in various branches of medicine, including internal medicine, paediatrics, psychiatry, public health, pain management, and addiction medicine. To overcome privacy concerns, the system uses the university proprietary Miruba internal video conferencing software, as there have been multiple cybersecurity complaints with other publicly available software. The system has been highly relevant, as it has reduced barriers to access telemedicine and conventional medicine, increased the catchment of patients for Hospital UMS, and also provided increased visibility for our services especially less-known services like pain management and addiction services.

PHC Community Based Healthcare Solution

At the same time, HUMS has collaborated with a team from Kyushu University which have developed a highly viable rural medicine toolkit called the Portable Health Clinic (PHC) [18-19], which has been demonstrated to be instrumental in South Asian countries in reducing the treatment gap between the urban areas and rural areas distant from traditional medication provisions [20].

The design philosophy, intention and background of the PHC is to bring tertiary level healthcare to remote villages through a combination of telemedicine, portable healthcare devices, and trained healthcare workers to interpret findings. It hence solves the crucial problem of last mile connectivity, whereby there are sufficient doctors and allied healthcare professionals in district hospitals and remote health clinics, but due to logistics reasons and distance factors in the Bornean healthcare landscape, they do not reach the people a healthcare system needs to reach most, namely those in rural areas with poor transport connectivity. The PHC integrates with the OHIDAS system whereby there is a direct link from the OHIDAS application to telemedicine; hence individuals who are utilizing the app to monitor and get information regarding their own healthcare and diseases can immediately contact a specialist to obtain an appointment directly without going through the necessary intermediary of a referral letter via another healthcare facility at secondary levels. Hence, they do not interoperate, but rather, complement each other. The intended outcome of the PHC is hence, as with OHIDAS, to improve the autonomy, competence and relatedness of the villagers that are related, and also in the long term, to improve health markers in the villages concerned, both through core markers of wellness such as diabetes and hypertension measures, and through better cost effectiveness. The PHC will be rolled out in 5 villages in the Kudat district, 3 hours drive from a specialist tertiary hospital, and has received the blessing and collaboration of the Health Department of Kudat district. It will be a highly innovative project, allowing provision of specialist quality healthcare services to people in rural areas off the grid. The PHC intends to train up community health representatives (CHRs) in each village involved. Their roles will be as follows: to provide access to high quality specialist healthcare services to remote rural villages via teleconsultation, to provide access and linkage to local medication dispensaries and health facilities, to reduce the treatment gap in common non-communicable diseases, to provide training to other relevant villagers e.g., church/mosque leaders in essential psychological interventions, to participate in local health clinic team meetings about their village’s healthcare, and discuss indicated individuals with difficult health concerns.

Their terms of reference of the CHRs will then be as follows. Firstly, they will be dealing with gatekeeping, and will be trained to use IT facilities to access *Tanya Pakar HUMS*, which will be

used to contact a specialist or medical officer via telemedicine. Secondly, they will be able to interpret common results such as blood pressure, pulse, sugar, and pick up common signs and symptoms. Moreover, they will also be upskilled in basic life support skills (BLS), hence all CHRs will be expected to be trained in BLS by the UMS rural medicine clinic in Kudat (RMEC) and updated periodically. Importantly too, they will become part of formalised referral pathways, as they will be trained to triage patients with the help of the PHC, to know which patients to refer to Hospital Kudat, which patients just need RMEC consultation, and which patients can be seen by themselves and dispensed basic medications. Last but not least, they will participate in team meetings, as there will be a monthly (or as indicated) team meeting with the doctors and healthcare staff at RMEC Kudat, where they will be able to bring up their concerns about particular members of their community, and discuss common issues. As one last value added proposition, they will be involved in delivering psychological interventions as part of a Train the Trainer system where over time, they will learn Ultra Brief Psychological Intervention skills adapted from Shoemith and James's 2018 module [21], and slowly train other key workers in the village. Anything beyond their capability will be referred to see a psychiatry trained doctor at RMEC by appointment, who will then refer on to Hospital Kudat for admission if indicated. From a logistics point of view too, in order to facilitate village residents, they will be in charge of logistics in terms of sending people to certain designated pharmacies or health clinics to collect medications, for patients who have been suitably consulted on telemedicine

The Portable Health Clinic will hence clearly be synergistic and augmented with the *Tanya Pakar* interface. Hence, this will represent an exciting new collaboration between Kyushu University and Hospital UMS. The existing PHC system, as hardware and infrastructure, will be augmented with the software and expertise of having potentially 120 experts in various branches of medicine from the Faculty of Medicine and Health Sciences available on *Tanya Pakar* UMS on teleconferencing, direct to the most rural of villages in Sabah.

In the long run, for this model to be viable, *Tanya Pakar* HUMS will be widened at hospital level to patients having reasonable video connections and reasonable levels of insight into illness with documented logistical or disability issues, they can begin telemedicine consults. This would be more restricted to patients who are well and may just need long-term dispensation of medications, strokes, diabetes or endocrine illness, and perhaps for lower-grade complaints. To corroborate on the history and for general examination purposes, for future reference, it is suggested community nurses would be the port of call, who are trained up in the relevant speciality examinations. If community nurses feel there are any points of discrepancy, then they would request for a referral back to the hospital for clarification.

The evaluation approach and plan for all three healthcare system digital innovations was as follows. In concordance with the expected theory of change frameworks, process indicators, and outcome indicators, qualitative groups are planned once the first two phases are completed to examine whether OHIDAS truly enhances autonomy, competence and relatedness. The information obtained from the early qualitative groups would then be employed to further modify the future phases of OHIDAS, in a structure akin to a participatory action research model. Also, as OHIDAS users will be part of the Hospital UMS overall network, cost-effectiveness measures will be incorporated, examining measures including reduced use of clinic facilities, reduced medication and care requirements, and correlations with frequency of use of OHIDAS. Similar qualitative and quantitative measures will be conducted

separately with PHC and Tanya Pakar, to assess if their users also feel they have increased autonomy, competence and relatedness; and whether they create more cost-effectiveness. For PHC, in particular, Hospital UMS is involved with Kyushu University in running a five-year cohort study in the Kudat area, encompassing 2,500 villagers, monitoring various aspects of healthcare, including non-communicable diseases, mental health, and COVID-19 related indices, before and after exposure to the PHC in their villages.

Results

Thus far, as all three systems (OHIDAS, Tanya Pakar, and PHC) are all in the infancy, large scale qualitative groups and cost effectiveness studies have not been formally conducted yet. The data for the PHC for the 5-year cohort study has only been collected from the first village, totaling around 500 individuals, hence there is no trend observable thus far in terms of long-term benefits of PHC usage. However, preliminary qualitative data gathered from focus groups that have trialed Tanya Pakar agree that telemedicine is a huge boon in the age of COVID-19. Many participants who would not have dared to seek help in the age of COVID-19 due to fear of contracting illness in hospitals have approached the online telemedicine service and obtained prescriptions that way which could be collected via drive-through methods. Also, participants appreciated the level of cybersecurity afforded by using a propriety system, and were more comfortable sharing intimate information online when they were certain that there were no security leaks or potential proprietary data usage by third parties on the level of Zoom or Google.

As for the PHC, the early qualitative data from the first village to have adopted the system suggests that the village really feel that they have built closer relationships with tertiary hospitals, and are generally impressed with the fact that they are one video call away from tertiary level doctors. They have yet to see the long term effect on improvement of village community health, but agree that the project lasting in their village for many years, with sustainable founding principles, are highly suggestive of a good outcome.

Discussion

Various ethical pitfalls need to be ironed out especially at the later stages of the project. As researchers at the same time, there is big data involved which is valuable as most Sabahan data has been captured on small unrepresentative sample populations or from statistical surveys from healthcare sites, without individual data points. However, this is a repository of big data that can allow us to do the same kind of large scale retrospective studies that have sufficient power. Hence patients need to be adequately consented before embarking on this kind of data collection venture. Also, there is a high possibility of data breaches and hacking therefore highly secure biometric security systems need to be installed from the onset

Moreover, patients who are unwell according to the app may fail to respond or are unresponsive to our reminders and attempts to contact. There is a risk of potential litigation so early measures need to be put in place for that. Also, there are patients deliberately withholding certain aspects of vital medical history as this app is an "opt-in" application hence only aspects patients intend to divulge should be divulged

Potential rights to devolve to family

There is potential of family rifts and disharmony if certain confidential information is revealed from inadvertent unlocking

of app, hence a protection clause against HUMS needed at onset. Also, there is a potential need for family member to unlock app if individual is comatose or has no capacity and is in non-HUMS hospital. They will need to have named biometric assistant or emergency authentication measures at onset

Conclusion

OHIDAS has the potential to become a highly effective tool for health promotion and primary prevention. This is because it is poised to be a few things that others are not. It can be highly tailored to patients' illnesses, personalised care plans, ideas, concerns and expectations, which is very different from generic care plans that may be downloaded from other more mass-market apps. Also, it has a high level of ethnic and cultural sensitivity, as there will be a large team of content curators to provide Malay language content, and in the future, other ethnic languages. At the same time, with the integration of collaboration from Kyushu University's PHC system to facilitate rural teleconsultation, and HUMS's very own *Tanya Pakar* system to link up rural areas to the specialists in the academic side of the university, OHIDAS can take on a more ubiquitous, multifarious and omnipresent role, as it is able to provide healthcare in many different dimensions of the technological sphere.

Importantly, HUMS OHIDAS has to be economically and financially sustainable. Hence, it will be crucial to conduct research regarding the health economics of OHIDAS to establish what whether using OHIDAS has financial ramifications in preventing or delaying the onset of a certain number of non-communicable diseases. In the long run, there will be big data collected from the application that will be available for good quality retrospective studies of colossal sample sizes. However, all this will require a solid medicolegal base, and more focus groups will be crucial in determining the direction OHIDAS is going to take in the context of the university hospital ecosystem.

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There are no potential conflicts of interest.

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