A PRELIMINARY STUDY ON TRUSTWORTHINESS FRAMEWORK FOR TRADITIONAL MALAY MEDICINE DATA RETRIEVAL

M. A. Basar[1], M. S. Abu Seman[1*], M. A. Mohd Shafri[1], and F. binti Mohamed[1]

[1]Kulliyyah of Information and Communication Technology, IIUM, Kuala Lumpur, Malaysia

[*]Corresponding Author's Email: msadri@iium.edu.my

Article History: Received August 28, 2024; Revised October 18, 2024; Accepted October 18, 2024

ABSTRACT: Traditional Malay Medicine data retrieval may potentially contribute to the COVID-19 pandemic response. However, trustworthiness issues may hinder for medical professionals from accepting its formulations. This paper presents a preliminary study of trustworthiness frameworks in PubMed and IEEE related to Covid-19. The study examined three aspects of Traditional Malay Medicine data retrieval; (1) Manuscript Original Verification, (2) Author Profiling method, and (3) in-database module trust framework. Three relevance frameworks are selected based on each focus aspect. In contrast to current frameworks which may give priority to quantitative metrics such as citations, our proposed framework places emphasis on the authenticity of the source material, specifically the manuscript. Within the database, we incorporate trust metrics into the author profiling method, prioritising formulation replicability over context authorship methods. This measure of replicability not only enhances the credibility of the formulation but also functions as a tool to detect potential biases or errors in the original formulation. Furthermore, our in-database module trust framework prioritises the ability to adapt to new information and trends. This inherent flexibility can result in increasingly precise assessments of trustworthiness over time, requiring fewer resources for upkeep. This review aims to establish fundamental criteria and principles for evaluating the reliability of Traditional Malay Medicine. Hence, it is imperative to inspire contemporary researchers to delve into the role of Traditional Malay Medicine in tackling forthcoming pandemics.

KEYWORDS: *Trustworthiness Framework; Traditional Malay Medicine; Malay Manuscript; Data Retrieval; Network Pharmacology.*

1.0 INTRODUCTION

Getting multiple COVID-19 vaccinations does not guarantee protection against new variants [1]. Many new treatments are in development, including drug tests and anti-viral strategies. COVID-19 treatment guidelines vary by country, and traditional medicine holds promise for new treatments. For example, traditional Chinese medicine could help treat symptoms with no side effects [2].

Malaysia, just like other countries, boasts its distinctive traditional medical practices. Traditional Malay Medicine boasts an extensive array of formulations that can potentially alleviate symptoms of various illnesses. Most valuable formulations are often found in ancient manuscripts or passed down through generations. It may disappear if there is no proper preservation [3]. However, the credibility of Traditional Malay Medicine, characterised by its unique formulation, ingredient and modern formulation replicability, may face challenges arising from scepticism surrounding its origins, effectiveness and the limited availability of comprehensive data compared to other traditional medicine.

Trustworthy preservation is essential to encourage more research on Traditional Malay Medicine. It involves retrieving and indexing the data and trustworthy verification for convenient searching. Trustworthy formulations and medicine development require a robust data retrieval method. It boosts the efficiency of screening approaches such as verification, retrieval, virtual screening, and mining [4].

1.1 Traditional Malay Medicine Data Retrieval Workflow

Institutions like libraries or universities commonly preserve traditional Malay Medicine. The preservation can be divided into two main phases: Pre-verification [5], Digitalization [6], and data mining [5,7-9]

In the pre-verification phase, the researcher physically visits the source of the manuscript, such as a library or museum [4-5]. We need someone knowledgeable in codicology and philology to verify if the manuscript is genuine and reliable. It is rare to use carbon dating as it requires a sample of the manuscript, and it is considered damaging to

the manuscript itself [6]. After that, the manuscript was scanned into a set of images and stored in a database, server, cloud, or hard drive. If textual restoration is needed, it requires some process, such as Segmentation, Annotation, or Philology [10]. Traditional Malay Medicine manuscripts are not limited to the Malay Peninsula but are also found in various regions of Indonesia and Borneo. Consequently, each manuscript possesses its unique writing style, which can pose difficulties in translation due to limited resources, thereby presenting a challenge in the verification and mining process.

The manuscript is translated and sorted into medical or non-medical categories during data mining. Provenance and author profiling determine the manuscript's origin and authorship. The formulation is extracted from the manuscript and stored in the database in string/text format [5,7]. Researchers can access the formulation data from the database. Trustworthy evidence requires data verification and validation in all phases. This step is crucial in determining the proper use and safety of formulations from Traditional Malay Medicine in clinical practice [11].

1.2 Traditional Trustworthiness in Traditional Malay Medicine

Building trust is vital for Traditional Malay Medicine's reliability, validity, and replicability. The format manuscripts are not in the standardised form or language, and the terms used in writing, such as the name of materials, may be different. Manuscript MSS2515 mentions Garam siam, Garam jantan, and Garam hormuz, which could all mean Sodium chloride. However, Garam siam refers explicitly to a salt produced in Southern Thailand during the late 1700s-1800s, while others do not. These factors can cause misinterpretations of the original formulation, materials, and methods. It may influence the formulation quality and credibility [12]. While these formulations offer some health advice/prescription, they do not give clear guidance on preparing, using, or applying them. There is no historical or empirical evidence supporting their effectiveness as a treatment. Thus, trustworthiness becomes the main issue for researchers to use as a reference in new medicine formulations.

The formulation must be original, trusted, and replicable for modern medicine development. Those are critical factors in providing trust to encourage researchers to explore the potential of Traditional Malay Medicine. To draw an accurate conclusion, it is vital not to use unreliable data [13], especially in the development of medicine,

particularly during a pandemic. Every ingredient in the formulation was carefully mapped based on current knowledge, and unidentified ingredients were regarded as less reliable, thereby decreasing the assessment of formulation replicability.

Evaluating multiple trustworthiness assessment mechanisms in this study is critical to addressing trust concerns. The review enhances data retrieval for Traditional Malay Medicine and aids in developing new drugs for pandemics in the future.

2.0 METHODOLOGY

This paper presents a preliminary study comparing available trustworthiness frameworks. A framework was selected to enhance the reliability of the data of the Traditional Malay Medicine database. The process of the preliminary study is summarised in Figure 1.

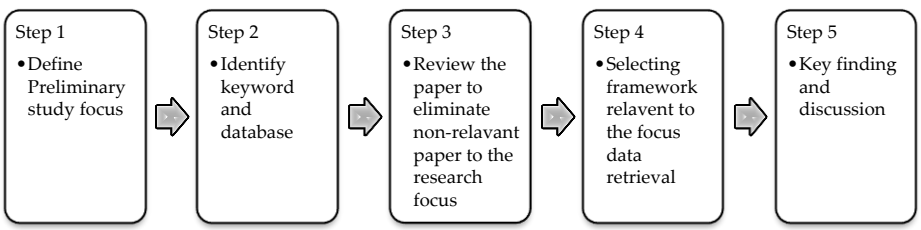

Figure 1: Preliminary study method

For this study, we only focus on three (3) parts of the data retrieval: Manuscript Original Verification, Author Profiling method, and in-database module trust framework. We selected keywords such as *Trustworthiness Framework, Trustworthiness Literature, and Trustworthiness Database*. In light of the restricted availability of online databases, our search is confined to PubMed and IEEE databases, spanning 2020 to 2023, and is specifically tailored to topics concerning the COVID-19 pandemic. Extensive efforts were made to search the literature and locate pertinent articles from the designated database. A careful review was conducted of the titles and abstracts of each piece of literature to exclude any irrelevant ones. This assessment considered factors such as a reliable data-sourcing mechanism, the credibility of the manuscript or literature, and the database architecture. Three (3) pieces of literature from January 2020 until September 2023 were selected for final review as they closely related to the research focus

(Figure 2). The final review includes the trustworthiness assessment mechanism, algorithm, research aim, and scope. In addition, the comparison of how the framework can provide trust to its target audience/researcher is included. Based on the review, a few mechanisms are selected for implementation based on the research aim. We discussed the preliminary study and summarised the chosen framework for each aspect. We also put forth our trustworthiness framework.

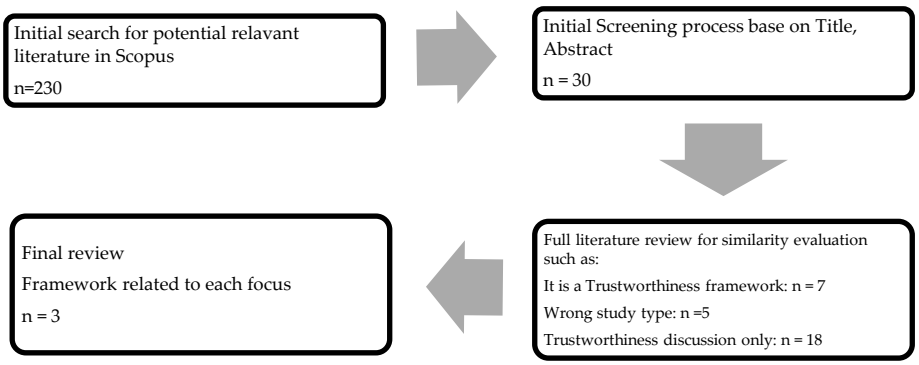

Figure 2: Literature review method

3.0 RESULT

Trustworthiness is a matter of something worthy of trust [14]. With COVID-19, the virus has damaged public trust in the ethical aspects of pandemic medicine. The media widely covered trust in vaccination programs, patenting, and copyright issues [15]. Therefore, we need a trustworthy framework for data retrieval in the Traditional Malay Medicine database. This option allows researchers to trust Traditional Malay Medicine in drug development. Researchers have developed many trustworthiness methods and frameworks to minimise the trust issue [13]. These frameworks measure and evaluate data reliability and trustworthiness.

3.1 Assurance Cases System Trustworthiness Evaluation

A Trustworthiness Evaluation Framework that considers multiple domains, such as hardware, software, and IoT [16]. The authors attempted to cover various trust contexts in a single framework. The proposed framework serves as a starting point for future studies on trustworthiness. Six attributes and seven requirements must be

considered for developing a new trustworthiness system. The proposed framework assesses evidence, reasoning, performance, direct trust, trust aggregation, and dynamic trust. We only focus on those closely related to our proposed medicine database part of the framework: Assurance Cases and Trust Aggression. It covers designing a trustworthiness framework for the evidence-based argument focusing on claims. It can be applied in the Pre-Verification phase of Traditional Malay Medicine data retrieval. The assurance Cases phase can evaluate the authenticity and reliability of manuscripts. Use the Trust Aggression phase to assess the current guide or manual for manuscript verification.

3.2 RipetaScore

This framework assesses the trustworthiness of a scientific research paper [17]. The authors discuss measuring quality, transparency, and trustworthiness using automated trustworthiness framework systems. RipetaScore is a software tool that uses Natural Language Processing to analyse text variables. It can provide a trustworthiness score based on authorship and research reproducibility. The framework was tested with 12,000 datasets (research papers) from various studies and fields. Three attributes have been verified within RipetaScore: Reproducibility, Professionalism, and Research. We can use the RipetaScore framework for author profiling in the Traditional Malay Medicine data mining phase. Reproducibility can further enhance trust in Traditional Malay Medicine by scoring formulation replicability.

3.3 Trust but Verify Middleware

The Trustworthiness middleware framework is a software component used for the distributed peer-to-peer model [18]. Authors concerned about data exchange between two nodes may encounter trust risks. Hence, the proposed framework can maintain data consistency during the handshake process. The framework comprises three elements: RuleTemplateDB, StateDB and RuleVerification Engine. All data underwent RuleVerification Engine. The engine performs verification based on a rule stored in RuleTemplateDB. Any verified data can have a good pass, while a related exception handler invokes unverified data. The framework can help to refine trust in the Traditional Malay Medicine database. It provides a data-integrity framework on how to maintain trust in data. Researchers can study the formulation without

concerns, as it is protected from malicious intentions. Table 1 compares three frameworks based on domain, aim, trustworthiness, and mechanism.

Table 1: Comparisons of different available trustworthiness frameworks.

Framework	Domain	Aim	Trustworthiness	Mechanism
Assurance Cases System Trustworthiness Evaluation [16]	General Usage	To serve as a pioneer or starting point for more deep-focus further studies on the trustworthiness framework [16]	Source reliability, Claim reliability	There 6 parts: 1) Evaluation of Evidence: We need to quantify trustworthiness based on evidence and have an expert perform the judgment. 2) Evaluation of Reasoning: Evaluation of supporting elements first, then evaluation of the base of the main claim on the supporting elements score. 3) Evaluation of Performance: evaluation of the relationship among proposed requirements. 4) Evaluation of Direct Trust: Evaluation based on Performance, Ability, and Honesty. 5) Trust Aggregation: Evaluation based on indirect trust from a third party (e.g. policy, guidelines) 6) Trust of Dynamics: Evaluation is based on a threshold score greatly influenced by experience.
RipetaScore [17]	Scientific Research Paper	To measure the quality, transparency, and trustworthiness of scientific research paper	Author integrity, Research replicability	Measure the quality, transparency, and trustworthiness in systematic systems based on three criteria: Professionalism, Reproducibility, and Research verification.
Trust but Verify Middleware [18]	Inter-component data in the distributed system	To verify data communication between the sender and receiver	Data-integrity	Set up what rule needed to be verified in the rule database. The verify engine filters and verifies each data piece based on the rule set. A set of related exception handlers invoked upon any unverified data detected.

4.0 DISCUSSION

The preliminary review revealed that each framework fulfilled different requirements for trustworthiness assessment. However, implementing trustworthiness can be a troublesome task [19]. For example, author profiling requires a database to update author records, and some manuscripts have a nameless author. It is expected to slow

down data mining and pose stakeholder risks.

Assurance Cases System Trustworthiness Evaluation provides a basic skeleton in a trustworthiness framework. It helps assess system reliability and personalise data handling methods. The review provides valuable concepts from Part 1 and Part 5 [16] to evaluate the manuscript's authenticity. RipetaScore [17] conceptual helps assess the author's professionalism, trustworthiness, and reproducibility score for medicine formulations. To keep patterns and copyrights secure, we require middleware that ensures trustworthy data handshaking.

4.1 Proposed Framework

A conceptual trustworthiness framework was developed based on three (3) research focuses. We can develop or enhance the framework using methods from the preliminary study to be more trustworthy. Our proposed framework ensures the reliability of sources, authors, and data integrity.

Manuscript Source Score

The literature review's first finding states that evaluating evidence is crucial for building trust. Our evaluation process involves scoring based on sources like libraries, universities, and museums (Table 2). Manuscript experts determine the score through pre-digitalised original verification. We record the score in our database once the manuscript is scanned and copied. The initial evaluation should show the researcher that the trust issue has been reduced since the early data retrieval phase. We also kept the low-scored manuscript in our database, as it was noteworthy for future reference by others.

Table 2: Proposed Manuscript Source Score

Source	Score
Public Library, Public Museums	4
Universities	3
Private Libraries, Private Museums	2
Individual	1

Author Profiling

It is not easy to profile authors in Traditional Malay Medicine manuscripts. Because the original authors are no longer available,

nameless authors exist, and there is a risk of false authorship claims. We recommend analysing an author's medical formulation compared to the one in the manuscript. The scores for author profiling are given in Table 3. The researcher can see the total score when searching for alternative formulations in our database, as shown in Table 4.

Table 3: Proposed Author Profiling Score

Author Profiling	Score
>85%	4
>60% ~ 84%<	3
>20% ~ 59%<	2
0 ~ 19%<	1

Table 4: Formulation GUI in Traditional Malay Medicine Database

Formulation Name	Formulation ID	Manuscript	Trust Score
Formula X	0000X	Manuscript A	8
Formula Y	0000Y	Manuscript A	8
Formula Z	0000Z	Manuscript B	3

Inter-module/API middleware

A set of dynamic rules established aims to protect formulation patterns and copyright. It can be changed according to the current situation. The middleware verifies any data request from the user or API; if it is a verified update, it can channel the data to the update database and for verified view, it can route it to the view database. This configuration can prevent any attempt to temper the data via the API's viewing process/request. Meanwhile, middleware db backup focuses on updating the database daily. The middleware can be summarised in Figure 3.

RuleDB is an independent database with a table called *GeneralRules*. It stores rule details like type, status, and trigger condition. **UpdateDB** is the database for user updates. This database safeguards RealDB against data tampering. **ViewDB** is a database solely for viewing information via API or Apps. **BunkerDB** is a dedicated backup database updated through middleware at noon every day. **RealDB** is an isolated database that holds all data. **Middleman Verifier** is an engine that activates upon any data request. **Middleman db backup** updates *RealDB* via *UpdateDB* if changes occur. The middleman updates the view database from the *RealDB* hourly. The backup from *RealDB* to *BunkerDB* at the

Data Recovery Centre occurs daily at midnight.

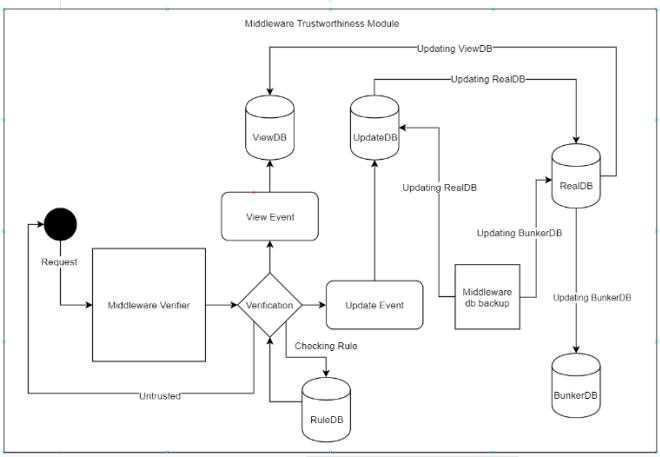

Figure 3: Formulation GUI in Traditional Malay Medicine Database

4.2 Implementation

Each method can be implemented across three phases of the data retrieval process of Traditional Malay Medicine (Figure 4). The scoring method of manuscript sources can be incorporated into the retrieval process, involving manual source validation. The manuscript's sources, title, author, text integrity, overall condition, and medical content will all be recorded in the database. Subsequently, the manuscript underwent a screening process and was assessed according to its sources, assigning a distinct ID number to each.

In data mining to extract formulations from transliterated manuscripts, each formulation can be evaluated using SAKTI-iComPSE methods [1] to ascertain its replicability in modern medicine technology. The criteria for evaluating the replicability score encompass the accessibility of ingredient information concerning modern knowledge, the number of ingredients required, the inclusion of production methods within the formulation, and the dosage specified. Subsequently, we were employed our proposed author profiling methods to assign a score to the authorship based on the replicability of their formulations.

Inter-module/API middleware (ImAPI) can be implemented as part of the Traditional Malay Medicine database architecture. The

development of each module in ImAPI utilised the PHP Laravel framework, specifically version 10 or the latest, to ensure a robust foundation and responsive compatibility across multiple platforms. RuleDB was developed using the MYSQL InnoDB engine to ensure query performance stability and maintainability. RuleDB can be developed independently from the main database to protect against potential data tampering.

4.3 Limitation

The limitations of our framework involve the formulation review process and scoring annotation. The frameworks we proposed did not include specifications regarding the responsible party for score annotation in the manuscript, author profile, and middleman rules guide. The integrity of the proposed framework is at stake when scoring is conducted by individuals who are either anonymous or unqualified. This situation can discourage researchers from further investigating the potential of Traditional Malay Medicine.

It is crucial to have a comprehensive set of guidelines that unambiguously specify the individuals accountable for score annotation in Traditional Malay Medicine data retrieval methods (e.g., manuscript reviews, transliteration process, formulation mining and ingredient mapping process). Establishing positions for competent annotators or committees tasked with evaluating scores may be necessary, ensuring they possess the requisite expertise in Traditional Malay Medicine. The guideline could incorporate predetermined standardised criteria that the annotator must comply with. This approach aids in maintaining uniformity and impartiality when evaluating various manuscripts.

5.0 CONCLUSION

The review explores trustworthiness frameworks for evaluating trust scores in various domains. It is focusing on their application in the Traditional Malay Medicine database. These frameworks evaluate trust from various perspectives, such as authenticity, authorship, and middleware. It offers reliable ways to implement trustworthiness in the database. This review helps establish standards and guidelines for evaluating Traditional Malay Medicine Trustworthiness. To score trust early, the proposed framework will incorporate Part 1 and Part 5 from Assurance Cases System Trustworthiness Evaluation [16].

RipetaScore [17] concepts evaluate the author's professionalism and formulation reproducibility. To protect copyrights, trustworthiness middleware can be implemented in the database.

Establishing a robust trustworthiness framework is expected to catalyse empirical research in Traditional Malay Medicine. This strategy improves the dependability and accuracy of Traditional Malay Medicine research findings, facilitating comparative studies across diverse practices and databases. Researchers can conduct longitudinal studies to assess how the trustworthiness of Traditional Malay Medicine evolves. This situation could lead to valuable insights into the factors that shape the credibility and acceptance of TMM practices in modern medicine.

Future research can delve deeper into refining the trustworthiness framework for Traditional Malay Medicine, incorporating valuable user feedback and adapting to evolving trends. This exploration could lead to innovative solutions for the framework and remain relevant in addressing the needs of the TMM community. Furthermore, integrating advanced technologies such as blockchain or machine learning can significantly amplify the effectiveness of trustworthiness middleware in the Traditional Malay Medicine database.

Our next step is to enhance the conceptual trustworthiness framework into a working system.

ACKNOWLEDGMENTS

The Ministry of Higher Education Malaysia supports the review through the Fundamental Research Grant Scheme (FRGS 22-277-0886)

REFERENCE

[1] A. M. Mohd Shafri, "SAKTI INDEX: TOWARDS SCIENTIFIC EVALUATION OF MALAY MEDICAL MANUSCRIPTS," *INTERNATIONAL JOURNAL OF ALLIED HEALTH SCIENCES*, 2021.

[2] H. F. Tsang, L. W. C. Chan, W. C. S. Cho, A. C. S. Yu, A. K. Y. Yim, A. K. C. Chan, L. P. W. Ng, Y. K. E. Wong, X. M. Pei, M. J. W. Li and S.-C. C. Wong, "An update on COVID-19 pandemic: the epidemiology,

pathogenesis, prevention and treatment strategies," *Expert Review of Anti-infective Therapy*, vol. 19, p. 877–888, 2020.

[3] K. Sundara Rajoo, P. Lepun, R. Alan, D. Singh Karam, A. Abdu, Z. Rosli, N. Izani and G. James Gerusu, "Ethnobotanical study of medicinal plants used by the Kenyah community of Borneo.," *Journal of ethnopharmacology*, 2023.

[4] S.-J. Yea, B. Seong, Y. Jang and C. Kim, "A data mining approach to selecting herbs with similar efficacy: Targeted selection methods based on medical subject headings (MeSH)," *Journal of Ethnopharmacology*, vol. 182, p. 27–34, 2016.

[5] N. S. A. Halim, M. A. M. Shafri and I. A. Shahdan, "Finding Cures for the Emerging Yaws: Analysis of Kitab Tib Muzium Terengganu and MSS1292," *INTERNATIONAL JOURNAL OF ALLIED HEALTH SCIENCES*, 2020.

[6] H. F. Josef, "Digitizing Ancient Manuscripts:Both Ancient Manuscripts Physically and Ancient Manuscripts in Digital Format," *Regional Library and Archive Office of Yogyakarta Special Region*, 2019.

[7] N. A. M. Rihan, R. A. Ghani and M. A. M. Shafri, "Breastfeeding Challenges: Data Mining On Malay Formulation And Practice As Recommended In The Malay Medical Manuscripts," *INTERNATIONAL JOURNAL OF ALLIED HEALTH SCIENCES*, 2021.

[8] R. N. R. Perdaus, M. A. M. Shafri and I. A. Shahdan, "Ancient Remedies For Coughs And Cough-Related Symptoms: Analysis From Malay Medical Manuscripts," *INTERNATIONAL JOURNAL OF ALLIED HEALTH SCIENCES*, 2021.

[9] N. S. F. Hamdee, M. A. M. Shafria and M. Mohammad, "TREATMENT FORMULATIONS FOR 'RESDUNG' IN MALAY MEDICAL MANUSCRIPT, MS 699," *INTERNATIONAL JOURNAL OF ALLIED HEALTH SCIENCES*, 2021.

[10] P. PANDU, "Restorasi Digital untuk Pelestarian Manuskrip," Kompas.id, 2023.

[11] S. P. Riley, B. T. Swanson and C. E. Cook, ""Trustworthiness," confidence

in estimated effects, and confidently translating research into clinical practice.," *Archives of physiotherapy,* vol. 13, no. 1, p. 8, 2023.

[12] S. M. Shaughnessy, A. Dimagli, B. Kachulis, M. Rahouma, M. Demetres, N. Govea and L. Q. Rong, "Evaluation of the quality of COVID-19 guidance documents in anaesthesia using the Appraisal of Guidelines for Research and Evaluation II instrument," *British Journal of Anaesthesia,* vol. 129, p. 851–860, 2022.

[13] M. A. Basar, "A Preliminary Study on Mechanism and Measurement of Trustworthiness on a Crowdsourcing Platform," *International Journal of Advanced Trends in Computer Science and Engineering,* vol. 8, p. 409–415, 2019.

[14] R. Peels and L. Bouter, "Replication and trustworthiness," *Accountability in Research,* vol. 30, p. 77–87, 2021.

[15] A. Gallagher, "Reflections on 2020: Trustworthiness and the Consolation of Culture," *Nursing Ethics,* vol. 28, p. 3–5, 2021.

[16] J. Li, B. Mao, Z. Liang, Z. Zhang, Q. Lin and X. Yao, "Trust and Trustworthiness: What They Are and How to Achieve Them," in *2021 IEEE International Conference on Pervasive Computing and Communications Workshops and other Affiliated Events (PerCom Workshops)*, 2021.

[17] J. Q. Sumner, C. H. Vitale and L. D. McIntosh, "RipetaScore: Measuring the Quality, Transparency, and Trustworthiness of a Scientific Work.," *Frontiers in research metrics and analytics,* vol. 6, p. 751734, 2021.

[18] R. M. Albarrak and D. A. Menasce, "Trust But Verify: A Framework for the Trustworthiness of Distributed Systems," *IEEE Transactions on Dependable and Secure Computing,* vol. 19, p. 2105–2121, 2022.

[19] B. Morrison, T. A. Boyle and T. Mahaffey, "Demonstrating institutional trustworthiness: A framework for pharmacy regulatory authorities.," *Research in social & administrative pharmacy : RSAP,* vol. 18, no. 10, p. 3792–3799, 2022.