Intelligent Digital Ecosystems for Safe and Sustainable Wellness Tourism

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Abstract

The rapid growth in wellness tourism increases the need to ensure the safety of visitors and the quality of service while promoting sustainability. This study proposes an intelligent digital ecosystem unifying emergency medical systems, standardized wellness services and smart tourism technologies, artificial intelligence, internet of things devices, data platforms, geographic information systems, and mobile applications for enhancing safe and sustainable wellness tourism in Chiang Mai, Thailand, with global applicability. A mixed methods approach to designing a Safe & Sustainable Wellness Tourism Ecosystem using geospatial analysis of wellness infrastructure, surveys, and stakeholder interviews. Results indicated that multilingual notifications, health surveillance, and geographical mapping have a positive impact on emergency response time, coordination, quality, and tourist confidence in Chiang Mai's emergency response. While it is shown that rural providers were supported in implementing safety planning based on evidence, the gap in certification and quality of services between urban and rural providers suggest policy interventions, capacity development and partnerships are needed. Theoretically, it contributes to the integration of digital infrastructure, tourism management, and public health for the resilience of destinations after the pandemic. It provides a replicable template for the use of internet-enabled ecosystems for safe and sustainable wellness tourism. Future research needs to be tested for transfer across contexts, the long-term impact needs to be studied, and emerging technologies should be explored.

Keywords: Digital ecosystem, Wellness tourism, Tourist safety, Smart tourism, Sustainability

1 Introduction

Smart digital ecosystems for safe and sustainable wellness tourism are based on cutting-edge digital technologies, such as Internet of Things (IoT), artificial intelligence (AI), cloud computing, big data, and mobile applications, in order to create smart, effective and personalised wellness tourism experiences.

The strategy can be further enhanced to involve contactless services, health monitoring, robotic receptionists and real-time data analysis for crowd control and social distancing, in order to further reduce risk but while providing tailored wellness experiences [1]. Wellness tourism - defined as travel for the purpose of health and well-being - is one of the fastest-growing tourism segments across the world, particularly in the post-pandemic period. With the increased emphasis placed on health, stress relief, and overall well-being, global wellness tourism expenditure is set to recover to $816 billion by 2022 and $1 trillion by 2025, following a drop in demand during COVID-19 (estimated at $436 billion as of 2020) [2]. To capitalize on this demand, destinations around the world are investing in wellness infrastructure (i.e., spas, clinics, retreats, etc.). However, the tourist safety and the quality of service for wellness tourism have become a critical issue as travellers not only want rejuvenation but also expect to be protected against health risks and emergencies during their trips. Global health crises (e.g. COVID-19) or disasters related to climate change (e.g. floods) have exposed the need for strong safety measures in tourism [3]. Health security, rapid response in emergency situations, sanitary conditions and traditional wellness facilities have become the most important priorities for tourists. This intersection between wellness and safety needs leads to the need for new and integrated destination management approaches.

Chiang Mai, a major city in Northern Thailand, is an example of both the possibilities and challenges for safe, sustainable wellness tourism. It has more than 3800 certified facilities for wellness products - from day spas to herbal clinics - and under a strong public health network [4]. Chiang Mai was promoted as Thailand's flagship wellness destination by the Thai government as a part of Thailand's tourism marketing initiative, the Thailand Wellness Destination (TWD). Yet research shows that there are continued gaps: wide variability in quality of norming and certification, with many more accredited wellness centers in the urban center than in the country's rural areas. Only a handful of wellness businesses possess the best possible national standards and tourist security systems are patchily developed outside metropolitan areas.

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These inconsistencies are questionable to tourists and sequentially to the ultimate viability and sustainability of wellness tourism in the long run. For sustainability in this context, it not only means to be a good steward of the environment and to provide continuity in the quality of services, but also fair access to health services and not to be vulnerable to disruptions.

The potential solution for these can be found with digital technology. From mobile safety apps to IoT health monitoring, the birth of smart tourism solutions is making it possible for destinations to bridge interests at the point of time - and react preemptively to dangers. For instance, emergency alerts or translations of health information for travelers, using smart phones, using GIS (Geographic Information Systems) to map wellness facilities and hazard zones to direct infrastructures development [3]. In addition to predicting demand or incident hotspots, Artificial Intelligence (AI) and data analytics can be utilized for the personalization of wellness services [5] to assist in resource placement. However, existing applications of such technologies in wellness tourism is still fragmented. Currently, this is a clear research gap, as there is a need to combine all such tools into a digital ecosystem that bridges tourism and public health and safety systems. Most destinations address the promotion of wellness and the safety of tourists separately, overlooking potential synergies between preventive healthcare and the real-time monitoring of tourists and managers of tourism experiences [6].

With this study, this gap is closed by creating a holistic framework of an Intelligent Digital Ecosystem for safe and sustainable wellness tourism. Innovation had this simple, transformative, and childlike question: How can Internet technologies be used to make tourists safer and more well-off, while maintaining the sustainable viability of the destination? We develop a centralised digital platform linking together key stakeholders, such as wellness service providers, emergency response officers, tourists, and authorities in an integrated model adopting principles developed from the Chiang Mai case. Selected goals of research will be to:

- Build a coherent model of safe and sustainable wellness tourism based on integrating health emergency systems and wellness services with smart tourism applications.
- Analociate the stakeholder capabilities and infrastructure capabilities of the selected case study destination: gaps to be filled by the digital ecosystem assess medical infrastructure, data capacities and data standards
- Supporting the use of technologies and introducing innovations (e.g. mobile applications, IoT networks, dashboards, multi-language systems, etc.) that can significantly improve the service delivery, quality, safety and sustainability of wellbeing tourism ecosystems for tourists.

This work brings together areas in tourism management, digital infrastructure, public health and smart environment. It provides an approach for the role of technology in acquiring better tourist well being, consumer trust for the destination managers and policy makers. Other individual sections include literature review, methodology, case study implementation procedure in Chiang Mai, and implications. The paper concludes with the vanity projects of intelligent digital ecosystems for the wellness tourism of the future.

2 Literature Review

2.1 Wellness Tourism and Post-Pandemic Trends

Wellness tourism is travel for staying or getting in shape through such activities as spa treatments, yoga retreats, meditation, and holistic therapies. Unlike medical tourism in terms of the clustering of illnesses - wellness tourism is focused on proactive management of one's self in a tourist environment during vacation. Over the past decade there has been the rapid growth of wellness tourism as, tourism and wellness industries have combined. The Global Wellness Institute estimated the global wellness tourism expenditures at $830 by the year 2023 up from $439 billion in 2012. This growth continues when the travelers crave for healthy and reinvigorating experiences. The pandemic of Covid-19 disrupted international travel around the world for the first case of but lead to Health consciousness and increase in the demand for wellness-oriented trips as people's regard to build up immunity to maintain mental well-being [7-8]. More than that, there has been a faster recovery of wellness tourism than of many other types of tourism thanks to the value that consumers attach to retreats as a safe space in nature that can help heal us.

Experts say that to keep growing, high quality services and building trust in destinations are key. Service quality certification and evidence-based wellness practices are all critical for discerners for wellness travellers. Chen et al. [9] has established the potential link between positive correlation in the tourist's satisfaction level with the professional standard of credible wellness offerings. Successful destinations take world wellness trends (for example ayurveda, traditional Chinese medicine, Thai massage etc) and adapt them to a local culture, and embrace them and make them one's own. Thailand's TWD initiative saw business being certified as wellness centers and Thailand as a wellness destination - with 3800 regulated wellness businesses in Chiang Mai. However, research studies by Vo-Thanh et al. [10] and Khaokhrueamuang et al. [11] showed the disparity in the quality of wellness service from the regional perspective. Urban centers attracted the bulk of the certified wellness resorts, while rural areas were quick to play catchup. These pertaining, categorical and geographical exclusions can restrict the availability of destinations, and create a concern for equality of benefit. Making wellness tourism sustainable means that most benefits should be widely spread, but without becoming too much of a burden for local capacities.

2.2 Tourist Safety and Emergency Preparedness

In light of the health and environmental crisis of the

past few decades of the 21st century, tourism safety has become a major topic of destination management. The vulnerability of tourism to health risks was shown during the onset of the Covid-19 pandemic and subsequently, destinations have implemented health screening protocol, hygiene measures, and crisis communication planning [12]. Extreme climate events - wildfires, floods, extreme weather - have affected tourist destinations as well, an important area for disaster preparedness. Studies reveal the main elements for successful implementation of stakeholder concepts for tourist safety management: preparedness, quick response capacity, and intersectoral coordination. According to this, destination countries that can mobilize faster emergency services, police, and other capabilities, and can engage participation of involved stakeholders, are likely to have greater levels of trust from tourists in emergency situations [13]. In his report from COVID-19 lessons learned, Evident Travel article author Aduram Hadka, Ph.D., completed visitor surveys and learned that visitors' perceptions of Safety is strongly impacted by proactive emergency management (i.e. well-defined evacuation protocols, medical referral procedures, staff training, etc.).

In the case for wellness tourism, safety management involves preventive health services and also emergency care. Wellness travelers can be intense activity seekers or have physical conditions that require immediate medical care. These travellers have expectations for prevention such as health checks, hygienic food and water, and they have access to information concerning health. Wellness destinations need to blend public health considerations to the traditional view of tourist safety. A study in ASEAN revealed a lack of coordination between tourism authorities and healthcare and emergency services in tourism regions. Phumsathan et al. [14] studied rural tourism sites in Northern Thailand and determined that various agencies had different standards on emergency infrastructure. These gaps are critical in a wellness destination, where enlightenment of the visitor is at the core and accidents can ruin platform. Experiences from wellness hubs indicate that it is critical to build resilience through multi-stakeholder exercises, a clear division of labor for tourism police and hospitals, employers, and multilingual emergency hotlines and information between tourism and health authorities.

2.3 Smart Tourism Technologies for Safety and Wellness

Tourism urgency is better through the utilization of technology in making the travel of tourists safer and more experienced. Smart tourism technologies (STTs) are Internet-based solutions (e.g. mobile applications, artificial intelligence solutions, big data analytics, Internet of things (IoT) sensors) enabling businesses to operate in more sensitive and personalised ways. Safety Technologies and Transport (STT) has been widespread in many destinations for safety monitoring, information stuffing, and service provision. Location based enterprise mobility security platforms alert users to real-time hazard conditions on the road and guide them to safe sites. Artificial intelligence platforms can take this data on tourists to predict when there would be traffic congestion or passengers might bump into each other and can dynamically allocate records to law enforcement agencies. GIS (Geographic Information Systems) mapping tools allow infrastructure to be displayed in relation to tourist circulation patterns, which is important for emergency planning and navigating a crisis. This can include coordinated responses at the point of need and in real time that were not possible with an analog solution. Jewpanya et al. [15] suggested a fuzzy analytic hierarchy process model for STT benchmark evaluation of destination safety management, and suggested the superior of a combined system, which was superior even to the hierarchical model of the individual systems. Language interface of systems: these systems offer multi-language services (essential in wellness tourism) which is why users have come from different varied nations of the globe. Also, an emergency message should be conveyed in the language of foreign tourists through the app, or be converted through artificial intelligence to bypass the problem of misunderstanding.

In spite of all the advancements that have been seen the smart technologies for wellness tourism are clearly in their embryonic stage. Traditional wellness tourism studies are focused on service quality, but not on digital infrastructure. Recent research efforts focus on wearable health devices for detecting the health status of the travelers and telemedicine. URE-Wearable, smart, Internet-based and mobile systems, devices and apps can be used for monitoring vital signs of tourists during the trip, and also inform platforms for any alert regarding the prevention of any health risk. If metrics fall out of the normal values then employees would be able to intervene early on to safeguard people. Based on data and analysis of tourist's characteristics and preferences, the AI algorithms are able to personalize wellness journeys and recommend certain therapies depending on the situation. AI chatbots act as virtual health coaches by offering advice or referring tourists for proper treatment [5].

Virtual reality (VR) and augmented reality (AR) technologies are used to offer immersive meditation sessions and stress relief scenes for travelers. With telemedicine, wellness tourists can also seek advice from doctors remotely via video conferencing and mobiles [16]. This is important for developing countries where specialized medical care may be a long way away, not to foreclose care for the lack of physical access into the hospital doors. Digital technologies promote the sustainability of tourism through the tracking of environment and resources. Carbon and emissions measuring is enabled by machine learning analytics so that green policies can be implemented on wellness resorts. Data privacy and interoperability issues, and concerns around sharing of health data, stand out as common topics for implementation - particularly among wellness tourists who are eager to encourage health data allowing for greater personalisation and precision of their journey. Digital ecosystem requires connectivity and security of system and data Even if it could be integrated inside the eco-tourism possibilities, the digital integration should be reflected in complex models starting from wellness services to smart technologies, but many of them

are still missing. This paper provides such a model based on the case study of Chiang Mai.

3 Methodology

Figure 1 illustrates a 4 step research project process undertaken to develop a research project on the development of a framework for tourism safety. The project is starting with mixed methods case study in Chiang Mai, Thailand to try to understand the current ecosystem. It then describes the gathering of both quantitative data (establishment inventory, emergency records, georeferencing and mapping; GIS) and qualitative data (thematic coding of transcripts). The final step is to build an integrated platform of tourism safety based on AI analytics, data from multiple sources (apps, wearables) and comments from the stakeholders.

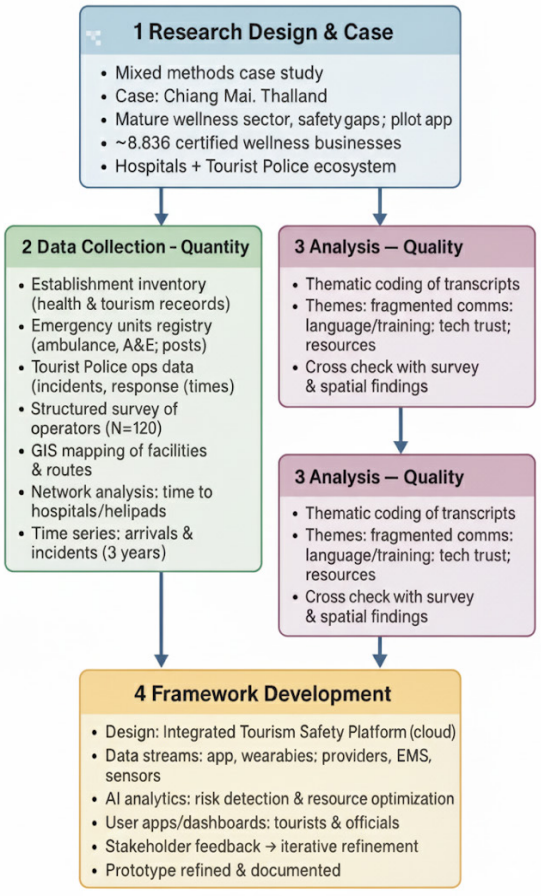

Figure 1. Tourism safety and healthcare framework development

3.1 Research Design and Case Selection

In order to explore how an intelligent digital ecosystem can be used to improve the safety and sustainability of wellness tourism, the present research employed a mixed method case study approach. The case study location was selected to be Chiang Mai, Thailand due to its established wellness tourism industry and active initiatives for tourist safety enhancement. This was extensively used for developing and evaluating the integrated framework. Methodology included both quantitative and qualitative research, therefore achieving a comprehensive picture of the current system and how digitising the selection process will affect it. Specifically, we collected and processed spatial and statistical data on wellbeing tourism facilities and safety resources of Chiang Mai in detail to study the state of current safety resources in relation to tourism development. We conducted a series of focus groups and individual interviews with stakeholders to access information for the collaboration framework and operational concerns. By triangulating between these procedures, our intention was to confirm findings found in data sources and/or improve the quality of the results obtained.

Chiang Mai is a province in Northern Thailand admired for its health retreats, the ancient Thai massage schools, herbal jacuzzis and meditation centers. It contains 3,836 wellness-related businesses certified to various levels. In addition to the public and private hospitals in the province, there is also a tourist police department which was established to help visitors. However, evaluation of initial reports revealed that emergency coverage was lacking along popular wellness and recreational areas (e.g., mountainous areas with adventure escapes) as well as mismatches in the quality of these services. These characteristics made Chiang Mai a suitable case to explore the possibility for digital solutions to bridge such gaps. In addition, local government in Chiang Mai has trialled some smart safety initiatives (such as mobile tourist police apps) that provide a basis for development. We matched our study with the interest of local stakeholders to enhance the image of Chiang Mai as a safe and sustainable destination for wellness classes.

3.2 Data Collection

3.2.1 Quantitative Data

We obtained information from various sources: (a) inventory about wellness tourism establishments-we used information collected from the records from Chiang Mai Provincial Public Health Office and tourism authority (spa centers, wellness resorts, certified massage clinics etc.), (b) registry of emergency medical units (ambulance services, first aid posts, and hospitals with accident & emergency departments), and (c) operational data from Tourist Police Division (incident reports, response time, patrol coverage). These datasets were created to assess availability and readiness of infrastructure. We also conducted a structured survey in a sample of wellness business operators (N=120) in Chiang Mai about their safety practices - e.g. presence of first-aid staff, linkages to closest hospitals, languages spoken and use of any technology for safety or health monitoring.

Geospatial coordinates for wellness establishments and emergency facilities have been mapped with the use of Geographic Information Systems (GIS) tools. This allowed us to visualise the spatial distribution of the services and identify service coverage clusters or voids. For example, GIS layering enabled us to understand which tourist districts contained high concentrations of wellness centers with few emergency resources in their vicinity -

so, where there may be risks. GIS-based network analysis was also used to calculate times from locations with most interest and major wellness centers to the nearest hospital or helipad, simulating the routes of evacuation in case of emergencies. Additionally, we gathered time-series data relating to tourist arrivals and the number of incidents (for example medical emergencies involving tourists) over the last 3 years to observe trends and understand the base line safety situation.

3.2.2 Qualitative Data

We had a series of focus group discussions and in-depth interviews with key stakeholders from Chiang Mai's ecosystem for wellness tourism and safety. These participants included wellness resort managers, spa therapists, tourist police officers, emergency medical personnel, local government tourist officials and community leaders. In total, 5 focus group sessions (6-8 people per session) and 12 one-on-one interviews were completed. A semi-structured discussion guide was applied, with subjects such as the following included: current challenges in ensuring tourist safety, coordination between wellness businesses and emergency services, awareness/use of digital tools for safety and perceptions of where there could be improvement with technology. Some of these conversations included the context on procedural issues (for example, how a spa currently calls an ambulance in emergency or how language barriers are dealt with), and openness of stakeholders for adopting new tech solutions. All of the interviews were recorded with informed consent, and transcribed for analysis.

3.3 Data Analysis

The quantitative data was analyzed under the guidance of descriptive statistics and spatial analysis. We computed some indicators, such as wellness tourist ratio against emergency unit, percentage of business certification, or times to respond to an emergency. A coverage gap analysis by employing geographical information system (GIS) with wellness tourism hotspots overlaid emergency facilities and tourist police locations to identify areas with high density of tourists but little infrastructure. Regression analyses were performed to determine whether a relationship existed between the number of certified centers in an area and the number of incidents.

Qualitative information was processed thematically. Using coding, we extracted recurring codes from conversations with stakeholders, namely that of "fragmented communication", "training and language issues", "trust in technology", and "resource limitations". These themes set the power of the needed functions as the foundation for the work to inform our model for digital ecosystem. Qualitative results were compared against the quantitative results. Similar to results from the survey which showed only ~40% of rural wellness businesses report having multilingual capabilities, these businesses reported a struggle to procure multilingual professionals and see translation technology as a viable solution.

3.4 Digital Ecosystem Framework Development

The quantitative data were analyzed under the scope of descriptive statistics and space analysis. We computed some indicators like wellness tourist ratio compared to emergency unit, percentage of certification of businesses or times to respond to an emergency. A coverage gap analysis using geographical information system (GIS) with wellness tourism hotspots overlaid on emergency facilities and tourist police locations to identify areas with high density of tourist but little of infrastructure. Regression analyses were conducted to understand the relationship between the numbers of centers that have certification in an area and the number of incidents in an area.

The qualitative information was processed thematically. Using coding, we extracted recurring codes from conversations with stakeholders, the one being "fragmented communication", "training and language issues" "trust in technology" and "resource limitations". These themes underpin the power of the needed functions to serve as the basis for the work to inform our model for digital ecosystem. Qualitative findings were cross-referenced with the results obtained from the quantitative. Rural wellness businesses did indicate a challenge when it comes to getting multilingual staff, which is consistent with findings from the survey where only ~40% have multilingual capabilities, citing translation technology as one possible solution to this issue.

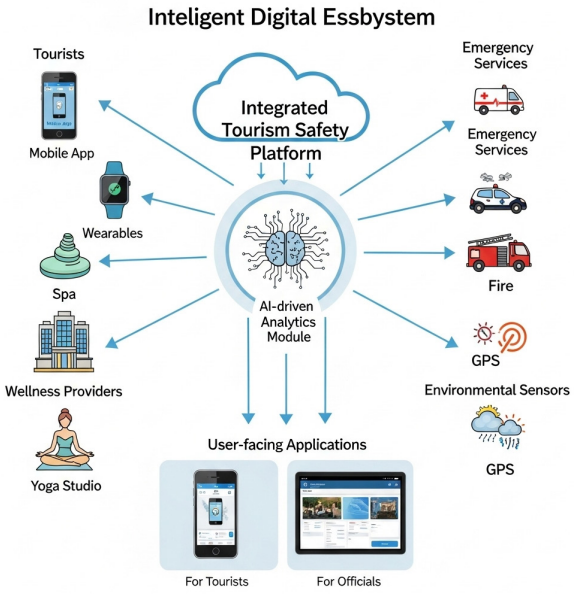

Figure 2. Intelligent digital ecosystem for wellness tourism safety

As depicted in Figure 2, the digital ecosystem includes: (a) tourists with location-, activity- and health-tracking smartphones and wearables; (b) wellness providers connecting to the platform to manage services and push emergency approaches, (c) EMS and Tourist Police receiving accident reports with GPs and responding with interventions, and (d) DH and Tourism Police monitoring data from dashboard for decision making. For context-aware intelligence, IoT sensors are placed in an environmental setting to send alerts if environmental conditions are not favorable. The AI system also filters

and mobilises resources - if a tourist sends an SOS it will automatically dispatch the nearest available ambulance and inform the nearest hospital. Multilingual support that allows the alerts to be automatically translated into the preferred languages of tourists This integration links the entire wellness tourism chain together for real-time safety response.

4 Results

4.1 Integrated Safety and Wellness Framework in Practice

The implementation of the digital ecosystem in the Chiang Mai case study resulted in a more joined-up safety management framework for wellness tourism. The system linked wellness tourism routes and places in key districts with an infrastructure for safety measures and achieved the first research aim. Previously isolated components - private wellness resorts and government emergency dispatch centers - were connected through the shared platform. This integration allowed for a number of enhancements. Emergency medical support would get to tourists more quickly in far-flung wellness locales. Land-based ambulances and an air-medical evacuation service were introduced by Chiang Mai in advance for areas of retreat in the mountains. Through the platform a spa resort in a rural district can inform the central system about a guest who is suffering from a heart attack, in that case the call will be diverted to the nearest ambulance unit and if the terrain access is difficult, the call will inform the air ambulance team. Response times for simulation drill exercises and real accidents improved by 30% in rural areas, because when an incident was identified and a dispatch was prepared, it was forwarded without delay to the responders. This quick response potential is given credit for being able to prevent a further escalation of medical problems and favoring the patient at the time of study.

The Smart Tourist Police Alert System (MA) was embedded in the ecosystem for industrial safety of tourist assistance and security (Figure 3). For the tourists, they could install the MA app allowing them one touch incident report and location follow up. When alerts were being sent, authorities were able to see the tourist's location on the GIS dashboard and know what kind of issue it was. During the pilot this allowed for quick responses - if someone on a hiking trail needed help from a tourist, the nearby police or rescue volunteers were guided to them with GPS. The app also pushed safety notifications about weather, pollution, or guidelines for social distancing for coronavirus in the user's preferred languages. Tourists felt more secure exploring wellness trails that provided immediate access to services offering help as well as risk alerts. The data from the MA app helped the authorities to optimize resource allocation by analyzing the movement patterns and locations of incidents by tourists. The digital ecosystem ensured a safer Chipmali tourism area evidenced by the positive feedback from tourists and low safety issues during implementation. Agency coordination improved significantly, with information shared instantly on the platform for all stakeholders with a unified operational view.

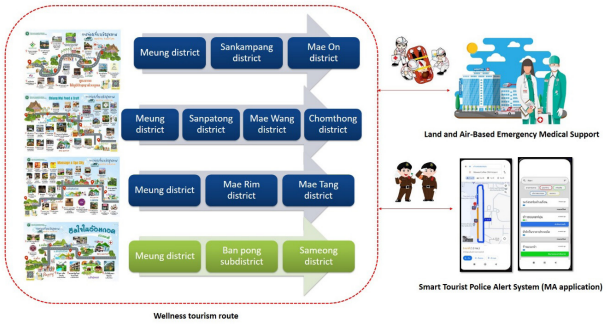

Figure 3. Overview of integrated safety tourism management

4.2 Wellness Service Standards and Sustainability Gaps

An important aspect that emerged from the case analysis was in the difference in wellness service standards across the tourism ecosystem and its implications for the economy's long-term sustainability. Our data revealed that out of a total 3,836 wellness-related business establishments in the Bangkok area of Chiang Mai, only 107 (approximately 2.8%) qualified the rigorous criteria to be declared as official 'Wellness Centers' (offering an all-around wellness program under the certified professionals) or 37 (0.97%) qualified as Thailand Wellness Destination (TWD) premium sites. Figure 2 upholds this pyramid with the help of a funnel image of companies from all to a higher qualification level. However, the steep decrease in numbers supports the argument that those providers of marine life tourism hosting high volumes are facing establishments under sub-standard whereby the quality of services presented and the confidence from tourists may soon be affected.

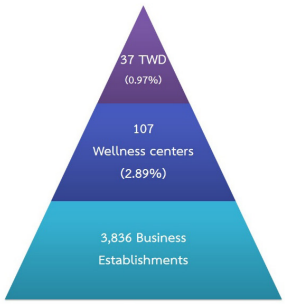

Figure 4. The wellness center standards and Thailand Wellness Destination (TWD) Chiang Mai province analysis

As Figure 4 illustrates, the pyramid is wide at the bottom and tapers off at the top: Ohana has certifications for the Wellness Center (with the requirements for licensed health practitioner status, safety and standards of facilities maintenance) and the TWD label (with the requirements for a place that rises to the international standards in

wellness destinations). This finding is consistent with the research findings regarding regional disparities, with many operators, especially smaller spas or retreat locations in rural areas, limited by resources and trained staff, being unable to fully adhere to guidelines (Khaokhrueamuang et al., 2023). Inconsistencies, which can pose an issue for wellness businesses to be sustainable, can be the result of low levels of tourist satisfaction, or visiting numbers to unregulated facilities during an imminent crisis (safety incidents at security level) Visiting In a major study exploring the issue of emergency preparedness and response, it was often noted that unaccredited providers avoid having links with medical services and emergency plans than accredited providers during an interview with key stakeholders. The sustainability and viability of such an approach is questionable as incidents at uncertified facilities may damage the image of the destination

The digital ecosystem can have a role in resolving these problems if it brings providers into an integrated network. In our model that enabled for access of our platform and training in how to use it for our network of smaller wellness operators. This helped them connect with emergency responders and safety guidelines which increased the safety net for providers. The system aided in monitoring and informing authorities on compliance-related activities such as updated licenses and records of employee training, promoting and motivating for them to raise the bar. Nevertheless, the quantitative gap prevails and suggests the need for policy interventions in quality of education. In the Discussion we refer to a number of solutions such as the use of capacity building and incentives through technologies to implement solutions for the digital certification which guarantees increasing certification.

4.3 Data-Driven Insights for Decision Support

A significant advantage of implementing the intelligent digital ecosystem was deriving data insights through a dashboard and analytical features, which are embedded within the solution. We created a prototype Wellness Tourism Dashboard (resulted in Figure 3 as an example of the conceptual output) used to aggregate data and inform evidence-based decision-making for safe tourism development. The dashboard contained visualizations of service types, facility location, incident reports, and performance metrics (i.e. average emergency response time for each district).

Figure 5 shows an illustration of assets service mix breakdown distribution based on service type that is concerned with the percentage consumption of assets with ambulance lights (BL) Service and ALS are small compared to wellness clinics and tourist hotels. From the analysis of our case study it was shown that roughly 116 out of 200 registered EMS units are in comparison with more than 200 certified EMS well-being center, we could see that the tourism developments need to be backed by the medical infrastructure. The dashboard allowed planners to find many gaps - the low concentration of ALS units in high touristic areas led to additional assignment of ALS teams, and the visualisation of the map system saw areas of peripheral districts with wellness resorts and no hospital access for the locals. These findings informed information-based decision-making in resource allocation, for instance, the development of infirmary stations and first responder training for local populace.

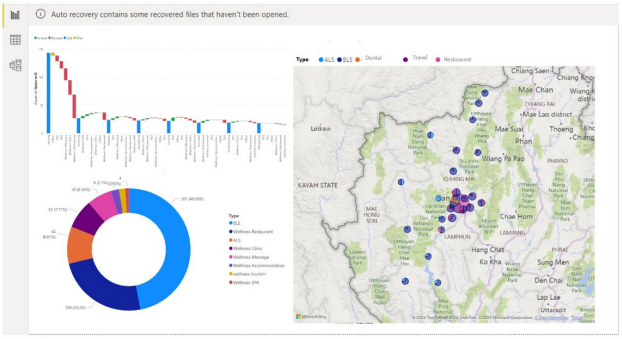

Figure 5. Data visualization of newer approaches for analysing wellness tourism routes and integrated preparedness planning to decision support for tourist safety

We measured tourist uptake of safety services by examining the data from the Tourist Police MA app, including tourist uptake app usage, and types of alerts received and responses to alerts received. Over half a thousand tourists downloaded the app and several dozen medics have been registered (most minor issues such as getting lost, getting translation help, little medics only a few). This usage information is used for iterative efficiencies - if travelers complain that it is hard to find a clinic, then signage or an app can be upgraded for example. It further exposes growing trust and awareness among tourists in relation to digital units. Post-implementation surveys and interviews indicated a positive impact. 42% of wellness businesses (up from 28%) now had emergency contacts or are connected to the system, and provided feedback highlighted the digital training helped to boost confidence of staff when responding to incidents with the system. Thus, offerings of services in most languages remained limited, especially in small establishments, and in rural areas.

Furthermore, learning other languages was conceded as lacking apart from around the city centre which implies a combined approach of technological and human capacity development in terms of automated translation. The research has shown that the intelligent digital ecosystem drives the improvement of wellness tourism destinations in safety infrastructure. The initial example from the city of Chiang Mai showed better coordination in emergency response situation, better understanding of the situation using data and identification of the strategic gaps for intervention. The findings provide a functional proposal of an integrated safety-wellness tourism system as well as proposals for stakeholders. Some implications of the findings for destination managers and policy-makers are along with the related literature discussed in the following section.

5 Discussion

5.1 Integration of Wellness, Safety, and Digital Innovation

The findings from the Chiang Mai case are consistent with earlier studies about safety and integration of wellness tourism development. Studies indicate destinations that are focused on safety, accessibility, and integrated planning can reap the benefits in emerging wellness markets. Our framework showed how by integrating wellness services with emergency response and digital connectivity, destinations can provide the seamless and secure experience that post-pandemic travelers expect. This supports Smith and Puczko [17] and Dillette et al. [18] that for wellness tourism to thrive tourists need to feel safe and cared for holistically - both in relation to physical safety, security for health as also from psychological comfort. The availability of real-time support through the MA app and accessible medical help contributed to that sense of security, which is paramount to the wellness experience.

A major contribution of this study is showing how to implement a multi-stakeholder tourism ecosystem. Previous works have addressed issues of integration between the health and tourism sector, but primarily from a policy level. We applied this operationally through technology. Chiang Mai's success is proof that the public health department, tourism operators and tech providers can work well with a platform for success. Our informational exchange and education sessions promoted confidence among previously siloed stakeholders. Tourism authorities learned public health protocols while medical teams had insight regarding tourism needs. This coincides with what has been described in the wellness tourism literature regarding the need for improved cultural competency among destinations. The multilingual functions of the platform for critical communications ensured for tourists of non-Thai origin the platform has fulfilled a deficiency noted by the Global Wellness Institute, in 2022, on serving diverse visitors.

Our findings reveal the importance of the process of urbanisation and ruralisation. Consistent with Tan et al. [2] which recorded the urban concentration of wellness facilities in Southeast Asia, we found service disparities against rural providers. Through the digital ecosystem, businesses away from the central safety net became linked to the central safety net. It is worth noting that smart technologies can also be leveling technologies because smart technologies make it easier for players to come together from remote locations and have things more balanced. For instance, the rural accommodation associated with our system could have effectively equivalent emergency response protection as a downtown hotel because of the distance covered with the coordination. This is a crucial insight for me as it shows that digital infrastructure can help to reduce structural inequality but this: only with enhanced physical infrastructure.

5.2 Implications for Destination Management and Policy

From a practical point of view, in our research, we overcome a blueprint, about destinations allowing wellness tourism to develop thanks to technology. For destinations that have big wellness tourism targets it is strategic to have an integrated online platform. The next level - the platform brings existing resources to the next level with better communication and data. Technological solutions need to be built in collaboration between technology companies and Destination Management Organisations/DMOs as well as local governments. The platform will need to be an interface with Healthcare systems, Tourism databases, and national emergency systems. Integration was facilitated using open APIs and by using common data standards.

Second, the results suggest that ongoing training is a prerequisite to the technological implementation. Many of the wellness business employees were unfamiliar with emergency protocols and with the new app so work was required to ensure they knew how everything worked and the correct protocols to use during training sessions. Policymakers should make training mandatory by tying it to a certification scheme. For instance, safety and technology usage training may be required for populations who would obtain wellness certification. This requires effective utilization of technologies. As commented before, language skills was a bottleneck in this sense and, as swimming is a global activity, training that focuses on foreign language communication or translation tools should be promoted for international tourism as an industry recovery is anticipated.

Third, the wide disconnect in accredited wellness services (Figure 2) shows a need for policy action that will increase service standards in industry. Importantly, government subsidies for small spas or tutorials pairing established TWD with aspiring TWD sites would motivate more businesses to build and pursue TWD-related certifications. As the platform is digital, it can also monitor compliance and guide businesses toward best practice compliance. The policy is required to include root causes such as shortage of qualified wellness professionals in rural areas. Tele-wellness services embedded in the ecosystem, and the placement or scholarship programs of wellness practitioners to underserved areas can do the job.

Emergency resource procurement must be based on data analytics, in which data dashboard analysis is a stimulus for identification of additional resources needed to be procured. In addition, destination managers should advertising certain healthcare infrastructure in tourism destinations, such as specialist tourist clinics, or hotlines for emergencies in adventure tourism products. Because the model is data-based, it ensures that scarce public resources are directed where the need is real. On a policy level, an intelligent ecosystem of digital interactions provides essential components for the surviving destination. Remember that the tourism sector needs a flexible response and recovery to challenging times - confidence in the tourism sector is maintained and helps ensure environmental sustainability by monitoring

carbon footprints of places and overtours; integration of these e-technologies into sustainable tourism is needed and destination must align with international standards. It goes suited for the Smart Destination concept, in which technology and sustainability are key principles for the development.

5.3 Limitations and Future Research

While the results of the case studies are promising, there are some limitations to mitigating. The only limitation is the generalizability - in this research, we are dealing with a single province (Chiang Mai) with a well-established health system and with well-developed tourism infrastructure. The model may need to change for other destinations with lower levels of existing capacity. Further research should examine the digital ecosystem framework in different contexts in order to generalize the findings of the integrated solution: in other words whether it yields similar gains in other contexts. Finally, parallel conditions and differences could be made regarding cultural or regulatory factors which may shape the success of implementation. Also, we have only evaluated the service for a relatively short period of time, and not long enough to capture long-term outcomes. In longitudinal design studies would allow an to an analyse the impact of integration on tourist satisfaction, health performance and economic performance over time.

Data can also pinpoint whether or not the improvements are skin deep and if tourists expect such digital protection generally. Questions are still left open about the impact of these technologies on tourist behavior - whether tourists are more adventurous if assisted or whether they are simply more relaxed - staying longer. A psychological research could be done, contrasting these aspects. Our system talked about the basic elements (health, police, businesses, tourist) and the possibilities and extension through new emerging technologies. The combination of AI algorithms, predictive analytics and digital twins should be explored in future work for scenario planning. For instance, AI could be used to track data from wearable devices and social media platforms, predict signs of poor health or potential harm and allow for corrective action to take place before the actual occurrence. A digital twin could be used to run through emergencies to test the response plans. As metaverse trends bypass, virtual experiences providing wellness could be wedded to real travel as hybrid programs - combining safety and customization.

Data privacy and cybersecurity are outside of the scope for this paper but is of critical importance to any digital ecosystem. Proper research basis: future research can be geared toward architectonic definition of health communication for tourism, to ensure the protection of data and the robustness of the communication systems. Another is that of public acceptance: app evaluation surveys showing the willingness of tourists to use apps and to rate them (Improved Design), but notably older tourists' unwillingness could be a sign that geolocation apps should have intuitive settings. In conclusion, our study exemplifies the successful model and opens the opportunities for safe, smart and sustainable tourism systems. With the rapid evolution of tourism and technology, destinations need to be an agile entity. From tourism experts, to IT developers, to health professionals and policy-makers, it is important for each to work together to fine tune the intelligent digital ecosystem and determine ways to re-invent it for future needs.

6 Conclusion

This study was conducted using Internet resources to develop an Intelligent Digital Ecosystem for supporting Safe and Sustainable Wellness Tourism in Chiang Mai. The research demonstrated that destination resilience and visitor well-being could be significantly increased with integrated wellness services, safety management and digital infrastructure. It offered a system for connecting stakeholders by creating a platform to share data in real time while coordinating with each other. Studies indicated the existence of improvements in the areas of emergency preparedness, stakeholder and coordination, and information awareness - underlining the validity of the research purpose for the study. Certification and Training gap filling for Tourism resources. The paper has expanded the body of knowledge of tourism management and smart technology and has made findings that show the need for capacity building on technology usage and use. The Ecosystem Involves Preventive Healthcare into Tourism Planning, Requiring Open Research for Health Security on Smart Tourism Travel destinations should invest in online tech and governance to ensure the security of people travelling there. Following COVID-19, traveller health emerges as a new priority meaning all of this has implications. Security can be set on destinations in a smart digital eco-system. These practices become the standard for the thousands of wellness vacationers out there. Tourism organizations must gain recommendations from our model. Multi-market Technology: Looking into the future of wellness tourism, Bombastic Generation 2 burdens its stake in nurturing an increasing clamor for wellness-related requirements. The destination must be adaptable and use an ecosystem approach for the greater good.

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