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Submission date: 13-Oct-2025 10:58PM (UTC+0700)

Submission ID: 2779950744

File name: KurniaRamadhani_Junior_MANIInsanCendekiaOKI_IARCO2025_Proposal_-_Kurnia_Ramadhani.pdf
(167.38K)

Word count: 1590

Character count: 8522

IARCO RESEARCH PROPOSAL

Full Legal Name: Kurnia Ramadhani

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Research Topic: Biomedical Science / Public Health Technology

Title: Affordable Rapid Early Colorimetric Analyzer: Paper-Based Saliva Strips for Early Detection of Oral Submucous Fibrosis (OSMF) in Betel Nut Chewing Communities

Research Problem

This study was motivated by concerns about the number of OSMF cases [1] which remain a global urgency to this day. OSMF is a precancerous condition of the mouth with a high risk of malignancy. Transformation into oral cancer can occur within a critical window of 5 to 10 years after the initial clinical diagnosis. [1]. The main factor triggering this disorder is the chewing of betel nut (*Areca catechu L.*), which has become a cultural aspect and tradition passed down from generation to generation in many rural areas [2][3]. Meanwhile, awareness of the systemic impact is neglected, low socioeconomic conditions, and limited access to medical specialists in endemic areas cause diagnosis to be delayed until symptoms are already at an advanced stage [4][5]. This trismus directly triggers frailty and a decline in neurocognitive function, which impacts overall quality of life [6].

Although saliva biomarkers are now accurate, they cannot yet be widely applied in clinical practice due to the gap between high-cost laboratory discoveries and low-cost needs in rural communities [7]. On the other hand, ROS (reactive oxygen species) induces a decrease in saliva pH and an increase in inflammatory proteins. Changes in saliva components, such as lipids, proteins, pH, and others, can be indicators for non-invasive examination and can be used as an initial screening for OSMF [8].

This opportunity led to the creation of a dual-indicator saliva screening strip as a solution that is directly proportional to resource constraints. This strip is designed to validate low-cost initial screening tools, but not for diagnosis, and to integrate them into a systemic disease prediction model for prestigious and sustainable preventive interventions. It is hoped that this research can serve as a bridge in improving the quality of life of smokers through low-cost initial screening as an early warning before taking further strategic medical steps.

Existing Literature

Previous studies have noted that communities that have a habit of chewing betel nut are usually from endemic areas and have deep cultural roots, especially in Southeast Asia [9]. They believe that traditionally, betel nuts have digestive and antimicrobial benefits, but they ignore the precancerous oral symptoms that originate from OSMF, and the main factor of OSMF is the alkaloid compounds contained in betel nuts. The lack of public awareness of this danger results in a reduced quality of life for OSMF patients, which correlates with low socioeconomic status and difficulty accessing medical specialists.

Diagnosis is often delayed, and patients present with advanced symptoms [10]. Expensive specialized laboratory instruments cannot be the right solution to prevent and reduce the incidence of this problem [6]. The existing solution is a Point Of Care (POC) device that often fails to function in developing countries, especially in endemic areas, because it requires a stable electricity supply, trained technicians who are rarely available, and is too complicated to be operated by lay health workers [11].

Other studies also mention that OSMF triggers ROS (active oxygen species) and causes oxidative stress, which is indicated by a decrease in pH and antioxidant enzymes in the saliva of patients, as well as a significant increase in malondialdehyde (MDA) and 8-hydroxy-2'-deoxyguanosine (8-OHdG) compared to healthy controls [8]. The above studies form the basis of this research in creating an initial screening solution in the form of a saliva strip test for patients, bridging the gap between high-cost laboratory diagnosis and low socioeconomic status in rural areas.

Research Question

To what extent can ARECA strips detect changes in saliva pH and be used as an initial screening tool for referral to medical specialists? How do the accuracy, specificity, and correlation of ARECA strip test results compare to standard laboratory methods?

Methodology

Research design

This study is a pilot study with a mixed-method approach to test a paper-based colorimetric saliva strip prototype called ARECA as an early screening tool for Oral Submucous Fibrosis (OSMF). The three main stages of this study are laboratory standardization, small-scale field testing, and comparison of strip detection results with expert medical diagnoses on the accuracy of the product in identifying pre-symptoms of OSMF [12].

Population and sample

Location: residential areas with betel nut chewing habits (or representatives from surrounding areas)

Criteria: aged 15+, willing to give consent and provide saliva samples as objects

Number of samples: consisting of 15 non-chewers, 15 chewers without symptoms, and 15 chewers with OSMF symptoms

Stage 1: Prototype Standardization in the Laboratory

1. Materials: filter paper (Whatman), commercial pH strips (pH 5.5-7.5), urine test, specified pH buffer solution
2. Process: small cards to be used as test strips are coated with pH and protein pads
3. Color test: the attached strips are dipped into a buffer solution, then photographed in constant light after 60 seconds to produce a color standard card

Stage 2: Sample collection and field testing

1. Subjects do not eat/drink/smoke 30 minutes before sample collection
2. Fill out a short questionnaire: age, gender, betel chewing habits, smoking habits, time of last meal and drink

3. Collect 2-3 drops of saliva, place in a sterile container, dip the test strip
4. Take a photo of the color that appears after 60 seconds
5. Compare with the specialist's medical diagnosis
6. Record all results in the data table

Descriptive analysis of the color results for each individual/group and linking betel nut chewing habits with the correlation between the test strip results and the medical specialist's diagnosis to prove accuracy.

Research Topic

This topic is relevant and urgent on a global scale. Despite the availability of sophisticated and accurate laboratory diagnostics, they cannot be used as a solution in areas with low socioeconomic awareness. With the ARECA strip, it is hoped that it can be used as a solution for early screening and prevention of OSMF symptoms to improve the quality of life in areas where betel nut chewing is common.

Quality of Writing

The language of this proposal is academically precise, clear, and appropriate for a multidisciplinary audience. Jargon is minimized, and the structure follows standard research norms. The proposal adheres to grammar, citation, and formatting guidelines strictly to meet IARCO standards

References

- [1] A. Meci, N. Goyal, and D. Goldenberg, “Malignant Transformation Rate of Oral Premalignant Disorders: A Large Database Analysis,” *Laryngoscope*, vol. 135, no. 10, pp. 3654–3659, Oct. 2025, doi: 10.1002/lary.32236.
- [2] P. Zhang *et al.*, “Molecular Mechanisms of Malignant Transformation of Oral Submucous Fibrosis by Different Betel Quid Constituents—Does Fibroblast Senescence Play a Role?,” *Int. J. Mol. Sci.*, vol. 23, no. 3, p. 1637, Jan. 2022, doi: 10.3390/ijms23031637.
- [3] K. Kazemi, A. Fadl, F. F. Sperandio, and [10] Leask, “The Areca Nut and Oral Submucosal Fibrosis: A Narrative Review,” *Dent. J.*, vol. 13, no. 8, p. 364, Aug. 2025, doi: 10.3390/dj13080364.
- [4] “Non-specific Chief Complaints Among Oral Submucous Fibrosis Patients at Outpatient Department and Pan Shop at Rural Region in India”.
- [5] R. Gupta *et al.*, “Evaluation of Noninvasive Adjuncts for Early Detection of Oral Cancer in Oral Potentially Malignant Disorders and Development of Risk-Based Management Strategies: Protocol for a Prospective Longitudinal Study,” *JMIR Res. Protoc.*, vol. 14, p. e66285, May 2025, doi: 10.2196/66285.
- [6] D. Kuupiel, V. Bawontuo, and T. Mashamba-Thompson, “Improving the Accessibility and Efficiency of Point-of-Care Diagnostics Services in Low- and Middle-Income Countries: Lean and Agile Supply Chain Management,” *Diagnostics*, vol. 7, no. 4, p. 58, Nov. 2017, doi: 10.3390/diagnostics7040058.
- [7] N. S. Piyarathne *et al.*, “Diagnostic salivary biomarkers in oral cancer and oral potentially malignant disorders and their relationships to risk factors – A systematic review,” *Expert Rev. Mol. Diagn.*, vol. 21, no. 8, pp. 789–807, Aug. 2021, doi: 10.1080/14737159.2021.1944106.
- [8] A. A. Poimenidou, P. Geraki, S. Davidopoulou, S. Kalfas, and A. Arhakis, “Oxidative Stress and Salivary Physicochemical Characteristics Relative to Dental Caries and Restorative Treatment in Children.,” *Antioxidants (Basel, Switzerland)*, vol. 14, no. 4, Mar. 2025, doi: 10.3390/antiox14040405.
- [9] A. Fudickar, D. Konetzka, S. M. L. Nielsen, and K. Hathorn, “Evidence-based art in the hospital.,” *Wien. Med. Wochenschr.*, vol. 172, no. 9–10, pp. 234–241, Jun. 2022, doi: 10.1007/s10354-021-00861-7.
- [10] S. M. Gondivkar, R. R. Bhowate, A. R. Gadball, R. S. Gondivkar, and S. C. Sarode, “Impact of socioeconomic inequalities on quality of life in oral submucous fibrosis patients.,” *Future Oncol.*, vol. 15, no. 8, pp. 875–883, Mar. 2019, doi: 10.2217/fon-2018-0645.
- [11] D. Bastías, A. Maturana, C. Marín, R. Martínez, and S. E. Niklander, “Salivary Biomarkers for Oral Cancer Detection: An Exploratory Systematic Review,” *Int. J. Mol. Sci.*, vol. 25, no. 5, p. 2634, Feb. 2024, doi: 10.3390/ijms25052634.

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- [12] S. Fàbregues, M. Sáinz, M. J. Romano, E. L. Escalante-Barrios, A. Younas, and B.-S. López-Pérez, “Use of mixed methods research in intervention studies to increase young people’s interest in STEM: A systematic methodological review,” *Front. Psychol.*, vol. 13, Jan. 2023, doi: 10.3389/fpsyg.2022.956300.

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