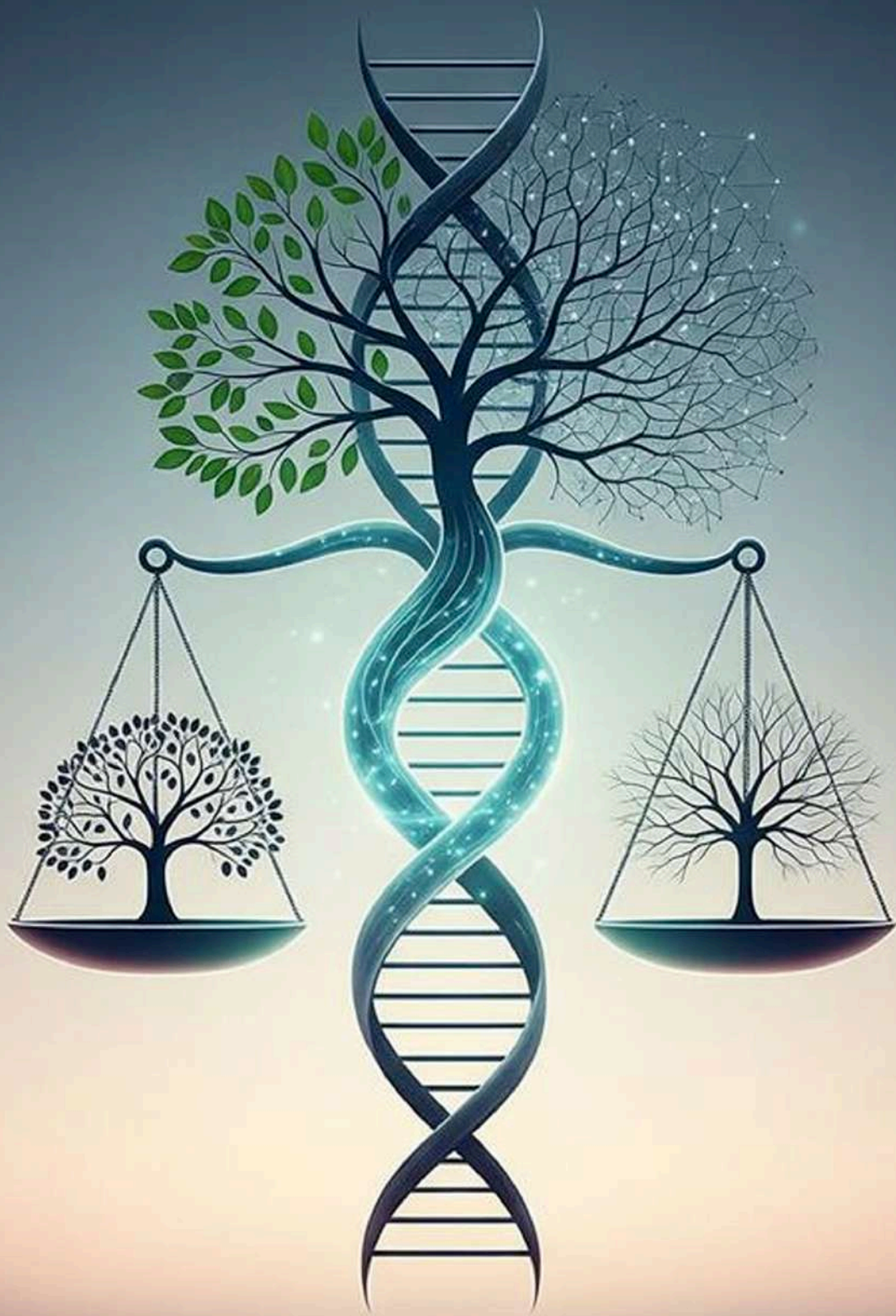


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Expanding the Teaching and Practice of Bioethics in Malaysian Research: Integrating the One Health Approach and Strengthening Ethics Committees

Sivalingam Nalliah

The definition of bioethics has evolved beyond its traditional Western-centric framework to embrace the One Health concept, reflecting a more integrated and holistic ethical perspective. Ethical considerations of interconnectedness and interdependence of human, animal, and environmental health in research proposals play an essential role in ethics committees. The Ministry of Health, Malaysia, supports the country in becoming a regional hub for industry-sponsored research. The traditional focus on clinical and biomedical ethics is not sufficient. This commentary discusses the need for increasing expertise in teaching research ethics that includes the One Health concept and justifies the design and development of a national bioethics' curriculum for higher education institutions. It will address the responsibilities of ethics committees in the context of contract research, research wastage, and protection of vulnerable populations.

Key words: *Bioethics, One Health, Contract Research, Research wastage*

Introduction

Bioethics serves as a foundational discipline that upholds the rights, dignity, and well-being of individuals involved in healthcare and research. It plays a crucial role in guiding ethical clinical practice, fostering public trust, and ensuring social accountability in health research (Sivalingam, 2014; Beauchamp & Childress, 2019). In Malaysia, the

clinical research landscape has expanded rapidly, fueled by industry-sponsored trials, technological advances, and regional collaborations. This expansion necessitates robust bioethics education and governance mechanisms to navigate emerging challenges effectively (Tengku *et al*, 2024; Clinical Research Malaysia, 2024).

Moreover, contemporary health complexities such as zoonotic disease outbreaks, antimicrobial resistance, and environmental threats demand a broader bioethical lens that transcends traditional human-focused perspectives. The One Health paradigm, emphasising interconnectedness among human, animal, and environmental health, introduces new ethical imperatives for education and ethical review processes (World Health Organization [WHO], 2023; Marcotullio, P *et al*.2022).

This article examines Malaysia's current bioethics education and research ethics governance landscape, emphasising the expanded role of Research Ethics Committees (RECs) in evaluating research aligned with the One Health concept. The integration of conventional bioethical principles with Asian cultural values in teaching is explored to foster culturally sensitive ethics education and enhance ethical review processes. Recommendations for strengthening bioethics capacity, harmonising ethics governance, and embedding One Health perspectives are provided to equip Malaysia for evolving 21st century bioethical challenges (Figure I).

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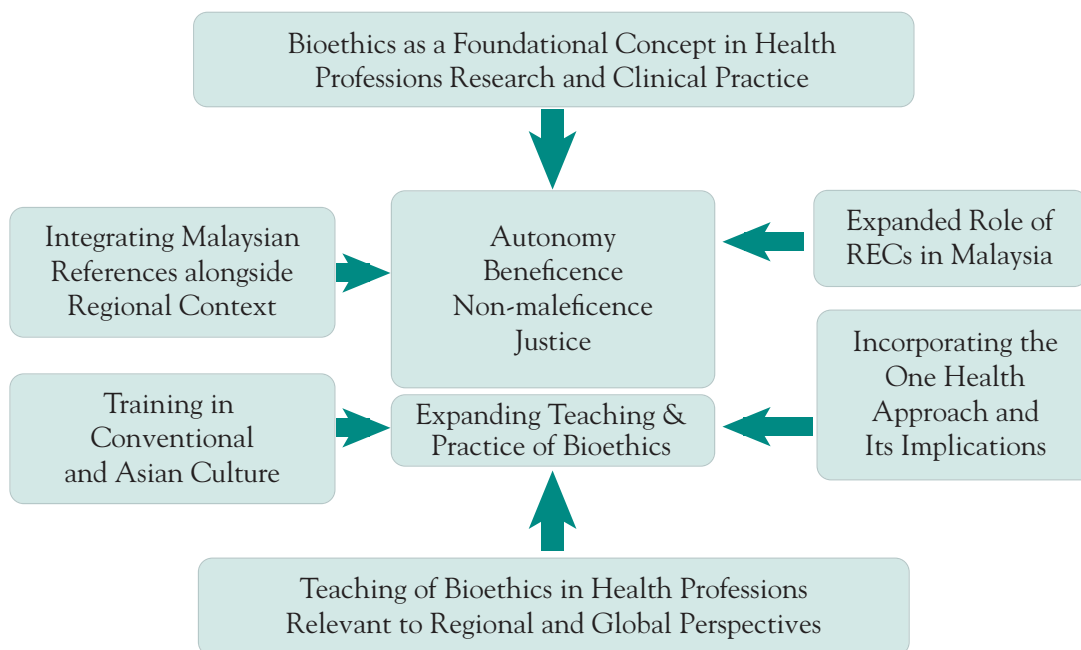


Figure 1: Foundational Principles of Expanding Teaching and Practice of Bioethics

Bioethics as a Concept and Its Importance in Malaysia

Bioethics encompasses the study of moral issues arising in healthcare, biomedical research, and public health, guiding decisions through principles of autonomy, beneficence, non-maleficence, and justice (Beauchamp & Childress, 2019). In Malaysia, bioethics empowers healthcare professionals and researchers to navigate complex dilemmas, respect patient vulnerability, and promote equitable, culturally sensitive care (Nordin, Ismail, & Othman, 2022). It directly links clinical practice with moral reflection, enhancing patient well-being and dignity, while also catalysing the establishment of ethics committees and regulatory frameworks.

Malaysia’s emergence as a regional hub for clinical trials, propelled by initiatives such as Clinical Research Malaysia (CRM), underscores bioethics’ pivotal role. CRM seeks to develop skilled talent and expand industry-sponsored research in Southeast Asia, attracting multinational collaborations that raise complex ethical considerations around participant protection, conflicts of interest, and equitable benefit sharing (CRM, 2024; SEABioethics, 2022). Integrating bioethics into biomedical and behavioral research supports the translation of findings into practice, promotes inclusive participation, and strengthens trust in the research enterprise (Ismail & Abdullah, 2023).

The Status of Bioethics Education and Teaching in Malaysia

Malaysian medical and health professions schools have incorporated bioethics into curricula; however, programme depth, scope, and cultural relevance vary widely (Nordin *et al*, 2022). Often led by clinicians or legal experts, these programmes have few dedicated bioethicists or interdisciplinary teams that include philosophers, theologians, or veterinary scientists — limiting exposure to diverse ethical perspectives (Nordin *et al*, 2022). Curricula predominantly follow Western frameworks and lack sufficient adaptation to Malaysia's multicultural, multiethnic, and multireligious context.

Emerging topics such as digital health ethics, genomic medicine, conscientious objection, compassionate care, and One Health principles remain underrepresented (Ismail & Abdullah, 2023; Tengku *et al*, 2024). Postgraduate specialised training opportunities in bioethics are scarce, restricting the development of local experts and educators. Addressing these gaps is vital to prepare future health professionals to be competent in addressing modern ethical challenges, sensitive to cultural pluralism and societal values.

Incorporation of diverse worldviews into an effective bioethics' curriculum would include:

- i. Enabling health professionals to be culturally competent to navigate family involvement.
- ii. Emphasising relational autonomy that acknowledges the social roles of individuals.

- iii. Awareness of the legitimacy of family consent where patients refer to relatives for decision-making.
- iv. Teaching community-engaged research ethics that are compatible with social values and justice in healthcare.

Integrating Conventional Bioethical Principles and Asian Cultural Values

In Malaysia and broader Asian contexts, bioethics education must reconcile Western ethical models with local cultural values and collective norms (Nordin *et al*, 2022; Tai, 2017). Unlike the Western emphasis on individual autonomy, many Asian societies emphasise relational autonomy, family-centered decision making, and social harmony (Ho, 2004; Niall *et al*, 2011).

Key Asian bioethical concepts such as Ahimsa (non-maleficence), Dharma (responsibility), Karma (ethical consequences), and Seva (selfless service) integrate individual and collective duties within familial and societal frameworks (Ten Have & Gordijn, 2011). These principles highlight the importance of compassion, respect, righteousness, and community cohesion in ethical deliberations (Bentahila, Fontaine, & Pennequin, 2021).

As discussed earlier, collective decision-making is unique to the local and regional population. It involves family or community consent. This reflects relational accountability and social cohesion. This concept arises frequently in indigenous people and contrasts with the Western philosophy of autonomy of individual consent. (Lioussis *et al*, 2020). Educating

health professionals in Bioethics must include cultural competency training that recognises these differences. Malaysia has a pluralistic and diverse population, and ethical reasoning must be context-sensitive (Nordin *et al*, 2022; SEABioethics, 2022). The redesigned curriculum should aim to support patient-centred care. Additionally, research ethics involving humans, animals, and the ecosystem must be socially and culturally aligned.

The Malaysian Ethics Review System: Moving to an expanded role

Thirteen research ethics committees (RECs) in Malaysia review research proposals that involve human subjects and animal studies. This includes university and hospital-based committees, as well as the Medical Research and Ethics Committee (MREC) under the Ministry of Health. Although this is a decentralised system, it has its strengths in being familiar with the requirements in the local setting and population and providing opportunities for training and conducting research. The limitations of this system are resource constraints and delays in recommendations for the initiation and conduct of research. Standards and processes differ among the committees, which makes it difficult to transfer ethical approvals across universities and other stakeholders. This limitation in cross-committee recognition is difficult to resolve without standardisation. However, there are challenges in drawing a national framework of guidelines, codes of practice, and institutional oversight into a single national law. One could attempt to harmonise procedures and standards across

committees and facilitate mutual recognition among the ethics committees in Malaysia to protect all stakeholders.

RECs must broaden their scope to develop expertise in reviewing research involving animals, apart from the impact of environmental and sustainability perspectives. Expertise from health professions, veterinary science, social sciences, digital health, and community and industry stakeholders are drawn in to ensure ethical diversity. Big data and (artificial intelligence) AI are proliferating at a rapid rate, and the utilisation of AI in research methods is commonplace. Digital ethics and cross-border data handling are emerging challenges that require specialised expertise and a high level of digital literacy. (Rahim, Zainal, & Hassan, 2023). Clearly, these strategies require additional training from members of RECs. Interdisciplinary knowledge is essential to evaluate complex, multisectoral research designs that are integrated with animal health and the ecosystem. (Bhadra, Ferreira, & Niemi, 2024; Thompson *et al*, 2023, Lerner *et al*, 2024). Harmonisation of ethics governance through a centralised or networked REC system shared resources could streamline approvals and strengthen ethical integrity. Building capacity through formal training programmes and national networks for ethics committee development is an urgent priority to sustain Malaysia's leadership in ethical health research (Jamaludin & Noor, 2022) (Table I).

Table I: Training Needs for Ethics Review Boards

- Harmonising ethics governance through a centralised or networked REC system.
- Development of policies and ethical guidelines for One Health research.
- Cross-disciplinary knowledge of human, animal, and ecosystem health ethics.
- Capability to evaluate complex, multisectoral research designs and outcomes.
- Training on application of bioethical principles to One Health-specific challenges Training in reflexive governance, community-focused ethics.

One Health and Its Ethical Implications in Malaysian Research and Education

One Health recognises that human health is fundamentally interconnected with the health of animals and the environment, necessitating multisectoral collaboration to tackle global health threats such as zoonoses, antimicrobial resistance, and environmental degradation (WHO, 2023; Kumar, Singh, & Ahmad, 2023). Working across disciplines to tackle emerging global health threats was exemplified during the Covid-19 pandemic. Interconnectedness of humans, animals, and the ecosystem ensures a holistic approach to developing sustainable health solutions. Bioethical perspectives to facilitate scientific research integrity, responsible use of data, and avoiding conflicts of interest fall under the expanded role of RECS. An expansion of traditional bioethics principles incorporates ecological interdependence, climate change, societal expectations of collective

responsibility, and justice in animal research of various species. (Marcotullio, Parks, & Johnson, 2022; Niemi, Bhadra, & Thompson, 2023). (Figure I)

Emerging bioethical dilemmas will require a balance between animal welfare and community health. Equitable benefit sharing across human and non-human stakeholders is the desired outcome. (Nguyen, Aziz, & Lee, 2022; Othman & Wong, 2024). Despite its critical importance, One Health remains marginal in Malaysian bioethics education and research as the focus is often on human research (Ismail & Abdullah, 2023).

Contract Research in Malaysia: Opportunities and Challenges

Ambitious goals have been set for Malaysia's Vision 2023. The Ministry of Health has stated,

“Malaysia is committed to becoming the regional hub for contract research, leveraging our robust regulatory framework, skilled talent pool, and diverse population. This will not only drive innovation and economic growth but also enhance our healthcare system's ability to deliver cutting-edge therapies to the rakyat”.

Under the ASEAN level initiatives (Ministry of Health, MOH 2024), three thrust areas are highlighted in this policy, ie, talent development, regulatory excellence, and regional collaboration.

If this objective materialises, there will be greater regional collaboration, with an increase in scientific and economic growth. This will also lead to increases

in cross-border research and knowledge exchange. However, the ethical challenges that arise from this venture will need to be addressed. Ethics committees will have to be able to resolve conflicts of interest when dealing with industry-sponsored clinical trials, as a balance between profits and over personal interests of human subjects. UNESCO has expressed its concerns about the protection of human rights for over two decades in industry-sponsored research (UNESCO, 2021). The concept of equitable benefit is relevant in all research activities.

The Problem of Research Wastage

Research wastage should be discussed at higher management levels due to an increasing number of student research projects. Ethics committees are mindful of the utilisation of resources and funding for research studies that do not yield meaningful outcomes. Researchers must employ sound methodology and ethical clearance before any data collection begins. Auditing and tracking mechanisms must be in place to capture the problem of underutilised data, unpublished research findings, and duplication of research that does not provide additional or added information that benefits society. Research wastage is both an ethical and economic issue as it exposes participants and other stakeholders to unnecessary risks (Chan & Fung, 2018).

Poorly designed studies, duplication of research, and a lack of One Health priorities often result in research wastage. Researchers should be aware of global trends and best practices. Ethical governance in One Health, with sufficient training in research methods and

bioethics education, would reduce research wastage.

Regional and Global Perspectives on Bioethics Education

Across Asia, progress in bioethics education and governance varies. Japan and Singapore maintain established undergraduate and postgraduate programmes with biologically and socially informed curricula, and active bioethics associations (Akabayashi, Slingsby, & Kai, 2014; Ho *et al*, 2010). Thailand has developed national bioethics curricula incorporating clinical, research, and One Health ethics (Sirimongkolkasem *et al*, 2020). India mandates ethics training for medical students but faces challenges with standardisation and quality assurance (Sheikh *et al*, 2013).

Common regional challenges include shortages of trained faculty, heavy reliance on Western ethical frameworks, and limited interdisciplinary approaches. (Oehring D *et al*, 2024).

Global trends emphasise integrated, context-responsive bioethics education coupled with balanced ethical governance frameworks that address digital technologies, genomics, and environmental health imperatives (Qiu, 2018; UNESCO, 2021).

Recommendations for Strengthening Bioethics and One Health Integration in Malaysia

The teaching of bioethics and professionalism has been incorporated into health professions curricula. However, it is timely to revise existing ones to include socio-cultural and religious perspectives and One Health contexts. Teachers of bioethics need to be

grounded in both Western and Asian philosophies, as well as medical and health law, veterinary sciences, and issues affecting the ecosystem. (Verma M *et al*, 2024). Formal bioethics health professions education is necessary to deliver such a curriculum effectively. This is better done with the establishment of national networks that encourage sharing resources and expertise and harmonisation of the health professions curriculum (Akabayashi *et al*, 2024; Tengku, M A, *et al*, 2024).

A unified operating system could be developed to support Research Ethics Committees nationwide that facilitates mutual recognition and addresses emerging challenges in bioethics (Rahim *et al*, 2023). Such an approach could be utilised for regular revision of national bioethics guidelines and ensure stakeholder accountability and public trust (Ministry of Health, Malaysia, 2019; 2023). Interdisciplinary partnerships among human, animal, environmental, and social sciences will lead to the enhancement of local experts and improve policy development. As contract research is expected to rise in Malaysia, policies must be transparent and training programmes must be ongoing. (Clinical Research Malaysia, 2024).

Conclusion

Teaching bioethics in Malaysia has reached a crossroads. Enhancement of the curriculum for health professions requires addressing emerging issues cohesively. The quality of patient care improves when ethical and moral perspectives are considered in ethical dilemmas. Modern bioethics education will expand to incorporate the protection of human subjects in diverse and vulnerable populations through transparency, inclusiveness, and societal needs. Additionally, governance in the conduct of research is essential through regular auditing and the prevention of research waste. Industry-sponsored research is on the rise, together with the increased utilisation of technology and artificial intelligence. One Health, contract research, and coordinated training of educators to run RECs will lead to sustained interdisciplinary collaboration and support equitable health outcomes across humans, animals, and the ecosystem. Incorporating socio-cultural values into the bioethics curriculum will reflect on community needs and better decision-making in clinical practice.

REFERENCES

- Akabayashi, A, Slingsby, B T, & Kai, I (2014). Perspectives on bioethics education in Japan. *Academic Medicine*, 89(7), 1009–1012.
- Beauchamp, T L, & Childress, J F (2019). *Principles of biomedical ethics* (8th ed.). Oxford University Press.
- Bentahila, L, Fontaine, R, & Pennequin, V (2021). Universality and cultural diversity in moral reasoning and judgment. *Frontiers in Psychology*, 12, 764360. <https://doi.org/10.3389/fpsyg.2021.764360>.
- Bhadra, S, Ferreira, J, & Niemi, M (2024). One Health research ethics review processes in African countries. *One Health Journal*, 12(1), 45–59.
- Clinical Research Malaysia. (2024). Malaysia charts path to regional leadership in clinical research. <https://www.linkedin.com/pulse/malaysia-charts-path-regional-leadership-clinical-cm7ec/>.
- Ho, C B (2004). Asian bioethics and clinical ethics: Lessons from Confucian ethics. *Journal of Medical Ethics*, 30(9), 308–313.
- Ho, C H, *et al* (2010). Bioethics education in Singapore. *Asian Bioethics Review*, 2(4), 324–332.
- Ismail, S, & Abdullah, S (2023). Integrating ecological ethics into bioethics education in Malaysia. *Malaysian Journal of Bioethics*, 10(2), 45–58.
- Jamaludin, N, & Noor, F M (2022). Strengthening research ethics committees in Malaysia: Challenges and future directions. *Asian Bioethics Review*, 14(1), 79–95.
- Kumar, A, Singh, P, & Ahmad, N (2023). Ethical implications of One Health: A Malaysian perspective. *Journal of Environmental Ethics*, 18(3), 205–220.
- Lerner, H, Niemi, M, Lederman, Z, Keller, J, Nash, P, & Bhadra, C (2024). Ethics, One Health approaches, and sustainable development goals: Conference lessons for building reflexive governance. *Sustainable Development Research Society Conference Proceedings*, 28, 1–35.
- Liossis, P, Rahman, A, Wahlberg, A, *et al* (2020). Indigenous values and bioethics in Southeast Asia. *Asian Bioethics Review*, 12(3), 235–247.
- Marcotullio, P, Parks, K, & Johnson, G (2022). Can One Health policy help us expand the ethics of interconnection and interdependence? *American Medical Association Journal of Ethics*, 26(2), 123–130.
- Ministry of Health Malaysia. (2019). *Guidelines on Ethical Issues in The Provision of Medical Genetics Services in Malaysia*. Available [http://efaidnbmnnnibpcajpcglclefindmkaj/https://www.moh.gov.my/moh/resources/Penerbitan/Garis%20Panduan/Garis%20panduan%20Umum%20\(Awam\)/Guidelines_On_Ethical_Issues_In_The_Provision_Of_Medical_Genetics_Services_In_Malaysia_\(1\).pdf](http://efaidnbmnnnibpcajpcglclefindmkaj/https://www.moh.gov.my/moh/resources/Penerbitan/Garis%20Panduan/Garis%20panduan%20Umum%20(Awam)/Guidelines_On_Ethical_Issues_In_The_Provision_Of_Medical_Genetics_Services_In_Malaysia_(1).pdf)
- Ministry of Health. (2023). *Guidelines For Ethical Conduct of In-Care and Use of Animals for Scientific Research in Ministry of Health Institutes and Facilities*.
- Nguyen, T H, Aziz, F, & Lee, B F (2022). Ethical challenges in wildlife surveillance during zoonotic outbreaks: Malaysia lessons. *One Health Journal*, 6, 100176.
- Niemi, M, Bhadra, S, & Thompson, R (2023). One Health Ethics: What then must we do? *One Health Ethics Journal*, 11(3), 210–225.
- Nordin, N A M, Ismail, S I F, & Othman, N (2022). Bioethics education in Malaysia: The need for interdisciplinary and globalised training. *Asian Bioethics Review*, 14(2), 123–134.
- Othman, H, & Wong, Y L (2024). Updating national bioethics guidelines for One Health issues in Malaysia. *Malaysian Journal of Medical Sciences*, 31(1), 1–15.
- Oehring D, Gunasekera P. Ethical Frameworks and Global Health: A Narrative Review of the “Leave No One Behind” Principle. *Inquiry*. Jan-Dec; 61:469580241288346. Doi: 10.1177/00469580241288346. PMID: 39385394; PMCID: PMC11465308.
- Qiu, R Z (2018). Bioethics Education in China: History, status, and challenges. *Cambridge Quarterly of Healthcare Ethics*, 27(2), 263–271.
- Rahim, F A, Zainal, Z, & Hassan, M (2023). Capacity building for Malaysian research ethics committees: A critical review. *Ethics Research & Integrity*, 15(2), 89–103.
- SEABioethics. (2022). *Bioethics in Southeast Asia: Ideals and challenges*. <https://seabioethics.com>
- Sheikh, A, *et al* (2013). Bioethics education in India: Status and future directions. *Indian Journal of Medical Ethics*, 10(2), 104–108.
- Sirimongkolkasem, S, *et al* (2020). Bioethics education in Thailand. *Asian Bioethics Review*, 12, 205–214.
- Sivalingam N (2004). Teaching and Learning Professionalism in Medical Schools. *Annals Academy of Medicine Singapore*. 33(6):706-10.
- Tai, M C (2017). Proposing Asian principles of bioethics from Asian perspectives. *Austin Anthropology*, 1(1), 1001.
- Ten Have, H, & Gordijn, B (2011). Respect for cultural diversity in bioethics is an ethical imperative. *PLoS Medicine*, 8(9), e1000447.
- Tengku, M A, *et al* (2024). Health research ethics system in Malaysia: Actors, functions, and gaps. *Journal of Empirical Research on Human Research Ethics*.
- Thompson, R, Bhadra, S, Niemi, M, & Lerner, H (2023). One Health ethics and regulatory procedures: Expanding ethical expertise for multidisciplinary review boards. *Bioethics Review*, 10(3), 134–148.
- Verma, M, Sahin, Z, & Khan, M (2024). One Health education nexus: Enhancing synergy among science, education, and society. *Frontiers in Public Health*, 11, Article 1337748.
- World Health Organization. (2023). *One Health*. <https://www.who.int/health-topics/one-health>.

Hope, Happiness and Holidays: A Psychological Travel Prescription

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The modern concept of tourism arises from the traditions of wealthy nobles in the 17th century Europe. Following this, advancements in technology and sociopolitical changes allowed leisure travel to be practised more widely, and it has since grown into a multi-billion-euro industry, with millions of people from every background travelling around the world each year. Leisure travel has significant economic and cultural implications as a result. COVID-19 arguably represented the biggest disruption to travel in history, and the resultant lockdowns and travel restrictions have been associated with the adverse effects on physical and mental health. Whilst the effects of political responses to COVID-19 on health outcomes is a complex area of ongoing study, it has exposed a significant lack of insight into the benefits of travel for mental health. This commentary will explore how the mental health benefits of travel, such as providing hope and enriching experiences, provide a unique opportunity for developing innovative clinical interventions.

There is a paucity of studies exploring the effects of travel on mental health. A recent article proposed the need for an integrated subspecialty of travel psychiatry to address this area.¹ The authors explored the challenges and risks of travel from a mental health perspective and considered how travel-related stress could precipitate acute decompensation of pre-existing mental illness or provoke the first clinical presentation of mental illness in an unfamiliar environment. The authors suggested actions to mitigate the potential hazards of travel for patients with mental illnesses and also highlighted the lack of

research exploring the potential benefit of travel for mental health.¹

Early studies have shown encouraging results. Pols and Kroon investigated the effect of holidays on patients with chronic mental illness.² Specific arrangements involving a specialist agency with accompanying psychiatric nurses facilitated a safe and positive travel experience for the patients. Participation in a holiday promoted psychiatric rehabilitation by enabling socialisation and relationship reinforcement behaviours such as sending postcards; this enriched self-esteem by providing unique and novel experiences. The patients also reported that the sense of adventure accompanying the holiday was a refreshing and rejuvenating experience that taught them new skills and provided them with a sense of hope and excitement for the future.² Hope has been shown to be an important factor in building resilience, countering the effects of adverse factors such as anxiety and stress, whilst promoting positive outcomes such as post-traumatic recovery and well-being.³

Travel may therefore, have significant positive effects on mental health. If sufficient research demonstrates this, travel could become a novel clinical intervention. Indeed, studies are beginning to highlight specific populations who may benefit from a travel prescription. For example, among members of the United Kingdom Armed Forces, the travel component of rest and recuperation leave from operational deployment was identified as a component contributing to improved mental health outcomes.⁴ The use of travel as a means of gaining

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respite can be extended beyond the military setting. Indeed, there is a growing population of individuals acting as primary carers for members of their family who are undergoing palliative care or suffering from chronic, debilitating illnesses. Research is focusing on developing strategies to promote the mental health of these individuals, and it would be interesting to explore the efficacy of travel interventions in this context. Business leisure travel is also a growing field and illustrates how a travel prescription could be useful for broader populations.⁵

Elderly people may also benefit from travel. Restorative activities such as travel have been shown to improve concentration, cognitive functioning and overall wellbeing.⁶ Jansen and von Sadowsky used qualitative methods of content analysis to explore how travel, as well as nature-based activities, physical exercise and social events, could have potential utility in optimising the daily functioning of frail elderly patients.⁶ Future studies should use quantitative methodology to objectively and precisely characterise this effect. In a separate study, Wen *et al*, reviewed the literature to explore how leisure travel could represent a novel adjunctive non-pharmacological treatment for patients with dementia.⁷ They proposed that the therapeutic benefit of travel may in part be mediated by positive psychology factors such as promoting hope and happiness.⁷

Travel also offers indirect benefits for mental health that are mediated by associated activities. For example, immersion in natural environments is understood to have beneficial effects on mental health and nature tourism has been recognised as a potentially useful public health intervention. Similarly, travel-associated physical activities, such as

hiking and swimming, have beneficial effects on both mental and physical health. Furthermore, the concept of digital-free tourism is an emerging area of interest wherein travellers abstain from using digital devices; this is thought to enhance wellbeing, though research is still investigating how this affects patients.⁸ Travel affords greater opportunities for people to participate in these activities. As such, as well as being a tool of health intervention, travel may be seen as a tool of health promotion.

The mental health benefits of international travel have been a neglected subject in the medical literature.⁹ We recommend multi-disciplinary approaches to original research to determine the effects of travel on protective psychological factors, including hope and resilience; its therapeutic effects on specific mental illnesses; identifying patient cohorts who could benefit from a psychological travel prescription; and characterising the determinants of any therapeutic effect to optimise outcomes.

In conclusion, there is emerging interest in exploring the therapeutic potential of leisure travel. Early studies have found that travel facilitates psychiatric rehabilitation and increased self-esteem by providing novel and exciting experiences. Moreover, studies have shown that travel can enhance psychological wellbeing in a military setting, whilst it also enables participation in numerous activities which have intrinsic benefit for mental health. In addition to exploring the benefits of leisure travel for mental health, future research should investigate the determinants of this putative effect. This could ultimately facilitate the development of a so-called travel prescription to optimise psychological wellbeing.

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Conflict of Interest

The authors declare that there is no conflict of interest.

REFERENCES

1. Flaherty G, Chai S Y, Hallahan B. To travel is to live: Embracing the emerging field of travel psychiatry. *BJPsych Bulletin*. 2021;45(3):167-70.
2. Pols J, Kroon H. The importance of holiday trips for people with chronic mental health problems. *Psychiatric Services*. 2007;58(2):262-5.
3. Senger A R. Hope's relationship with resilience and mental health during the COVID-19 pandemic. *Current Opinion In Psychology*. 2023;50:101559.
4. Jones N, Fertout M, Parsloe L, Greenberg N. An evaluation of the psychological impact of operational rest and recuperation in United Kingdom Armed Forces personnel: A post-intervention survey. *J R Soc Med*. 2013;106(11):447-55.
5. Tsaur, S-H, & Tsai, C-H (2023). Bleisure travel experience: Scale development and validation. *Journal of Travel & Tourism Marketing*, 40(1), 21-37.
6. Jansen D A, von Sadovszky V. Restorative activities of community-dwelling elders. *West J Nurs Res*. 2004;26(4):381-99.
7. Wen J, Zheng D, Hou H, Phau I, Wang W. Tourism as a dementia treatment based on positive psychology. *Tourism Management*. 2022;92:104556.
8. Hassan T H, Salem A E, Saleh M I. Digital-Free tourism holiday as a new approach for tourism well-being: Tourists' attributional approach. *Int J Environ Res Public Health*. 2022;19(10):5974.
9. Flaherty G T, Steffen R, Leder K. Towards travel therapy: Addressing the health benefits of international travel. *J Travel Med*. 2024 Jul 3:taae091. doi: 10.1093/jtm/taae091.

An Exploratory Study on the Adaptability of Malaysian Chinese Mothers Who Have Children with Dyslexia: Perspectives from a Special Needs Education Teacher and Mental Health Practitioners

Sheau Tyan Wong, Gaik Kin Teoh, Serena In

There have been past studies on the adaptability of mothers who have children with dyslexia. However, in the context of pseudo-single parenting households, which is happening frequently for fathers who would cross over the international border to their neighbouring countries for better work opportunities, these mothers' experience and adaptability deserve more understanding. Our exploratory study's findings underscore the importance of considering inherent cultural values when discussing mothers' adaptability. The mothers' stories provide insights to reevaluate current practices and interventions. However, the findings, based on two Malaysian Chinese mothers, cannot be generalised as the geographical, educational, ethnic and socio-economic status of the mothers of children with dyslexia vary. Future studies can be expanded to other ethnic groups.

The purpose of this research note is to highlight the observations the researchers had in conducting this exploratory study, to advocate for the needs of mothers of children with dyslexia in Malaysia. The authors believe that highlighting the following findings for further reflection enhances our understanding of the extent of the support needed for this population moving forward.

When children with special needs require additional care in their families, it has direct bearing on one's financial resources, intra-familial relationships, relationships outside of the family, and the main caregivers' career development. The negative

physical and mental health conditions of mothers with children with special needs are well documented (Carotenuto *et al*, 2017; Greaves *et al*, 2017; Huang *et al*, 2020) but not much literature is available on how mothers who have children with dyslexia have adapted, which this research note discusses below.

Adaptability through Community Resources

Research has shown that tapping on community resources such as acquiring knowledge and solutions from reading and exchanging views between professionals and parents has been helpful for mothers' adaptability (Griffiths *et al*, 2004) while building positive relationships with teachers has assisted in fostering greater acceptance in school (Chan & Mo, 2021).

Sharing experiences with friends has shown to enhance the mothers' confidence in managing their children's condition and their courage to communicate with authorities (Poon-McBrayer & McBrayer, 2014). Interacting with others who have similar experiences was comforting (Griffiths *et al*, 2004) as they felt not alone in their struggles. Mothers have reported positive experiences in settings that allowed them to build social networks (Multhauf *et al*, 2016; Griffiths *et al*, 2004), helping to combat social isolation and to gain valuable information about benefits and education rights for their children (Poon-McBrayer & McBrayer, 2014).

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Adaptability through Familial Relationships

Past literature also identified the positive association between familial relationships and mothers' adaptability. They felt supported when family members collectively cared for the child with dyslexia. Their spouses' initiatives and willingness to engage in discussion have strengthened their adaptability to raising kids with dyslexia (Carotenuto *et al*, 2017; Thwala *et al*, 2015).

Adaptability through Self-Determining Factors

Studies have shown that internal adjustments can induce one's adaptability to challenges and circumstances where mothers' emotional awareness helps to regulate their emotions and prevent unnecessary outbursts (Chan & Mo, 2021). Some mothers shifted from self-focused to external-focused, such as focusing on their children's strengths and exploring future opportunities for their children (Chan & Mo, 2021). Moreover, adopting different roles such as investigator, tutor, or advocator also signifies progress in adaptability (Woodcock, 2020).

Religion and spiritual support also play significant roles in helping mothers to foster courage and acceptance for their children with special needs (Thwala *et al*, 2015). The spiritual principles reframed the challenges into constructive beliefs (Chan & Mo, 2021). Perceiving their challenges as God's will increases acceptance and strengthens their spiritual faith (Senarath, 2021).

However, in contexts where community resources are lacking and where husbands' presence is intermittent,

these mothers' experiences with adaptability are worth investigating further. Particularly, with the high Singapore currency exchange rate, approximately 300,000 Malaysians commute daily to Singapore and 400,000 Malaysians work and live in Singapore (Bernama, 2024). The pseudo-single parenting household phenomenon in Johor Bahru is expanding. Hopefully, the voices of these mothers can serve as motivation for mothers who have experienced a similar situation. This was the primary reason we conducted this study.

After obtaining the University's Ethics clearance, the researchers interviewed two Malaysian Chinese mothers, ages 40-50 years old, currently residing in Johor Bahru, one-on-one, in a semi-structured setting. The mothers were recruited through the help of teachers in private children learning centres. They had at least, one child (between 2-18 years old) with dyslexia, and with husbands who physically work in Singapore for at least five days weekly. All participation was voluntary, and the interview transcripts were anonymised to protect participants' identity. Based on our observation, recruiting these mothers was challenging as "fear" and "shame" were deterrents for some potential participants of this study. The interviews revealed strong emotional responses, highlighting the psychological toll on mothers.

The findings of the current study have reflected that some of the findings overlapped with previous literature; differing from previous studies and expanding our knowledge of what has helped in mothers' adaptability, as depicted below.

Table I: Common and differing findings between the past and current study.

Themes overlapping with past studies:	Themes found in previous studies but not this study:	New themes derived from this study:
<p>External Inducers for Adaptability</p> <ul style="list-style-type: none"> – Acquire knowledge from reading. – Exchanging views between parents and professionals. – Sharing experiences with others who share similar experiences is helpful, as they feel relief to know they are not alone. – Education to increase knowledge and awareness through the media is helpful. – Family members share the responsibilities of caring for the child with dyslexia. 	<p>External Inducers for Adaptability</p> <ul style="list-style-type: none"> – Building positive relationships with teachers. – The spouse’s initiative and willingness to engage in discussion. 	<p>External Inducers for Adaptability</p> <ul style="list-style-type: none"> – Positive role models of mothers who strive. – Online information. – Child’s progress. – Financial support from spouse.
<p>Internal Inducers for Adaptability</p> <ul style="list-style-type: none"> – Religious faith. 	<p>Internal Inducers for Adaptability</p> <ul style="list-style-type: none"> – Emotional awareness helped to regulate emotions and prevent outbursts. – Adopting different roles. – Shifting focus from self-focused to externally focused. 	<p>Internal Inducers for Adaptability</p> <ul style="list-style-type: none"> – Personal time.

Discussion

This study's findings are aligned with previous studies where mothers' adaptability is enhanced through awareness of the symptoms, acquiring knowledge through media, education on managing the child's behaviors, collaboration with schoolteachers, experience sharing with others who have similar experiences; support from family members; mothers' emotional regulation and religious faith. Our findings expand on the current literature in areas that enhance mothers' adaptability: online platforms to gain knowledge, child's progress, financial support from spouse, positive role models and personal time.

While religious faith is used as an anchor to motivate these mothers in dealing with daily stressors, we have observed that early intervention could be delayed as stigma within the religious community may still be prominent with some mothers anticipating a faith-based "miracle" to happen. Moreover, in a male-dominant cultural context, top-down needed systemic intervention might be hindered, particularly since most policymakers are dominated by male figures. In the worst scenario, some mothers' distress might even be dismissed in the name of religion or "lacking faith". Hence, mothers' personal time out was highlighted as an important inducer for their adaptability. However, in an inherent male-dominant society, would mothers' personal time for self-care be validated or considered an act of selfishness?

The supportive involvement of fathers and siblings is found to be significant to the mothers' adaptability. However, we found that the statement of family

support can sometimes be oversimplified. Particularly, managing the needs of children with dyslexia requires not only having knowledge on dyslexia and intervention; rather, knowledge and skills in managing and negotiating relational expectations and differences were crucial. Thus, as family support is one of the important pillars to the mothers' adaptability, effectiveness in regularly managing expectations and communication among family members should be highly encouraged.

The findings also highlighted how children's progress can enhance their mothers' adaptability. It seems natural for mothers, even those without children with special needs, to feel encouraged and empowered when the efforts they have invested in teaching their children at home show improvements. Expanding on existing literature, the inherent collective Chinese cultural value of filial piety (Di Zi Gui 弟子规, based on the ancient Confucian teaching), respecting parents is observed to be highly emphasised. The value of respect entails various respectful behaviors towards parents, in which they even make an effort to possess what the parents emulate. In a modern society, materialism, status and high performance are highly valued. Parents' values can be permeated with external factors. Hence, re-evaluating the values of respect and personal pride that we have instilled in our children are important.

While the findings may not be generalisable to all mothers who have children with dyslexia, it is hoped to enlighten those in similar situations. The above is based on the perspectives of a teacher who has been

involved in special needs education, and mental health practitioners who are also mothers. We hope that our sharing based on our on-the-ground experiences while working with mothers, their children with dyslexia and their families could reiterate what reinforces

mothers' adaptability – combination of internal and external resources, to advocate that these needs be met collectively through continued support from society.

REFERENCES

1. Bernama (October 30, 2024). Perkeso to study social security protection for Malaysians working in Singapore. *The New Straits Times*. <https://www.nst.com.my/news/nation/2024/10/1127575/perkeso-study-social-security-protection-malaysians-working-singapore>.
2. Carotenuto, M, Messina, A, Monda, V, Precenzano, F, Iacono, D, Verrotti, A, Piccorossi, A, Gallai, B, Roccella, M, Parisi, L, Maltese, A, Lavano, F, Marotta, R, Lavano, S M, Lanzara, V, Ferrentino, R I, Pisano, S, Salerno, M, Valenzano, A, Esposito, M (2017). Maternal Stress and Coping Strategies in Developmental Dyslexia: An Italian Multicenter Study. *Frontiers in Psychiatry*, 8. <https://doi.org/10.3389/fpsy.2017.00295>.
3. Chan, T M S, & Mo, Y H K (2021). The Socio-cultural Interpretation of Parental Stress of Chinese Parents of Children with Dyslexia: Implications for Social Work Practice. *Child and Adolescent Social Work Journal*. <https://doi.org/10.1007/s10560-021-00753-0>.
4. Greaves, C E, Parker, S L, Zacher, H, & Jimmieson, N L (2017). Working mothers' emotional exhaustion from work and care: The role of core self-evaluations, mental health, and control. *Work & Stress*, 31(2), 164–181. <https://doi.org/10.1080/02678373.2017.1303760>.
5. Griffiths, C B, Norwich, B, & Burden, B (2004). Parental agency, identity and knowledge: Mothers of children with dyslexia. *Oxford Review of Education*, 30(3), 417–433. <https://doi.org/10.1080/0305498042000260511>.
6. Huang, Y, He, M, Li, A, Lin, Y, Zhang, X, & Wu, K (2020). Personality, Behavior Characteristics, and Life Quality Impact of Children with Dyslexia. *International Journal of Environmental Research and Public Health*, 17(4), 1415. <https://doi.org/10.3390/ijerph17041415>.
7. Multhauf, B, Buschmann, A, & Soellner, R (2016). Effectiveness of a group-based program for parents of children with dyslexia. *Reading and Writing*, 29(6), 1203–1223. <https://doi.org/10.1007/s11145-016-9632-1>.
8. Poon-McBrayer, K F, & McBrayer, P A (2014). Plotting Confucian and disability rights paradigms on the advocacy–activism continuum: Experiences of Chinese parents of children with dyslexia in Hong Kong. *Cambridge Journal of Education*, 44(1), 93–111. <https://doi.org/10.1080/0305764x.2013.860084>.
9. Senarath, S (2021). Mothers' Experiences of Parenting a Child with Dyslexia: A Case Study in Sri Lanka. *International Journal of Research and Innovation in Applied Science*, 6(9), 134–138. <https://doi.org/10.51584/ijrias.2021.6905>.
10. Thwala, S K, Ntinda, K, & Hlanze, B (2015). Lived Experiences of Parents of Children with Disabilities in Swaziland. *Journal of Education and Training Studies*, 3(4). <https://doi.org/10.11114/jets.v3i4.902>.
11. Woodcock, C (2020). Mothers of Children with Dyslexia Share the Protection, “In-Betweenness,” and the Battle of Living with a Reading Disability: A Feminist Autoethnography. *The Qualitative Report*. <https://doi.org/10.46743/2160-3715/2020.4162>.

Spectral Transmittance of Soft Contact Lenses Following One Month of Eyedrop Application: An In Vitro Investigation

Haliza Abdul Mutalib, Bashirah Ishak, Mohd Norhafizun Mohd Saman

This study investigated the spectral transmittance of six different types of soft contact lenses after exposure to normal eyedrops use over one month. The normal eyedrops were only meant to be instil into the eyes without contact lenses. The objective of this lab study was to look at the effect of the eyedrops on the spectral transmittance of all contact lenses.

The two types of eyedrops for dry eye (eyedrop A) and eye irritation (eyedrop B) were applied to the surface of each contact lens (two drops each) at 2-hour intervals ($n = 15$), following which the lenses were immediately immersed in saline solution. This process was repeated four times daily (eight hours for Eyedrop A) and five times daily (10 hours for Eyedrops B), with the lenses subsequently soaked in Optifree disinfecting solution overnight. This constituted one complete cycle, which was repeated daily for 30 consecutive days. The control group underwent a similar procedure but used a saline solution instead of a disinfecting solution.

Spectral transmittance measurements were conducted on Day 0 and Day 30 for both the experimental and control groups. The results were analysed to determine the average of spectral transmittance values, and the absolute differences between the measurements were calculated. All recorded values fell within the tolerance limits outlined in ISO 18369.

This study concluded that neither type of eyedrop induced significant changes in spectral transmittance after 30 days of daily use as recommended by the manufacturer. All tested lenses (in the FDA categories)

exhibited consistent spectral transmittance values throughout the study. Therefore, the eyedrops evaluated in this trial were deemed not to affect the spectral transmittance of any soft contact lens types.

Keywords: Spectral transmittance, contact lenses, ophthalmic solutions, ISO, Eyedrop

Introduction

Spectral transmittance in soft contact lenses denotes the lens's capacity to permit specific wavelengths of visible light to pass through while obstructing others. This value characterises the extent to which light of different wavelengths can penetrate the lens material and reach the eye.

Soft contact lenses are typically crafted from various polymer materials with distinct optical properties, which influence how the lenses interact with light, impacting factors such as visual clarity, comfort, and colour perception.¹ Spectral transmittance plays a critical role in determining the overall optical performance of the lens.

Different colours of light correspond to different wavelengths within the electromagnetic spectrum, and the human eye is sensitive to a range of these wavelengths, collectively constituting the visible spectrum.² A soft contact lens with standard range of spectral transmittance should facilitate a balanced and accurate representation of these visible wavelengths, ensuring clear vision and preserving natural colour perception.

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Contact lens manufacturers often assess and specify the spectral transmittance of their lenses to ensure compliance with specific optical standards and to provide wearers with optimal visual experiences. Consistent and accurate spectral transmittance properties are essential for contact lenses to avoid issues such as color distortion, diminished visual acuity, or discomfort resulting from improper light filtration. Thus, this study is significant as it evaluates the lens's optical performance when used with eyedrops daily.

Many contact lens wearers overlook the importance of verifying if the eyedrops they use are compatible with their lenses. Consequently, they may assume that the eyedrops are safe and will not alter the quality of the lens material, potentially affecting their vision quality.

Optishine[®] Eye Drops for Dry Eye Relief and Optishine[®] Eye Drops for Irritation & Discomfort Relief are two types of eyedrops commercially available in Malaysia, manufactured by Y S P Industries (M) Sdn Bhd. These products are registered under the Medical Device Act 2012 (Act 737). These two eyedrops were randomly chosen as it is commonly used and easily found in the market. These two eyedrops were meant to be used on eyes without contact lenses.

Optishine[®] Eye Drops for Dry Eye Relief (Eyedrops A) contains hydroxypropyl methylcellulose (3 mg) and are recommended for use 3-4 times daily, or as needed. Optishine[®] Eye Drops for Irritation & Discomfort Relief (Eyedrops B) contain Sodium Chloride

(4.4 mg) and Potassium Chloride (0.8 mg), and are recommended for use 5-6 times daily, or as needed. Presently, both eyedrops are recommended for use on eyes without contact lenses. The objective of this study was to assess the spectral transmittance changes of six different types of soft contact lenses after using these two different eyedrops in vitro. The parameters examined in this study include spectral transmittance, with the accepted measurement range based on the guidelines outlined in ISO 18369-3:2017.³⁻⁷

This study builds on previous investigations into the optical properties of contact lenses by focusing specifically on the potential impact of prolonged eyedrop use on spectral transmittance. While earlier research has evaluated changes in contact lens parameters after exposure to cleaning solutions or manufacturing processes, this study uniquely explores the interaction between eyedrops designed for use without lenses and different types of soft contact lenses over an extended period. It is the first study to systematically assess whether common commercial eyedrops for dry eye and irritation affect the spectral transmittance of contact lenses across FDA categories, using ISO standards as benchmarks. By confirming that these eyedrops induce no significant changes in transmittance after 30 days, the study fills an important gap in understanding the compatibility of eyedrops with contact lenses, offering reassurance about their safe use.

Material & Methods

Contact Lenses & Solutions

The contact lenses that were selected were soft lenses which were readily available in the Malaysian

market and the most preferred by contact lens wearers (Table I). These lenses were chosen to represent the FDA lens classification category. The brands and materials are as listed below:

Table I. The FDA classification is based on the lens brands and material used in this study.

Brands	Material	FDA Lens Classification
Bausch & Lomb, Softlens 38	Polymacon	Type 1
FreshKon 58	Etafilcon A	Type 4
Bausch & Lomb, Pure Vision 2	Balafilcon A	Type 5A
Alcon, Total 30	Lehfilcon A	Type 5B
CooperVision, Biofinity	Comfilcon A	Type 5C
Maxvue ColourVue (Sparkle Black Olive)	Hydrogel Terpolymer	Coloured Lens

The lenses used are with a power of -3.00DS, with base curve range of 8.6-8.7mm and diameter range of 14-14.5mm (as labelled on its blisters by the manufacturers). All lenses were of monthly wear modality and can be commonly found in the market. Fifteen lenses (of each category) were tested with Eyedrop A and Eyedrop B, and ten lenses (of each category) were used in the control group.

Soaking solution used for overnight soaking is a multipurpose Opti-Free disinfecting solution. Standard saline (0.9% NaCl) was used to simulate tears in the eye during daytime. All solution was recorded of its lot number and the expiry date was noted. Autoclaved phosphate buffered saline at pH 7.4 ± 0.1 and nominal osmolarity of $310 \pm 5\text{mOsm}$ was used throughout the lab test.

Lens preparation

All contact lenses underwent an equilibration process for eight hours in a standard saline solution, followed by an additional 16-hour soaking period in a solution designated for overnight use, resulting in a total conditioning time of 24 hours.^{3,7} This protocol ensured that the contact lens parameters remained constant before measurements were taken on Day 0.

Approximately 5 ml of saline solution was utilised to soak the lenses, and the temperature of both the saline solution and the room environment was maintained at a standard range of 23-24 degrees Celsius at all times.²

Test procedures

After a 24-hour equilibration period, measurements were taken on Day 0. To ensure thoroughness, two consecutive days were allotted for the completion of measurements for all 150 lenses by respective operators. For the instillation of the daily drops, we had assigned different unmasked operators to be in charged for a month, however, the operator that measured the spectral transmittance was one masked individual. Each contact lens was individually placed in a casing soaked with standard saline solution (0.9% NaCl) for eight hours, commencing at 8 am.

While the lenses remained in their casing, a plastic-padded forceps was used to gently lift the lens slightly to expose its surface. Two drops of Eyedrop A were applied to the contact lens every two hours. Immediately after the drops were applied, the lens was placed back into the same casing filled with saline solution. This process was repeated four times for Eyedrop A and five times for Eyedrop B. The number of drops were in accordance with the manufacturer's recommendation. Total drops instilled were eight drops and ten drops for Eyedrop A and B consecutively.

At 4 pm, the saline was drained from its casing and replaced with 5 ml of Opti-Free disinfecting solution, which was left in the casing for 16 hours until the following day at 8 am. This completed one full cycle. This cycle was repeated consecutively for 30 days.

Measurements were again carried out on Day 30. The schedules were pre-established to allow operators sufficient time to complete the measurements within a two-day period.

The study's methodology, which mimics real life conditions through daily application cycles over an extended period, provides a practical framework for future research and regulatory testing. It underscores the importance of balancing product efficacy and safety while addressing consumer needs and regulatory expectations, ultimately improving the overall experience for contact lens wearers.

Measurements

Spectrophotometry serves as a crucial technique employed to assess how different wavelengths of light interact with specific substances. In the context of contact lenses, spectrophotometry is utilised to analyse the optical properties of the lenses, including their transmission and absorption characteristics across various wavelengths of light.⁸

The spectrophotometer utilised in this study is the Shimadzu UV-Vis Spectrophotometer UV-1800 (Double beam optics), Japan, which incorporates a cuvette made of quartz glass (dimensions: 12.5x12.5x45mm). This instrument enables the evaluation of contact lens performance by measuring their transmittance and reflectance properties. By emitting light across a spectrum of wavelengths, the spectrophotometer determines how contact lenses interact with light, allowing for optimisation of clarity, colour perception, UV protection, and other desired optical attributes.

During the analysis, the contact lens and saline solution are placed within the cuvette, ensuring proper positioning to accurately measure the transmission of the central optic zone. All handling from the lens

casing into the cuvette was done using a padded plastic forceps. The spectrophotometer then measures the transmittance of the spectrum ranging from 400 to 800 nanometers (nm).

The contact lens was placed in the cuvette at a position where the light passes through the centre of the lens as shown in the side view diagram (Figure I). During spectral transmittance measuring, the lens does not move as it is held in position by the walls of cuvette as shown in the top-view diagram.

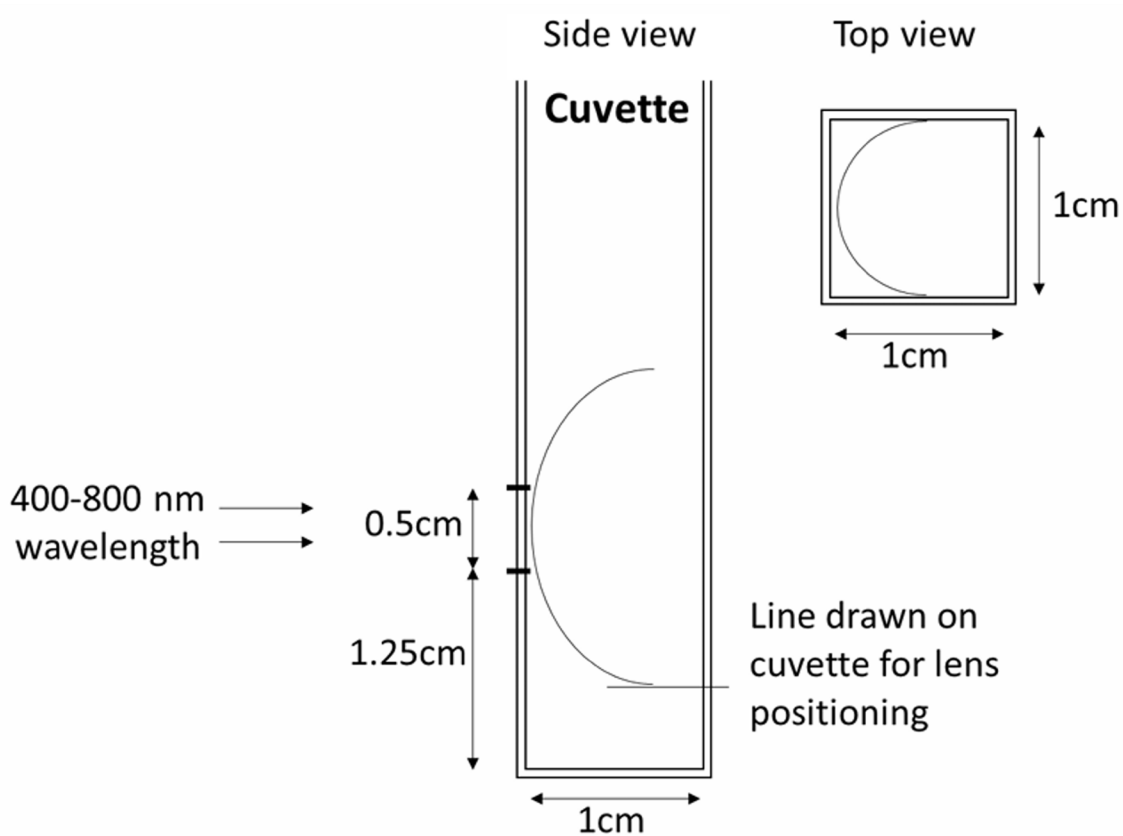


Figure I. The schematic diagram on how a piece of contact lens is being placed in the cuvette before measurements were taken.

All data collected for this study were analysed using SPSS version 26. Statistical comparisons of spectral transmittance value and after laboratory procedures were conducted accordingly. Furthermore, all results were compared to the ISO 18369-3:2017 standards, where the acceptable range of spectral transmittance in the visible region (400nm to 800nm) is within $\pm 5\%$ absolute.²

The absolute difference refers to the numerical difference in the transmittance values between Day 0 and Day 30. It was calculated as:

$$\text{Absolute Difference} = |T_{\text{day0}}(\lambda) - T_{\text{day30}}(\lambda)|$$

This measure highlights the magnitude of the difference in light transmission characteristics

without considering the direction (whether one is higher or lower). This is particularly useful in optical comparisons for quantifying deviations in transparency or filtering properties between samples.

Results

The measurements were conducted in a randomised fashion for each of the lenses on Day 0 and Day 30 (refer to Table II). The differences between pre- and post-readings were calculated in absolute values. It is important to note that the tolerance limits, as per ISO standards, are within $\pm 5\%$ absolute.

Table II. The spectral transmittance values of six types of contact lenses at Day 0 and Day 30.

EYEDROP A		Type 1 (n = 15)	Type IV (n = 15)	Type 5A (n = 15)	Type 5B (n = 15)	Type 5C (n = 14 ^a)	Colour (n = 15)
Spectral transmittance	Day 0	98.2941	98.5353	97.5041	91.8274	98.5809	84.6842
	Day 30	97.6029	96.8952	96.8782	89.4983	96.458	85.7778
Differences		-0.6912	-1.6401	-0.6259	-2.3291	-2.1229	1.0936
Absolute Differences in %		-0.70%	-1.66%	-0.64%	-2.54%	-2.15%	1.29%

EYEDROP B		Type 1 (n = 15)	Type IV (n = 15)	Type 5A (n = 15)	Type 5B (n = 15)	Type 5C (n = 14 ^a)	Colour (n = 15)
Spectral transmittance	Day 0	98.1941	98.4905	97.3779	91.7187	98.4672	84.4692
	Day 30	97.6919	97.3823	96.3618	89.2392	97.3148	85.6188
Differences		-0.5022	-1.1082	-1.0161	-2.4795	-1.1524	1.1496
Absolute Differences in %		-0.51%	-1.13%	-1.04%	-2.70%	-1.17%	1.36%

CONTROL		Type 1 (n = 10)	Type IV (n = 10)	Type 5A (n = 10)	Type 5B (n = 10)	Type 5C (n = 10)	Colour (n = 10)
Spectral transmittance	Day 0	98.2046	98.4759	97.1947	91.7502	98.2778	85.0327
	Day 30	97.4626	97.3313	96.4279	89.0915	96.7726	85.7574
Differences		-0.742	-1.1446	-0.7668	-2.6587	-1.5052	0.7247
Absolute Differences in %		-0.76%	-1.16%	-0.79%	-2.90%	-1.53%	0.85%

^alens damage

The data obtained revealed no significant changes in the spectral transmittance value of the lenses after 30 days of using Eyedrops A and B on separate lens groups. This demonstrates that the drops do not compromise the lenses' high optical standards and ensuring optimal vision correction. Measurements were scrutinised for any notable alterations and found to fall within the tolerance limits for all six types of contact lenses in both the Eyedrop A and B groups. In fact, both groups exhibited less than $\pm 5\%$ absolute differences, further supporting the conclusion that the eyedrops have negligible impact on the lenses' optical performance.

Discussion

A total of 300 lenses from six categories of soft contact lenses were divided into two groups: Eyedrop A (15 lenses for each lens type) and Eyedrop B (15 lenses for each lens type) in the study group, while the control group (10 lenses for each lens type) maintained spectral transmittance values within the acceptance range specified by ISO18369-3:2017 after 30 days of continuous use of eyedrops.

Eyedrops A and B, both consisting of simple chemical compositions but not mentioned of its suitability with contact lens wear were demonstrated to have no significant changes in the parameters of the contact lenses. All values observed after 30 days fell within the tolerance limits, indicating that both eyedrops had no adverse effects on the evaluated lenses.

Variations in spectral transmittance of contact lenses can be attributed to several factors, including lens material, manufacturing processes, coatings, and additional treatments. The molecular structure and composition of lens materials, categorised into hydrogels, silicone hydrogels, and colour tints in this study, influence their interaction with light, affecting spectral transmittance. Tinted or coloured lenses containing dyes or pigments exhibit lower spectral transmittance due to selective absorption or reflection of certain wavelengths of light, serving cosmetic or visual enhancement purposes. Spectral transmittance values were observed to be lower in tinted lenses compared to clear lenses.

To minimise confounding factors, parameters such as curvature, thickness, and design of contact lenses were standardised to a constant back-vertex power (-3.00DS). However, variations within each lens category may still occur due to differences in manufacturing processes and lens coatings. Coatings, while enhancing certain properties like UV protection or scratch resistance, can influence spectral transmittance, particularly over time as they age and potentially thin out.

Consistency in laboratory conditions, including temperature, humidity, and measurement instruments, was maintained throughout the study to mitigate variability introduced during the manufacturing process and lens handling.¹ Despite diligent handling procedures, minor variances may still contribute to differences in spectral transmittance values among lens categories.

Overall, the spectral transmittance measurements focused solely on differences between Day 0 and Day 30 after instillation of drops, providing insights into the impact of eyedrop use on the optical properties of contact lenses.

The findings of this study, which demonstrate that neither of the tested eyedrops significantly altered the spectral transmittance of soft contact lenses after 30 days of exposure, have important implications for consumer safety, regulatory standards, and product development. The compatibility of ophthalmic solutions with contact lenses is a topic of growing interest, especially as the prevalence of contact lens wear continues to rise globally. This research builds on earlier investigations into the interactions between contact lenses and external agents, such as cleaning

solutions and environmental factors, by specifically evaluating eyedrops that were not originally intended for use with lenses.

Previous studies have highlighted potential risks associated with the interaction between contact lenses and external agents. For example, Ogbuehi *et al*, examined the transmittance properties of contact lens multipurpose solutions, revealing that some solutions can cause measurable changes in lens material properties, including reduced transmittance.² Similarly, Mutalib and Lee reported parameter changes in soft contact lenses exposed to automated cleaning machines.¹ These findings underscore the importance of evaluating how commonly used ophthalmic solutions, such as eyedrops, might impact lens properties over time.

The current study is unique in its focus on two commercially available eyedrops containing hydroxypropyl methylcellulose and sodium/potassium chloride. Unlike earlier research that concentrated on cleaning solutions, this study examined products primarily intended for ocular surface relief rather than lens maintenance. The results showed no significant changes in spectral transmittance across various lens types and materials, even for coloured lenses, which typically exhibit lower transmittance due to dye incorporation. This consistency with ISO 18369 standards suggests that the tested eyedrops are safe for use with contact lenses, aligning with the broader aim of ensuring compatibility and maintaining optical performance.

Moreover, the study's method of simulating real life usage by applying eyedrops at prescribed intervals and immersing lenses in saline solution parallels practical

conditions, enhancing its applicability. This contrasts with studies like those of Turki *et al*, which often focused on isolated laboratory parameters without simulating daily wear cycles.²

The findings could inform updates to product labelling, specifically allowing manufacturers to indicate compatibility with contact lenses. For instance, adding statements such as “Safe for use with soft contact lenses” to packaging could alleviate consumer concerns and promote informed decision-making. This is particularly relevant given that a significant proportion of contact lens wearers may use eyedrops to alleviate dry eye symptoms or irritation.

From a regulatory perspective, the study underscores the need for standardised testing of ophthalmic solutions with contact lenses. Regulatory bodies, such as the International Organization for Standardization (ISO) or the US Food and Drug Administration (FDA), could incorporate protocols similar to those employed in this study as part of the approval process for ophthalmic products. Including spectral transmittance testing in these guidelines would enhance the safety and reliability of products intended for use alongside contact lenses.

This study also highlights the importance of consumer education regarding the compatibility of ophthalmic products with contact lenses. Many wearers are unaware of the potential for eyedrops to interact with their lenses. Educational campaigns could use the study’s findings to reassure consumers about the safety of certain products, potentially encouraging adherence to recommended usage guidelines and reducing misuse.

Limitations

While the current study provides robust evidence for the short-term compatibility of specific eyedrops with soft contact lenses, further research is necessary to expand the scope and real-world relevance of the findings. Future investigations should consider extending the study duration beyond 30 days – such as over 90 days or more – to assess whether cumulative effects emerge with prolonged exposure. Additionally, examining a broader range of ophthalmic solutions, including those containing preservatives (eg, benzalkonium chloride), antibiotics, or anti-allergic agents, would offer a more comprehensive evaluation of chemical interactions with lens materials. Beyond optical transmittance, future studies should also assess post-use mechanical properties of contact lenses, such as tensile strength, elasticity, and oxygen permeability, as these are essential to overall lens performance and wearer comfort. Moreover, *in vivo* studies are crucial to capture physiological variables like tear film interactions, blinking dynamics, and the impact of protein or lipid deposits – factors that cannot be fully replicated *in vitro*. Incorporating these elements into future research will strengthen the scientific foundation for developing safer, more compatible ophthalmic products and inform clinical practices and regulatory policies.

Conclusion

This *in vitro* study offers valuable insights into the chemical resilience of modern soft contact lenses when exposed to non-lens-specific ophthalmic solutions. The evidence suggests no clinically significant degradation in spectral transmittance, even in coloured lenses. These findings support more

flexible usage recommendations, potential product label updates, and informed clinical guidance. They also point toward a broader regulatory and product development shift where compatibility testing could enhance both consumer safety and product transparency.

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REFERENCES

1. Mutalib H A, Lee K C. Soft contact lens parameter changes after using the lens2^o automated lens cleaner machine. *Sains Malaysiana*. 2010;39(4):685–8. ISSN 0126-6039.
2. Ogbuehi K C, Khan F M J, Saud A A, Turki M A, Osuagwu U L. Transmittance properties of contact lens multipurpose solutions and their effects on a hydrogel lens. *Annu Res Rev Biol*. 2014;4(15):2484–500.
3. International Organization for Standardization. ISO 11981:2017. Ophthalmic optics – Contact lenses and contact lens care products – Determination of physical compatibility of contact lens care products with contact lenses. Geneva: ISO; 2017.
4. International Organization for Standardization. ISO 18369-1:2017. Ophthalmic optics – Contact lenses – Part 1: Vocabulary, classification systems and recommendations for labeling specifications. Geneva: ISO; 2017.
5. International Organization for Standardization. ISO 18369-2:2017. Ophthalmic optics – Contact lenses – Part 2: Tolerances. Geneva: ISO; 2017.
6. International Organization for Standardization. ISO 18369-3:2017. Ophthalmic optics – Contact lenses – Part 3: Measurement methods. Geneva: ISO; 2017.
7. International Organization for Standardization. ISO 18369-4:2017. Ophthalmic optics – Contact lenses – Part 4: Physicochemical properties of contact lens materials. Geneva: ISO; 2017.
8. Reusch W. UV-visible spectroscopy. In: Virtual Textbook of Organic Chemistry [Internet]. East Lansing (MI): Michigan State University; Available from: <https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/Spectry/UV-Vis/spectrum.htm>

A Pilot Study: Utility and Feasibility of a Workplace-Based Assessment (WBA) Digital Application in the Settings of Clinical Experiential Learning

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Background: Mobile applications with multi-source feedback and learner analytics identifying individual students' learning needs, providing personalised learning, and remediation are utilised to enhance Workplace-based assessment (WBA). This pilot study aims to investigate the utility and feasibility of WBA digital application, H. Prime, in the settings of clinical experiential learning.

Methods: A mixed methods analysis using quantitative data collected in Phase 1 and qualitative experience data from focus group discussion in Phase 2 was conducted. The educational impact was assessed using Kirkpatrick's hierarchical model of evaluation pyramid from level 1, "satisfaction" to level 4, "results".

Results: A total of 392 assessments were completed among 200 students across their clinical postings. 78.5% of students and 87.1% of faculty assessors perceived the application as an acceptable usability experience. Thematic analysis revealed a need to improve the digital interface and communication when scheduling assessments. Students found verbal and recorded feedback in the digital application closed learning gaps and facilitated reflective learning.

Conclusions: In summary, a digital app-based delivery of WBA is a positive experience for students and assessors. Students acknowledged that feedback generates opportunities for self-reflection and closing learning gaps. On technical aspects, there is a need to improve the process of timely scheduling sessions with assessors. We acknowledge prior training of the faculty, academic support staff, provision of

additional time in timetables, student knowledge, and sensitisation, are paramount for successful timely completion and enhancement of the educational impact of the WBAs.

Keywords: Workplace-based assessment, Digital app, Clinical training

Introduction

With the shift in assessment focus to better prepare medical undergraduates for clinical work, it is paramount to strengthen Workplace-based assessment (WBA) for lifelong self-directed learning and to becoming a reflective practitioner.¹ Workplace-based assessment (WBAs) addresses the higher levels of Miller's pyramid by capturing the complexity of clinical performance which reflects doctors' performance in their everyday practice.² Various tools of WBAs such as Mini-Clinical Examination (Mini-CEX), Directly Observed Practical Skills (DOPSs), Multisource Feedback (MSF), and Case-Based Discussion (CBD) can be adopted in the medical assessments as formative assessments measuring "assessment for learning".^{3,4} Collectively, these tools help to address a broad range of competencies including skill domains (eg. clinical judgement, communication, professionalism, and technical ability).⁵

With the development of a new medical curriculum in 2021 at the International Medical University, one of the largest private universities in Malaysia, the priority is producing adaptive graduates catering to future health professional practices and health systems. There is a definite need for assessment

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strategies based on sound educational principles which encompass both “Assessment for Learning” to improve performance and “Assessment of Learning” to ascertain minimum competencies achieved.⁶ With the emerging field of learner analytics which leverages on the data analysis of individual student’s learning needs such analytics becomes relevant as it is aimed at optimising the process of data measurement, data collection, data analysis, and reporting of data about learners and their learning contexts for understanding and optimising learning.^{7,8} Learner analytics in the context of workplace based electronic assessments is critical as it provides real time assessments of learners’ competence in actual clinical settings. Information uploaded into such e-assessments platforms enables the learners’ progress to be monitored and personalised feedback to be given.^{9,10} The current workplace-based assessments in our medical school utilise a manual recording of student’s performance results, and feedback captured in their logbooks. This system poses numerous challenges such as inconsistency in the quality of recorded information, time consuming as manually entering data in labor intensive, difficulty in sharing the data among stake holders resulting in feedback delay, likelihood of errors and omissions in entries, and lack of scalability with limitations in analysing the data for insights of performance trends. The objective of this study is to investigate the feasibility, acceptability and utility of an electronic app-based WBA and feedback among students in clinical training.

Methods

For this pilot study, the university subscribed to H. Prime² Mobile App which is currently used in Australian Specialty training for junior doctors and it allows the end users who are the assessors, trainees and administrators to easily manage their workplace-based assessment responsibilities. This digital application allows access to the assessment forms and the formative assessment and feedback to be filled in and submitted via the -trainees’ digital gadget.

Clinical Experiential learning involves structured clinical rotations in core disciplines at various clinical settings. Students develop hands-on experiences in the real world setting for developing competencies such as clinical reasoning, practical skills and professional behavior to develop into competent medical practitioners.¹¹ The electronic app has prebuilt assessments forms of various Workplace assessments such as MiniCEX, Directly Observed Procedural Skills (DOPS), Case based discussions and Multi source Feedback (MSF). The assessment forms are optimised to be used on iPads and all types of mobile devices.

The current workflow in the assessment process as illustrated in Figure I. The potential impact of the intervention was assessed using Kirkpatrick’s hierarchical model of evaluation pyramid from a lower level to a higher level: level 1, “satisfaction”; level 2, “learning”; level 3, “behavior”; level 4, “results”.

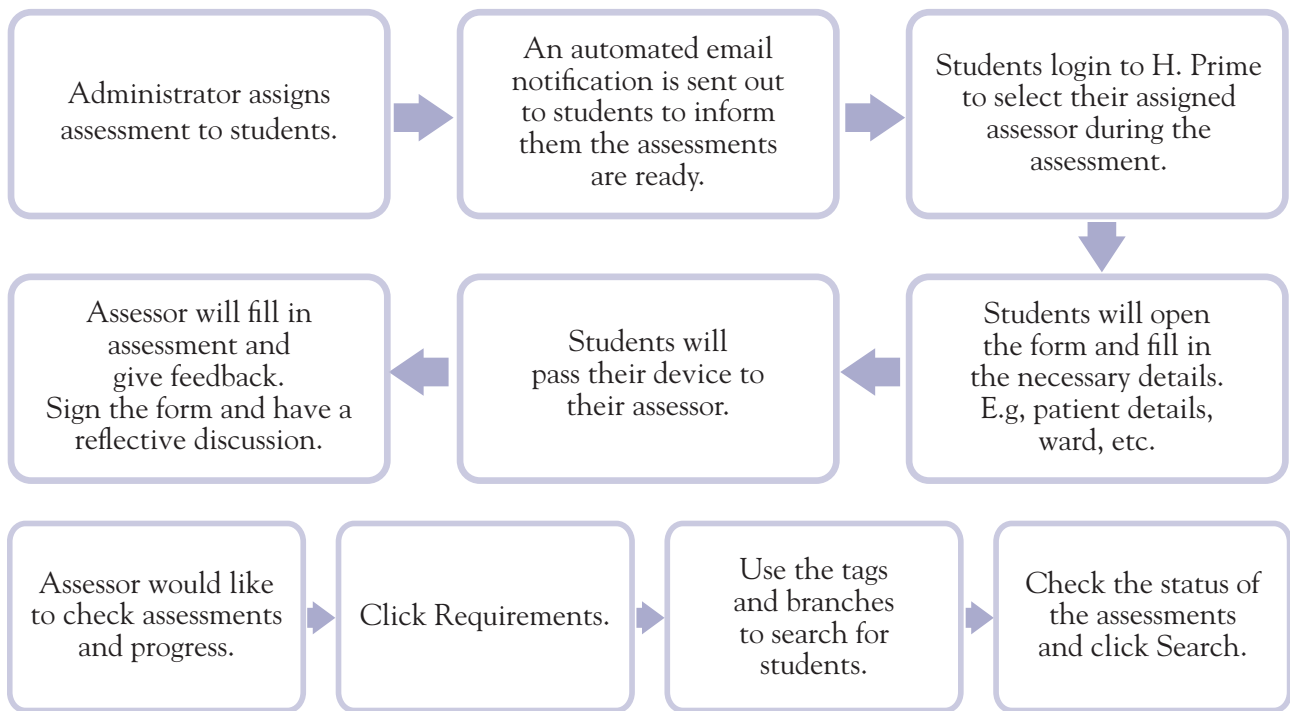


Figure 1: Workflow in the Assessment Process.

The following are the stages of implementation:

- A. Development of workflow as described in Figure 1.
- B. Sensitisation workshop:
A hands-on training on the importance and utilisation of WPBA and its role in assessment was organised for both faculty and students.
- C. Launch of Pilot study:
Each student was assigned two WBAs per clinical rotation with named assessors. Following completion of the assessment, they receive real-time verbal feedback, as well as feedback entered via the digital application.

Data Collection and Analysis

A mixed method of analysis with quantitative and qualitative feedback from focus group interview was performed.

Ethical Clearance

This project has received ethics approval from the IMU Joint-Committee on Research and Ethics (IMUJC) (IMU 594-2023).

Results

A total of 400 WBA assessments were administered among 200 students with 41 clinical assessors. The total number of completed assessments was 98% (392/400). A total of 35 students responded to the survey, with a response rate of 28 (80%) from semester 9, and 7 (20%) from semester 8, respectively. A quantitative analysis of the usability experience of 35 students is presented in Table I.

Table I: Quantitative Survey from Students.

Quantitative Survey from Students (n=35)					
Statement	Easy	Somewhat easy	Neutral	Somewhat difficult	Difficult
After my initial login, I can easily access the digital application even though there are internet connectivity issues.	25.7%	25.7%	22.9%	17.1%	8.6%
I can navigate the digital application easily.	37.1%	28.6%	14.3%	8.6%	11.4%
I can find which assessments are due for me in the digital application.	37.1%	34.3%	11.4%	11.4%	5.7%
I can easily select my assessor in the digital application.	40%	25.7%	20%	5.7%	8.6%
It is easy to view the feedback I've provided from my previous assessments in the digital application.	22.9%	34.3%	14.3%	22.9%	5.7%
It is easy for me to keep track of my workplace-based assessments.	29.4%	20.6 %	26.5%	17.6%	5.9%

The results suggest that 50% can easily access the application both online and offline, 65.7% can navigate the application easily, 71.4% can navigate to find the assessments, and 75.7% can select assessors. About 57.2% can easily view their past feedback in the previous assessments. 50% can keep track of and monitor their WPBAs. In all usability experience items, an average of 18.2% have a neutral opinion which needs further evaluation.

The following are open comments from the quantitative survey in Table II. The thematic analysis of comments 5 and 6 is related to the difficulty in scheduling the assessments and has helped to generate further questions used in semi-structured interviews in the qualitative stage of the study.

Table II: Open comments from quantitative survey from students.

No.	Comments
1.	Sometimes there's issues with choosing the assessor (when I'm picking an assessor, the app will refresh and automatically pick another assessor from a different department).
2.	I am not notified of my assessments through the app.
3.	Please incentivize the community (students, staff, and lecturers) for pilot programmes like these. Thank You.
4.	Students are put off and reluctant to engage in the app as it currently exists as an ADDITIONAL submission on top of what the students already must submit. They had hoped that this would be an alternative pathway to their submissions. The possibility of immediate in-class feedback on our performance is still worth advocating for.
5.	The application itself does not pose any significant issue. However, it was highly inconvenient to schedule an assessment date with the allocated assessor, either because we did not have any class with that person prior to the deadline or that they were not free to conduct the assessment.
6.	The app itself is easy to use, but being assigned to specific lecturers for the assessment is quite difficult as they may not be available.

Table III: A quantitative analysis on the usability experience of 14 assessors.

Quantitative Survey from Assessors (n=14)					
Statement	Easy	Somewhat easy	Neutral	Somewhat difficult	Difficult
It is easy to access the digital application even though there are internet connectivity issues.	36.4%	9.1%	36.4%	18.2%	0
I can navigate the digital application easily.	36.4%	9.1%	45.5%	9.1%	0
It is easy to find the assessments in the digital application.	36.4%	9.1%	45.5%	9.1%	0
It is easy to select the student in the digital application.	36.4%	0	36.4%	27.3%	0
It is easy to provide feedback in the digital application.	27.3%	18.2%	45.5%	9.1%	0
It is easy to insert my signature and submit the assessment in the digital application.	27.3%	54.5%	9.1%	9.1%	0

Table III results suggest that more than 87.1 % of assessors have positive usability experience and can easily access the application both online and offline.

There were 32 students and 5 assessors who participated in the focused group discussion. The thematic analysis of the semi-structured interviews generated the following themes – “Feasibility/ accessibility of an app for WBA”,

“acceptability and impact of feedback of using an app for workplace assessment and its potential impact on improvising the delivery of the assessments”. The results are summarised in Table IV.

Table IV: Thematic Analysis from Qualitative Survey from Students and Assessors.

No.	Theme	Comments from students	Comments from assessors
1.	Feasibility/ accessibility of an app for WBA	<ol style="list-style-type: none"> 1. Accessing H. Prime is possible at the workplace so long as an internet connection is available – some wards and health clinics had internet issues. 2. iPhone and android users had issues with dark mode – difficult to see the assignment and signature, had to turn on the bright mode to see the assessment easily. 3. Navigating the app when first created was difficult, but the new interphase is easy to navigate. 4. Lack of knowledge on the usage of the app made it difficult to use it. 5. Easier to use on iPad rather than phone due to screen size. 6. Those who did a second assessment found it easier to navigate the app. 7. In some cases, feedback could not be retrieved after submitting assessment. 8. Feedback could be retrieved in android phones by going to side panel, go to requirement status, go to assessments done and retrieve feedback. 9. First round some assessor names did not pop up. 10. Interphase not as intuitive as would like it to be. 11. Smaller screens had difficulty seeing the whole assessment – had to press one by one. 12. Received notification about the assessment on email but not on phone. 	<ol style="list-style-type: none"> 1. Connectivity issues in some of the primary health clinics. 2. No connectivity issues in hospital settings. 3. Using the tablet to input feedback was easier compared to the mobile phone as the phone had a smaller interphase. 4. Assessors received notification in email before the assessment when checked email. Students also had the notification on their phones which they showed as proof that he was their supervisor. 5. All present who used the app to conduct WBA found it usable to conduct the WBA digitally.

(cont'd) Table IV: Thematic Analysis from Qualitative Survey from Students and Assessors.

No.	Theme	Comments from students	Comments from assessors
2.	Acceptability and impact of feedback	<ol style="list-style-type: none"> 1. Verbal feedback was more than the written/typed in feedback as difficult to type a lot of comments on the phone. 2. Nice to have the same assessor throughout posting to gauge improvement. 3. Good to have different assessors and to have different perspectives. 4. The second group has no issues retrieving the feedback and relooking at it many times. 5. Retrieving feedback was similar to method in eLearn. 	<ol style="list-style-type: none"> 1. It was more difficult to type in all the feedback, especially on the mobile phones. 2. User-friendly and was able to visualise assessment and the grading given. 3. All who used the app to conduct WBA found it usable to conduct the WBA digitally.

Discussion

This pilot study highlights the results of the feasibility and acceptability of the H. Prime app-based delivery of formative WBA for undergraduate medical students. This pilot study was able to assess levels 1 and 2. In this study, 81.9% of the trainers and 71.6% of the trainees perceived the app as an acceptable usability experience. These results are encouraging in our attempt to deliver formative workplace-based assessments as technology-driven digital assessments. There has been recent research highlighting high levels of satisfaction among users of workplace app-based assessments. Such tools allude to convenience and feasibility which allows real time feedback and performance tracking.¹² Due to the pilot nature and time constraints of the study, we could not demonstrate improved efficiency. However, there is evidence that app-based assessments are shown to significantly enhance the efficiency of the assessment process related to automate data entry and reduction

in time spent by administrative tasks by 40%. Such an approach allows educators to focus more on teaching and mentorship.¹³

However, there is a need to improve the digital interface and effective communication in scheduling the assessments at the right time of the clinical posting. As to acceptability, from the thematic analysis, the face-to-face feedback discussions were generally valued by students, which is expected to close their learning gaps and opportunity to revisit the feedback as a reflective learning opportunity. Clearly from our results, both students and faculty appreciate the ability to receive and give feedback quickly, supporting continuous improvement and reflective learning. This experience is similar to study results by Patel *et al*, (2021) which revealed that students who received feedback through an app-based system showed a 30% increase in their engagement with the feedback process compared to those using traditional methods.¹⁴

We did note several issues related to the technical implementation of this tool, which warrant further discussion. The prominent issue is the scheduling of the assessments, and the timeline provided. The students expressed those assessments to be scheduled with the assessor in the respective training site, which precludes them from leaving their respective clinical placements in the attempt to complete their assessments. There was a need to improve the feedback process by the assessor which mandates faculty development and training on structured feedback process. It is reported that inadequate feedback undermines the credibility of such an assessment process.^{9,10} It has also been estimated that variation in WBA scores is related to the effects of rates and context of assessments impacting the scores given on the observations.^{11,12}

Supervisor and student training is paramount to understanding the purpose and intent of the assessment.¹³ Understanding the barriers and defining the enablers can enhance learning experiences, streamline evaluation processes, and provide real-time feedback.¹⁴

Conclusion

In summary, the results of the pilot study have the following recommendations tied to the quantitative and thematic analysis of the results. A digital app-based delivery of workplace-based assessments is

found to be generally a positive experience by both students and assessors. There is a need for ongoing training to increase enthusiasm, motivation, and engagement. There is a conviction among students that the feedback provided on multiple encounters will enhance their competencies and reflective practice.¹⁵ There is an opportunity to improve the scheduling of sessions by identifying the protected time in the timetable for the completion of the WBA, including time for structured feedback and discussion. The most crucial consideration is the sustainability of a system. This calls for constant user support facility while using the app.

Limitations

This study has potential limitations. Small sample size and limited clinical settings preclude generalisation of the results. A short duration of study may limit the ability to sufficiently reflect acceptability and limitations. The pilot nature of the study being exploratory may not necessarily be conclusive of its effectiveness as there is a need for validation with comprehensive large sample size studies.

REFERENCES

1. Van Der Vleuten C P. The assessment of professional competence: Developments, research and practical implications. *Adv Health Sci Educ.* 1996;1(1):41–67. <https://doi.org/10.1007/bf00596229>.
2. Kirkpatrick D L. Evaluation of training. In: Craig R L, Bittel L R, editors. *Training and Development Handbook*. New York: McGraw-Hill; 1967. p. 87–112.
3. Saedon H, Salleh S, Balakrishnan A, Imray C H, Saedon M. The role of feedback in improving the effectiveness of workplace-based assessments: A systematic review. *BMC Med Educ.* 2012;12(1):25. <https://doi.org/10.1186/1472-6920-12-25>.
4. Marty A P, Linsenmeyer M, George B, Young J Q, Breckwoldt J, ten Cate O. Mobile technologies to support workplace-based assessment for entrustment decisions: Guidelines for programs and educators: AMEE Guide no. 154. *Med Teach.* 2023;45(11):1203–13. <https://doi.org/10.1080/0142159x.2023.2168527>.
5. Mathew A, Beard J, Bussey M. An evaluation of the use of direct observation of procedural skills in the Intercollegiate Surgical Curriculum Programme. *Bull R Coll Surg Engl.* 2014;96(9):e10. <https://doi.org/10.1308/rcsbull.2014.96.9.e10>.
6. Shalhoub J, Marshall D C, Ippolito K. Perspectives on procedure-based assessments: A thematic analysis of semistructured interviews with 10 UK surgical trainees. *BMJ Open.* 2017;7(3):e013417. <https://doi.org/10.1136/bmjopen-2016-013417>.
7. Weller J M, Castanelli D J, Chen Y, Jolly B. Making robust assessments of specialist trainees' workplace performance. *Br J Anaesth.* 2017;118(2):207–14. <https://doi.org/10.1093/bja/aew412>.
8. van der Schaaf M, Donkers J, Slof B, Moonen-van Loon J, van Tartwijk J, Driessen E, *et al.* Improving workplace-based assessment and feedback by an E-portfolio enhanced with learning analytics. *Educ Technol Res Dev.* 2016;65(2):359–80. <https://doi.org/10.1007/s11423-016-9496-8>.
9. Telio S, Regehr G, Ajjawi R. Feedback and the educational alliance: Examining credibility judgements and their consequences. *Med Educ.* 2016;50(9):933–42. <https://doi.org/10.1111/medu.13063>.
10. Sukhera J, Wodzinski M, Milne A, Teunissen P W, Lingard L, Watling C. Implicit bias and the feedback paradox: Exploring how health professionals engage with feedback while questioning its credibility. *Acad Med.* 2019;94(8):1204–10. <https://doi.org/10.1097/acm.0000000000002782>.
11. Nikou S A, Economides A A. Mobile-based assessment: A literature review of publications in major referred journals from 2009 to 2018. *Comput Educ.* 2018;125:101–19. <https://doi.org/10.1016/j.compedu.2018.06.006>.
12. Chen T, Peng L, Yin X, Rong J, Yang J, Cong G. Analysis of user satisfaction with online education platforms in China during the COVID-19 pandemic. *Healthcare (Basel).* 2020;8(3):200. <https://doi.org/10.3390/healthcare8030200>.
13. Davis R, Jones K, Smith J. Role of confidence in adapting to digital tools for successful change management in educational administration. *J Educ Adm.* 2019;24(3):45–56.
14. George B C, Bohnen J D, Schuller M C, Fryer J P. Using smartphones for trainee performance assessment: A SIMPL case study. *Surgery.* 2020;167(6):903–6. <https://doi.org/10.1016/j.surg.2019.09.011>.
15. Phang K W, Patel P. 115 Enhancing learning and improving feedback through QR codes. *BMJ Paediatr Open.* 2021;5(Suppl 1):A27. <https://doi.org/10.1136/bmjpo-2021-rcpch.66>.
16. Touchie C, Kinnear B, Schumacher D, Caretta-Weyer H, Hamstra S J, Hart D, *et al.* On the validity of summative entrustment decisions. *Med Teach.* 2021;43(7):780–7. <https://doi.org/10.1080/0142159x.2021.1925642>.

Diagnostic & Therapeutic Challenges of Actinomycosis: A Benign Speck Masquerading as a Soft Tissue Malignancy

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Actinomycosis is a chronic infection caused by filamentous gram-positive anaerobes, typically presenting in cervicofacial regions. We report a rare case involving the lower limb of an immunocompetent male, initially suspected to have soft tissue sarcoma based on imaging. The diagnosis was confirmed histologically with characteristic sulfur granules and the Splendore-Hoeppli phenomenon. Despite antibiotic therapy, non-compliance led to disease progression and necessitated a below-knee amputation. This case emphasises the importance of early diagnosis, patient compliance, and a multidisciplinary approach in managing rare infections mimicking malignancies.

Introduction

Actinomyces species are gram-positive filamentous bacteria capable of causing a broad spectrum of infections, particularly in immunocompromised individuals. *Actinomyces israelii* is the most implicated species.¹ Actinomycotic osteomyelitis, resulting from hematogenous dissemination, is rare and typically affects children and immunocompromised patients with underlying risk factors.¹ Literature on the prevalence of cutaneous and long bone involvement is limited.

Actinomycosis has been reported in various anatomical sites, including the face, bones and joints, respiratory tract, gastrointestinal tract, central nervous system, skin, and soft tissues. Notably, it often mimics malignancy or tuberculosis due to its presentation as a progressively enlarging mass with draining sinuses and multiple cold abscesses.² The male-to-female ratio (3:1) suggests a gender

predilection for actinomycotic abscesses and empyemas.³ Chronic cutaneous involvement is often characterised by abscess formation, fibrosis, and sinus tract development, further complicating diagnosis.²

Histologically, the infection presents with granulomatous inflammation and abscesses containing sulfur granules – aggregates of bacteria surrounded by eosinophilic material, known as the Splendore-Hoeppli phenomenon.⁴ Treatment typically includes prolonged intravenous beta-lactam antibiotics, to which *Actinomyces* species are highly susceptible.⁵ For primary skin and soft tissue involvement, management includes abscess drainage and extended antimicrobial therapy.^{4,5}

Case Presentation

A 33-year-old man presented with a three-year history of progressive swelling in his left foot, intermittent pain, and foul-smelling pus discharge. He reported no fever, appetite or weight changes, and denied any insect or animal bites. The patient, unmarried and residing in a remote forestry reserve, initially led an active outdoor lifestyle but had become sedentary due to the growing mass.

On examination, the foot was grossly swollen with multiple pus-draining sinuses and was non-functional for ambulation. No inguinal lymphadenopathy was noted. Blood investigations showed elevated C-Reactive Protein (97.2 mg/L), low haemoglobin (7–8 g/dL), and mildly raised White Blood Cells ($13.2 \times 10^9/L$). Mycobacterium Tuberculosis (MTB) testing (TB Polymerase Chain Reaction, MTB

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culture, Acid fast bacilli Stain) was negative. Initial radiographs of the foot were normal. The presentation

resembled a diabetic foot ulcer, though without fever or lymphadenopathy.



Figure 1: Clinical pictures of the left foot swelling during the initial presentation.

(a) Dorsum aspect of left foot with few draining sinuses.

(b) Multi-lobulated irregular soft tissue swelling over plantar aspect of left foot resembling soft tissue malignancy.

MRI of the left foot revealed features suggestive of infiltrative soft tissue sarcoma involving intrinsic muscles and encasing the plantar neurovascular bundle. A subsequent incisional biopsy revealed colonies of *Actinomyces* with the Splendore-Hoeppli phenomenon, confirmed with Periodic Acid-Schiff (PAS) and Grocott's Methenamine Silver (GMS)

staining. The patient was started on oral Amoxicillin 625 mg twice daily for four months. No surgical debridement was performed. Ultrasound showed sclerotic and cystic changes with irregular periosteal involvement of the metatarsals, suggesting chronic midfoot osteomyelitis. However, the patient was lost to follow-up.

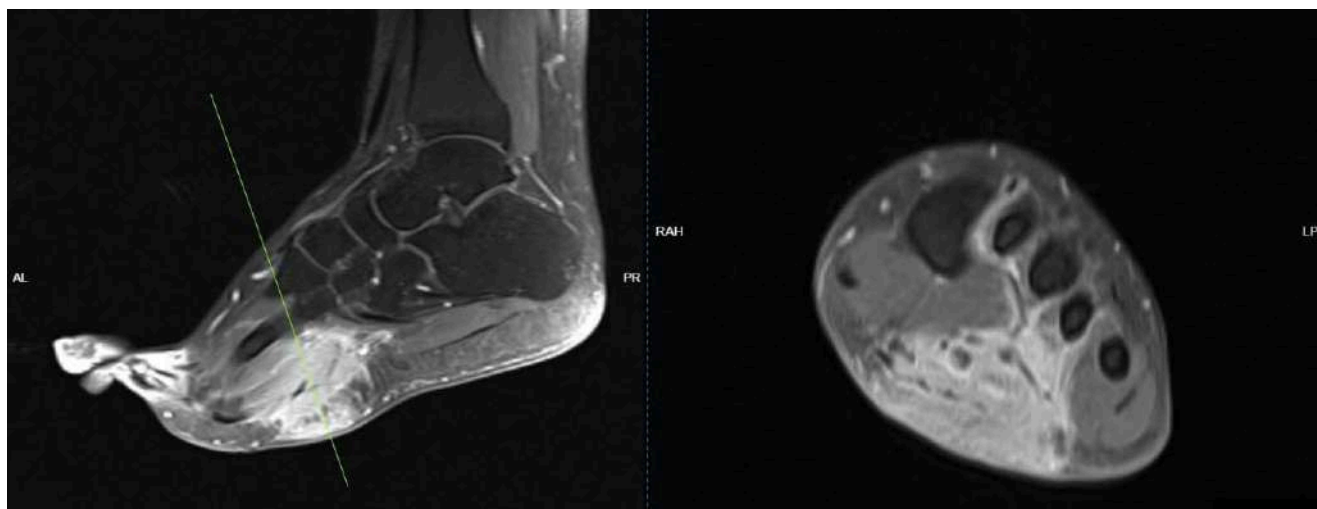


Figure II: MRI Left Foot (T1 fat suppressed view) showing hyperintense heterogenous mass involving intrinsic muscles and encasing the plantar neurovascular bundle, which resembles soft tissue malignancy.

Eighteen months later, he returned with severe swelling and classic features of Madura foot – tumefaction, draining sinuses, and granule-like discharge.⁶ He experienced significant pain and was unable to walk. Radiographs showed extensive osteomyelitis with osteolysis extending from the distal tibia and fibula to

the metatarsals. Ultrasound of the left inguinal region showed lymphadenopathy with pus collection. Biopsy of the lymph node revealed sulfur granules surrounded by suppurative granulomatous inflammation with the Splendore-Hoeppli phenomenon.



Figure III: The left lower limb exhibited gross deformity upon the latest visit.
 (a) Increasing numbers of draining sinuses over dorsum and plantar aspect of foot extending proximally to the distal leg.
 (b) Worsening of the foot swelling caused by extensive infection from forefoot until ankle joint causing significant anatomical distortion.



Figure IV: Comparison of the initial left foot x-ray. (A) with the latest x-ray of left foot. (B) showing extensive osteomyelitis changes with osteolytic and bone destruction of both AP & Lateral of the left foot.

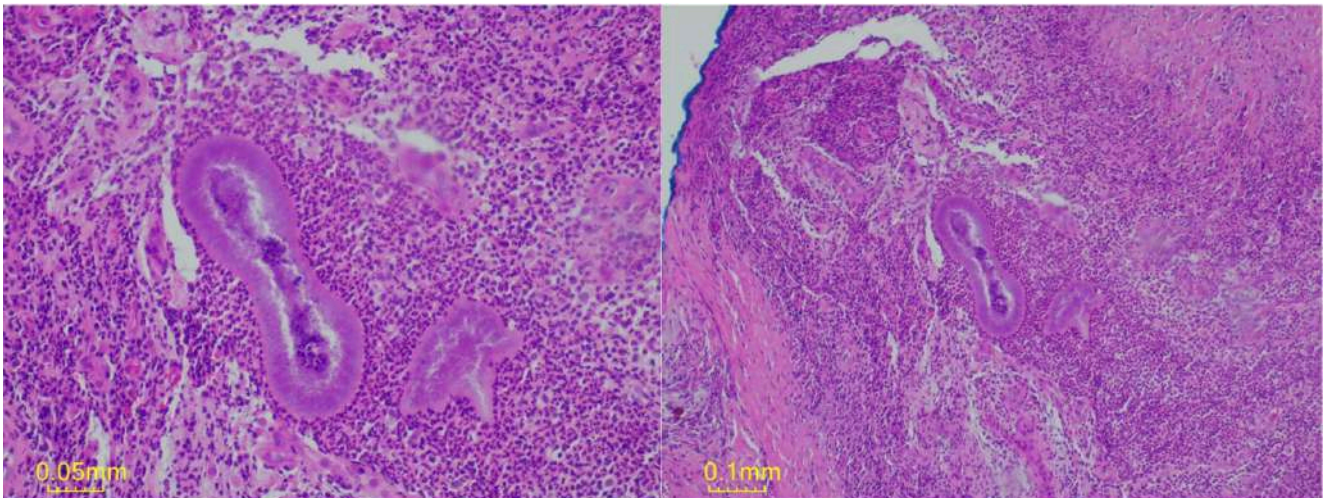


Figure V: Histological slides during the latest biopsy take. (A) Biopsy from the foot showing acute on chronic inflammation with Actinomycosis infection (A) at 20x magnification, and (B) at 10x magnification – during the initial presentation.

Due to the extensive infection and foot deformity, a below-knee amputation and lymph node drainage were performed. Post-operatively, he received intravenous Augmentin (1.2 g TDS) followed by oral Augmentin (625 mg BD) for four months, alongside rehabilitation. At one-year follow-up, the patient had a well-healed stump and was ambulating independently with minimal difficulty.

Discussion

Actinomycotic osteomyelitis is a rare condition often misdiagnosed as soft tissue sarcoma, tuberculosis, or pyogenic osteomyelitis due to similar clinical presentations.¹ Few cases have been documented in the literature.¹ In our case, delayed diagnosis and non-compliance led to an advanced stage of disease resembling Madura foot, necessitating amputation.⁶

While culturing *Actinomyces* is challenging, histopathology remains the gold standard for diagnosis. This underscores the importance of biopsy in chronic soft tissue lesions mimicking malignancy. In this case, the initial presentation and imaging findings were indicative of a soft tissue malignancy, mirroring reported instances where actinomycosis mimics neoplastic conditions.² Given this circumstance, we confirmed the diagnosis through biopsy examination and formulated a comprehensive treatment strategy after the biopsy result.

The cornerstone treatment typically involves prolonged beta-lactam antibiotic therapy – commonly penicillin G or amoxicillin – for a minimum of four to eight weeks, often extending to several months depending on disease severity.^{4,5} In our case, the patient initially received oral amoxicillin but failed

to complete therapy. During the first presentation, our patient was initially started on oral Amoxicillin for two months and subsequently changed to oral Augmentin for 6-12 months. However, during the subsequent presentation he was started on oral Amoxicillin post-operatively until following review. At recurrence, extensive bone and soft tissue involvement precluded conservative treatment, highlighting the importance of early intervention. A delayed diagnosis can result in bone sclerosis, impeding the penetration of penicillin and complicating infection control efforts.¹ Hence, surgical intervention becomes imperative to drain the chronic abscesses formed by these micro-organisms.¹

Chronic infection leads to bone sclerosis, limiting antibiotic penetration. Surgical debridement or resection is often required to remove necrotic tissue and reduce bacterial load.⁶ In this patient, amputation was necessary due to extensive osteomyelitis and non-functional limb.¹ However, to forestall disease recurrence, it was complemented with antibiotic therapy.⁴

Conclusion

Actinomycosis remains a diagnostic challenge due to its indolent progression and clinical similarity to malignancies and tuberculosis. In regions with limited resources or high TB prevalence, actinomycosis should remain a differential in chronic soft tissue infections. Early biopsy, appropriate antibiotics, and patient compliance are critical to avoid devastating outcomes such as amputation.

REFERENCES

1. Ryu D J, Jeon Y S, Kwon H Y, Choi S J, Roh T H, Kim M K. Actinomycotic osteomyelitis of a long bone in an immunocompetent adult: A case report and literature review. *BMC Musculoskelet Disord.* 2019;20(1):185. doi:10.1186/s12891-019-2576-2. PMID: 31043170; PMCID: PMC6495508.
2. Yusof M I, Yusof A H, Salleh M S, Harun A. Actinomycosis of the knee. *Malays J Med Sci.* 2005;12(1):68–9. PMID: 22605950; PMCID: PMC3349416.
3. Schaal K P, Lee H J. Actinomycete infections in humans – A review. *Gene.* 1992;115(1–2):201–11.
4. Cretella P, Italia M C, Serio B, Zeppa P, Caputo A. Actinomycosis mimicking malignancy: A report of three cases diagnosed with fine-needle aspiration cytology. *Infez Med.* 2022;30(3):459–63. doi:10.53854/liim-3003-16. PMID: 36148168; PMCID: PMC9448306.
5. Valour F, Sénéchal A, Dupieux C, Karsenty J, Lustig S, Breton P, et al. Actinomycosis: etiology, clinical features, diagnosis, treatment, and management. *Infect Drug Resist.* 2014;7:183–97. doi:10.2147/IDR.S39601. PMID: 25045274; PMCID: PMC4094581.
6. Alam K, Maheshwari V, Bhargava S, Jain A, Fatima U, Haq E U. Histological diagnosis of madura foot (mycetoma): A must for definitive treatment. *J Glob Infect Dis.* 2009;1(1):64–7. doi:10.4103/0974-777X.52985. PMID: 20300390; PMCID: PMC2840937.

Early Recognition of Tuberous Sclerosis Complex in Primary Care: A Case Report

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Tuberous sclerosis complex (TSC) is a rare, multisystem genetic condition marked by the development of benign tumours in multiple organs. TSC is the second most common neurocutaneous disorder and is inherited in an autosomal dominant pattern, although the rate of spontaneous mutation is high. Although the condition is often identified in paediatric neurology settings, the first clues can emerge in primary care. This case report describes the presentation, diagnosis, and initial management of a child with TSC in a general practice, highlighting the pivotal role of primary care in recognising early signs and initiating multi-disciplinary care.

Keywords: Genetic disorder, hypopigmented macules, paediatric epilepsy, primary care, seizures, tuberous sclerosis

Introduction

Tuberous sclerosis complex is an autosomal dominant disorder caused by mutations in either the *TSC1* or *TSC2* gene, resulting in abnormal cell growth and the formation of noncancerous tumours.¹ The disorder can affect the brain, skin, kidneys, heart, lungs, and eyes.² The gene mutation may also occur spontaneously, and most cases present sporadically, with no known family history. Although the classic triad of seizures, intellectual disability, and facial angiofibromas (adenoma sebaceum) is well-known, most patients do not present with all three features, making early diagnosis challenging.³ In primary care, clinicians may encounter the earliest signs such as subtle dermatological findings or developmental concerns well before a formal diagnosis is made.⁴

Case Report

A 9-year-old boy was brought to a family practice clinic by his mother, who was concerned about recent episodes of “blank staring.” She described two events within the past week where the child paused mid-activity, stared into space, and was unresponsive for about 15–20 seconds. He had no convulsions or loss of consciousness and recovered quickly afterward. His school performance had recently declined, and teachers had raised concerns about his focus and learning pace.

On general examination, he appeared well and developmentally appropriate in conversation but lagged slightly in school-level academic tasks. A skin check revealed three pale patches of varying sizes from 7mm to 10mm on his back and lower flank, which had been present since early childhood. These hypopigmented areas were not previously assessed. Under Wood’s lamp examination, the lesions became more prominent, consistent with hypopigmented macules known as ash-leaf spots, which are often seen in tuberous sclerosis complex. Neurological examination was normal.

Given the combination of suspected absence seizures, learning difficulties, and hypopigmented macules, the clinician considered a neurocutaneous syndrome, particularly tuberous sclerosis and initiated further investigations.⁵

A referral was made for an EEG and MRI of the brain. The EEG showed focal epileptiform discharges in the left temporal region. MRI findings revealed cortical tubers and three subependymal nodules, consistent

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with features seen in TSC.² A renal ultrasound was performed, revealing small, bilateral renal angiomyolipomas. An echocardiogram showed normal cardiac structure, with no evidence of rhabdomyomas. Genetic testing confirmed a pathogenic mutation in the *TSC2* gene, establishing a diagnosis of tuberous sclerosis complex.

The child was started on levetiracetam to manage seizures and responded well, with no further episodes in the following two months. A multi-disciplinary team including paediatric neurology, nephrology, dermatology, and clinical genetics was involved in ongoing care.⁶

In the general practice setting, the clinician continued to monitor the patient's development, seizure control, and general health, through regular three-monthly follow-ups, while maintaining close communication with the hospital-based specialists. The multi-disciplinary team including paediatric neurology, nephrology, and dermatology provided yearly ongoing care. Educational support was arranged through the school system to address learning delays and behavioural support was also regularly provided. The family received genetic counselling as TSC is an autosomal dominant disorder, and neither parent tested positive for TSC mutations, suggesting a spontaneous (de novo) mutation in the child.¹

Discussion

TSC presents with highly variable clinical features, which can lead to delays in diagnosis.³ In this case, the presence of subtle skin lesions such as hypopigmented macules combined with the seizure activity and cognitive concerns raised sufficient

suspicion to warrant investigations.⁵ The skin lesions, often dismissed as benign birthmarks, can be among the earliest signs of the condition.

Primary care providers are often the first point of contact for families and are uniquely positioned to notice patterns that might otherwise be overlooked. Recognising hallmark features, such as developmental delays paired with dermatologic signs or seizure-like behaviour, is essential.⁷ However, limitations within the primary care setting such as time constraints, limited access to specialised investigations, and challenges in long-term follow-up can hinder comprehensive screening and early diagnosis. Early diagnosis allows for better surveillance of potentially serious complications, such as renal tumours or brain lesions that can progress without symptoms.²

The diagnosis of TSC is based on the 2021 International TSC Consensus Conference criteria, which include major and minor clinical features and/or identification of a pathogenic mutation in *TSC1* or *TSC2*.⁸ (Refer Table I) A definitive diagnosis requires:

- Two major features, or
- One major and two or more minor features, or
- Identification of a pathogenic variant in *TSC1* or *TSC2* (which alone is sufficient).

Table I. Diagnostic Criteria for TSC (2021 Revised).⁸

Major Features	Minor Features
≥3 hypomelanotic macules (≥5 mm)	“Confetti” skin lesions
≥3 facial angiofibromas (adenoma sebaceum) or fibrous cephalic plaque	Dental enamel pits (≥3)
≥2 ungual fibromas	Intraoral fibromas (≥2)
Shagreen patch	Retinal achromic patch
Multiple retinal hamartomas	Multiple renal cysts
Multiple cortical tubers and/or radial migration lines	Nonrenal hamartomas
≥2 Subependymal nodules	Sclerotic bone lesions
Subependymal giant cell astrocytoma (SEGA)	
Cardiac rhabdomyoma	
Lymphangiomyomatosis (LAM)*	
≥2 angiomyolipomas*	
Diagnosis	
<ul style="list-style-type: none"> • Definite TSC: 2 major features or 1 major feature with 2 minor features. • Possible TSC: either 1 major feature or ≥2 minor features. • * A combination of the 2 major clinical features LAM and angiomyolipomas without other features does not meet criteria for a definite diagnosis. 	

In this patient, apart from genetic testing confirming a pathogenic mutation in the TSC2 gene (which by itself is diagnostic), the following four major features were present satisfying the criteria for a definitive diagnosis:

- Three hypomelanotic macules of varying sizes from 7mm to 10mm
- Cortical dysplasias (cortical tubers)
- Three subependymal nodules
- Renal angiomyolipomas

Children with TSC often experience neurodevelopmental and behavioural issues. These are grouped under the umbrella of TSC-associated neuropsychiatric disorders (TAND), which may include autism, anxiety, ADHD, and learning disabilities.⁹ In this patient, early coordination with school services and regular behavioural assessments were part of the care plan.

Newer treatments, such as mTOR inhibitors like everolimus, have shown effectiveness for certain TSC-related growths, particularly when surgical options are limited.¹⁰ Although not indicated in this case at the time of diagnosis, it remains an important treatment option as the disease progresses.

Conclusion

This case highlights the important role of primary care in the early recognition of TSC, even though the diagnosis can be challenging and often delayed. Primary care providers must maintain a high index of suspicion, especially when symptoms appear gradually and seem unrelated such as learning difficulties, minor seizures, and hypopigmented macules even in the absence of classic features such as adenoma sebaceum. Ongoing observation and attention to subtle changes over time are essential. Early identification and timely referral can enable prompt intervention, help prevent complications, and improve long-term outcomes for children with this lifelong condition.

REFERENCES

1. Curatolo P, Moavero R, de Vries P J. Neurological and neuropsychiatric aspects of tuberous sclerosis complex. *Lancet Neurol.* 2015;14(7):733-45.
2. Northrup H, Koenig M K, Pearson D A, Au K S. Tuberous Sclerosis Complex. In: Adam M P, Everman D B, Mirzaa G M, et al, editors. *GeneReviews*® [Internet]. Seattle (WA): University of Washington, Seattle; 1999-. [Updated 2022 Jul 7].
3. Crino P B, Nathanson K L, Henske E P. The tuberous sclerosis complex. *N Engl J Med.* 2006;355(13):1345-56.
4. Kingswood J C, d'Augères G B, Belousova E, et al. Tuberous Sclerosis registry to increase disease Awareness (TOSCA)-baseline data on 2093 patients. *Orphanet J Rare Dis.* 2017;12:2.
5. Schwartz R A, Fernández G, Kotulska K, Jóźwiak S. Tuberous sclerosis complex: Advances in diagnosis, genetics, and management. *J Am Acad Dermatol.* 2007;57(2):189-202.
6. de Vries P J, Belousova E, Benedik M P, et al. TAND (TSC-Associated Neuropsychiatric Disorders): Findings from the TOSCA natural history study. *Orphanet J Rare Dis.* 2018;13(1):157.
7. Manohara D. Primary care management of tuberous sclerosis complex in children. *J Am Acad Nurse Pract.* 2012 Jul;24(7):391-399. doi:10.1111/j.1745-7599.2012.00734.
8. Northrup H, Krueger D A; International Tuberous Sclerosis Complex Consensus Group. Updated international Tuberous Sclerosis Complex diagnostic criteria and surveillance and management recommendations. *Pediatr Neurol.* 2021;123:50-66. doi:10.1016/j.pediatrneurol.2021.07.011.
9. de Vries P J. Targeting cognitive and neurodevelopmental disorders in tuberous sclerosis complex. *Neurotherapeutics.* 2010;7(3):275-82.
10. Franz D N, Belousova E, Sparagana S, et al. Efficacy and safety of everolimus for subependymal giant cell astrocytomas associated with tuberous sclerosis complex (EXIST-1): A multicentre, randomised, placebo-controlled phase 3 trial. *Lancet.* 2013;381(9861):125-32.