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Empowering Rural Youth through Mobile Cancer Detection Vans: Combating the Socioeconomic Burden of Oral Cancer in Rural Madhya Pradesh

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Abstract

Oral cancer presents a growing public health challenge in India, particularly affecting young adults in rural Madhya Pradesh. This research explores the complex interaction of socioeconomic determinants, cultural norms, and limited access to timely diagnosis and care. The paper examines the potential of mobile cancer detection vans (MCDVs), equipped with advanced diagnostic tools like fluorescence spectroscopy and AI-enabled technologies, as a transformative public health intervention. Drawing upon secondary data and a thorough literature review, the study underscores the increasing oral cancer burden among youth, the diagnostic delays caused by infrastructural gaps, and the operational feasibility of mobilebased early detection models. With over 1500 early-stage cancer detections already attributed to MCDV programs, the paper provides a robust policy framework for scaling up such initiatives in underserved areas. Recommendations target health system strengthening, youthcantered outreach, and socioeconomic resilience to foster equitable cancer control.

Keywords: - Oral Cancer, Mobile Detection Vans, Rural Health, Fluorescence Spectroscopy, Madhya Pradesh, Youth, Socioeconomic Determinants

1. INTRODUCTION

Oral cancer accounts for a significant share of the global cancer burden, disproportionately affecting low- and middle-income countries (LMICs). India bears nearly 25% of global cases, with Madhya Pradesh exhibiting high incidence rates due to cultural and socioeconomic factors. Alarmingly, the age profile of oral cancer patients is shifting, with a marked increase among individuals aged 21–40 years. This rise is associated with early tobacco and betel nut initiation, often compounded by poor awareness and limited healthcare infrastructure.

This paper highlights the need for decentralized, technology-driven solutions. Mobile Cancer Detection Vans (MCDVs), equipped with diagnostic tools such as fluorescence spectroscopy, offer promising avenues for early detection in resource-constrained settings.

1.1 Background of the study

Oral cancer is a significant and growing public health crisis globally, particularly in South Asia. India alone contributes to nearly one-fourth of all global oral cancer cases. With an estimated 75,000 annual deaths and $5.6 billion in economic losses, the burden of this disease is both human and financial. Traditionally regarded as a disease of older adults, recent trends show an alarming rise among young adults, especially those between the ages of 21–40 years. This shift is driven by early initiation of high-risk behaviours most notably smokeless tobacco and betel nut use common in culturally and economically marginalized communities. In rural India, including Madhya Pradesh, the challenge is compounded by delayed diagnosis, poor health literacy, and inadequate access to diagnostic facilities. More than 60–80% of cases are detected at advanced stages, drastically reducing survival rates. Emerging portable diagnostic technologies like fluorescence spectroscopy now offer opportunities to detect early-stage oral lesions even in low-resource settings. The deployment of Mobile Cancer Detection Vans (MCDVs) equipped with such technologies has the potential to bridge rural health inequities by reaching underserved youth where conventional health infrastructure fails.

1.2 Significance of the Study

The early onset of oral cancer among rural youth is not just a health concern it is a socioeconomic crisis. Delayed diagnosis and treatment in this demographic lead to increased mortality, disability, and long-term financial hardship for families. The study's significance lies in its focus on:

- Quantifying the youth burden of oral cancer in Madhya Pradesh.
- Highlighting cultural and socioeconomic drivers such as tobacco normalization, poverty, and low health awareness that perpetuate this crisis.
- Evaluating the operational feasibility and cost-effectiveness of deploying mobile screening vans equipped with advanced diagnostics.
- Demonstrating evidence-based success, including the detection of over 1,500 earlystage cases via MCDVs.

- Proposing scalable policy interventions that link mobile health solutions to national programs like Ayushman Bharat and NPCDCS.

This study aims to serve as a critical resource for public health planners, policymakers, and implementers by outlining a model for reducing oral cancer incidence and mortality among India's most vulnerable populations through mobile, accessible, and technology-driven strategies.

2. OBJECTIVES

1. To assess the rising trend of oral cancer among rural youth in Madhya Pradesh.
2. To explore the role of socioeconomic mindset and cultural practices in disease burden.
3. To evaluate MCDVs as a strategic early detection intervention.
4. To identify barriers and enablers in implementing mobile oral screening programs.
5. To provide actionable recommendations for policy and program design.

3. METHODS

3.1 Study Design

This is a secondary data-based analytical review using peer-reviewed journals, government reports, and health databases.

3.2 Data Sources

Sources include PubMed, Scopus, WHO, NCBI, NPCDCS, and others. Keywords included: oral cancer, fluorescence spectroscopy, mobile health, tobacco use in youth, rural screening.

3.3 Study Area

Rural Madhya Pradesh, with a focus on tribal and underserved populations.

3.4 Indicators

- Oral cancer incidence and prevalence (ages 21–40)
- Tobacco and betel nut use patterns
- Cultural risk factors and health beliefs
- Healthcare access and diagnostic delays
- Outcomes from mobile screening interventions

4. RESULTS

4.1 Epidemiological Shifts

- 38.5% of oral cancer cases occur in the 31–40 age group; 35.2% in 21–30.
- Early tobacco initiation (as early as 7 years) is prevalent.
- Rural prevalence of OPMDs is 12.8%; confirmed cancer at 3.1%.

4.2 Socioeconomic and Cultural Influence

- 90% of patients are from low or lower-middle socioeconomic strata.
- Tobacco is normalized as a social and dental practice.
- Delays up to 9 months in diagnosis are common due to system inefficiencies.

4.3 Mobile Vans and Technology Integration

- MCDVs with fluorescence spectroscopy have a sensitivity of 90% and specificity of 94.1%.
- Over 1500 early-stage cases detected through mobile initiatives in MP.
- AI-enabled smartphone diagnostics and tele-cytology improve access and speed.

5. DISCUSSION

The findings indicate that MCDVs can significantly mitigate diagnostic delays and reach youth in remote areas. The integration of portable technologies addresses workforce shortages and bridges access gaps. Addressing socioeconomic mindset through culturally resonant education is essential. MCDVs should be linked with national health programs (e.g., Ayushman Bharat) for continuum of care. Challenges include infrastructure, funding, training, and community mistrust, but these can be overcome with SOPs, community involvement, and sustainable financing models.

6. CONCLUSION

Mobile cancer detection vans represent a scalable, impactful solution to the oral cancer crisis in rural India. By focusing on youth, leveraging technology, and integrating with existing programs, these vans can transform oral cancer control. Sustained efforts must address operational challenges, socioeconomic inequalities, and build culturally tailored prevention campaigns.

7. RECOMMENDATIONS

- Expand MCDVs: Target tribal and underserved districts.
- Equip with tech: Fluorescence spectroscopy, AI tools, tele-cytology.
- Awareness campaigns: Youth-cantered IEC in local languages.
- Financial incentives: Reduce out-of-pocket costs; encourage participation.
- Referral and follow-up: Develop digital tracking and health navigator roles.
- Train CHWs: Emphasize OVE, ORR, and tech use.
- Research: Long-term impact studies and cost-effectiveness analysis.

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