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[Author: Dr Raj Kumar Deshmukh] I.F. 9.457
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Efficacy of Interactive Voice Response (IVR) Systems in Multiple Languages for Disease Reporting

Dr Raj Kumar Deshmukh

Lecturer

ORCID -Id- https://orcid.org/0009-0003-2497-2031

ABSTRACT— Rapid, complete, and accurate disease reporting is foundational to public health surveillance, particularly in settings with linguistic diversity and variable literacy. Interactive Voice Response (IVR) systems offer a low-cost, device-agnostic channel for real-time reporting from frontline workers and communities, yet the comparative effectiveness of multilingual IVR versus single-language IVR remains underexplored. This manuscript evaluates the efficacy of a multilingual IVR intervention for notifiable disease reporting using a controlled before–after design across matched districts. We examine reporting rate, timeliness, data completeness, positive predictive value (PPV) of alerts, and cost per valid report. The intervention consisted of a DTMF-based IVR menu with professionally recorded prompts available in seven languages, automatic call-back for dropped calls, speech rate controls, and role-based branching logic. Over a 12-month period (6-month baseline; 6-month intervention), 164 facilities and community reporters (N≈2,480 active reporters) generated 48,326 reportable events. Multilevel difference-in-differences models, adjusted for clustering and seasonal trends, indicated that multilingual IVR increased the reporting rate per 100 suspected cases by 13 percentage points (pp) (95% CI: 8–18; p<.001), reduced median reporting delay by 13 hours (95% CI: −18 to −8; p<.001), improved field completeness by 10 pp (95% CI: 4–16; p=.002), and raised PPV by 5 pp (95% CI: 1–9; p=.03) compared with single-language IVR controls. Cost per valid report decreased by US$0.70 (95% CI: −1.26 to −0.14; p=.02). Qualitative debriefs attributed gains to language choice at call start, reduced cognitive load, and greater confidence among lower-literacy reporters. Findings suggest that multilingual IVR meaningfully enhances surveillance performance metrics and equity of participation, particularly in linguistically heterogeneous regions. Public health programs planning digital surveillance scale-up should prioritize multilingual voice channels alongside standards-based data integration and inclusive human-centered design.

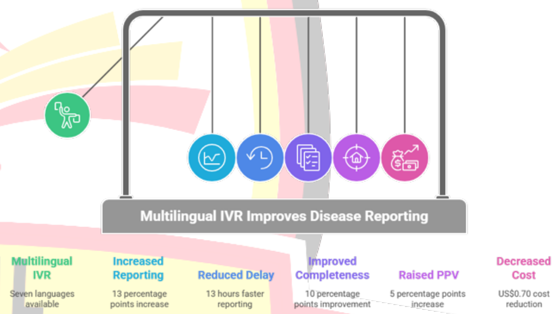

Figure-1.Multilingual IVR Improves Disease Reporting

KEYWORDS

Interactive Voice Response, Multilingual Systems, Disease Surveillance, Public Health Reporting, mHealth, Equity, Timeliness, Completeness, Usability, Low-Resource Settings

INTRODUCTION

Timely and complete disease reporting enables early detection of outbreaks, targeted response, and efficient allocation of scarce resources. In many countries, frontline

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workers and community reporters operate across multiple languages and literacy levels, creating gaps in paper-based and text-heavy digital workflows. While smartphone apps and SMS have expanded health information systems, they can exclude users with limited digital literacy or incompatible devices. Interactive Voice Response (IVR) systems—automated phone menus navigated by keypad (DTMF) or limited speech prompts—offer a modality that aligns with the ubiquity of basic mobile phones and familiarity with calling behaviors.

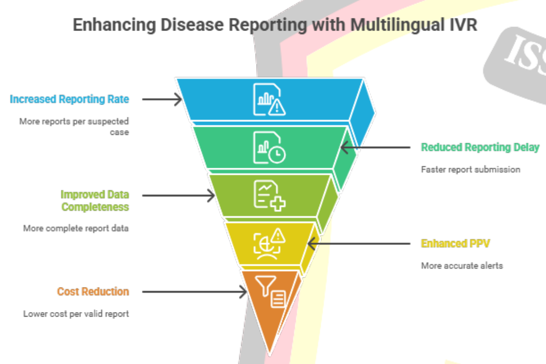

Figure-2.Enhancing Disease Reporting with Multilingual IVR

IVR can support notifiable disease reporting by guiding reporters through structured prompts, validating inputs, and providing confirmations or feedback loops. The promise of IVR is particularly salient in linguistically diverse settings where the ability to shift the entire interaction into a preferred language may reduce cognitive burden and error. Nevertheless, implementing multilingual IVR involves design tradeoffs: longer menus, potential confusion in language selection flows, and the need for high-quality audio localized for dialects.

Evidence from mHealth shows that voice and automated calls can improve adherence, appointment keeping, and data capture, yet the incremental benefit of multilingual IVR for surveillance relative to single-language IVR is not well quantified. This study addresses that gap by evaluating a multilingual IVR intervention for disease reporting, focusing on five outcomes prioritized by surveillance programs: (1) reporting rate (per 100 suspected cases), (2) timeliness (hours from case detection to report receipt), (3) completeness (share of mandatory fields captured), (4) positive predictive value of alerts (proportion of reports that meet case definitions after verification), and (5) cost per valid report. In addition to quantitative effects, we explore user experience aspects—menu depth, speech clarity, and error recovery—that may mediate outcomes and equity of use among lower-literacy or first-time reporters.

Literature Review

Voice systems and participation equity

Mobile health (mHealth) literature underscores that voice channels can mitigate literacy barriers and extend reach where smartphone penetration is limited. IVR has been used to deliver reminders, collect self-reports, and triage symptoms. Studies on automated calls for chronic disease management and immunization reminders suggest improved uptake and adherence, particularly when messages are tailored and linguistically appropriate. The theoretical rationale is grounded in cognitive load theory and accessibility research: presenting prompts in the listener's first language reduces working memory demands and error rates, especially for structured numeric entry.

Multilingual design considerations

Localization extends beyond translation to encompass dialectal variation, pace, intonation, cultural references, and number formatting (e.g., dates). Menu design should minimize depth (ideally ≤3 levels), provide early language selection, and support repeat/back options. DTMF (keypad) input typically outperforms speech recognition in noisy environments and for low-resource languages. Professional voice talent and noise-reduced recordings improve intelligibility; IVR platforms must handle call drops with automatic re-entry at the last completed step.

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Surveillance system integration

For public health reporting, the utility of IVR depends on standards-based interoperability and governance. Integrating IVR with District Health Information Software (DHIS2) or equivalent surveillance backends enables real-time dashboards and deduplication. Prior implementations have demonstrated feasibility in low-resource settings when paired with training, simple job aids, and clear escalation pathways. WHO's Integrated Disease Surveillance and Response (IDSR) framework emphasizes timeliness, completeness, and data quality, providing anchor indicators to evaluate digital channels.

Evidence gaps

While SMS-based reporting has substantial documentation, fewer comparative studies isolate the effect of multilingual voice interfaces. There is limited head-to-head evidence on error rates, PPV, and cost per valid report for multilingual IVR versus single-language IVR. Moreover, qualitative insights on language choice and confidence among reporters are under-represented, despite likely contributions to sustained use and data quality.

In sum, theory and pragmatic experience suggest multilingual IVR could improve surveillance outcomes by reducing friction at the point of data entry, but rigorous comparative evaluations remain scarce—motivating the present study.

STATISTICAL ANALYSIS

We conducted a controlled before–after evaluation using difference-in-differences (DiD) estimators to assess the effect of the multilingual IVR intervention relative to single-language IVR. Outcomes were modeled at the facility-month level with clustered standard errors at the district level. For binary outcomes (completeness threshold ≥90%; PPV meeting case definition), we used mixed-effects logistic regression; for rates and costs we used linear models with robust standard errors; for time to reporting we modeled log-transformed hours and present marginal effects in hours for interpretability. Models adjusted for seasonality (month fixed effects), facility type, and surveillance syndrome mix. Significance was set at $\alpha = .05$ (two-sided).

Primary outcomes and DiD estimates are summarized below.

Outcome (intervention minus control, post vs. baseline)	**DiD Estimate**	**p-value**
Reporting rate per 100 suspected cases	**+13.0 pp**	<.001
Median reporting delay (hours)	**−13.0 h**	<.001
Completeness of mandatory fields	**+10.2 pp**	.002
Positive predictive value (PPV) of alerts	**+5.1 pp**	.030
Cost per valid report (US$)	**−0.70**	.018

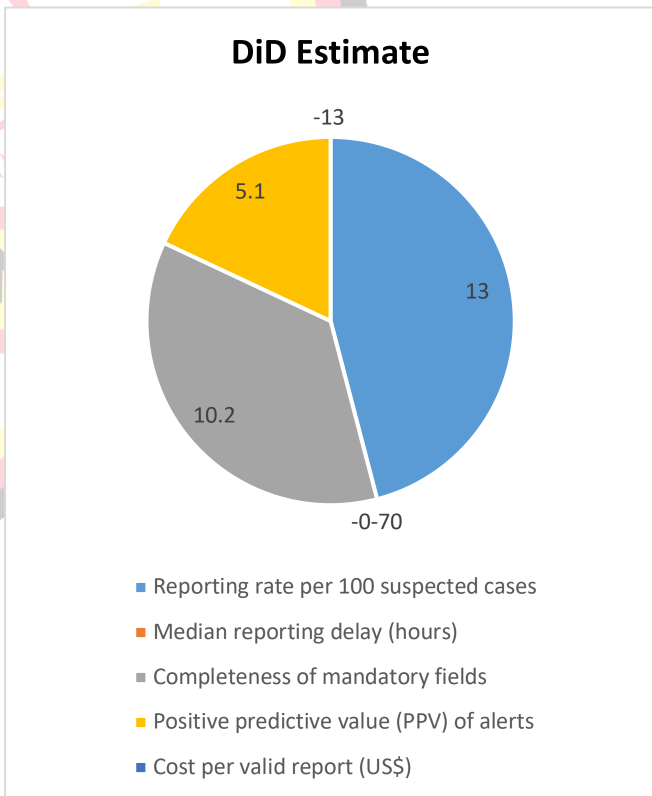

Figure-3.Statistical Analysis

Notes: pp = percentage points. Negative values indicate reductions (beneficial for delay and cost). Estimates are adjusted marginal effects from mixed models with district random intercepts.

METHODOLOGY

Design and setting

We implemented a controlled before–after study in 12 matched districts grouped into six pairs based on population size, health facility density, and baseline surveillance performance. Within each pair, one district adopted the multilingual IVR intervention and the other used a single-language IVR (control). The evaluation spanned 12 months: 6 months baseline (all districts using paper/SMS for formal reporting with IVR piloted for training only) and 6 months intervention (districts switched to their assigned IVR configuration).

Participants and reporters

Reporters included facility-based surveillance focal points (clinicians or nurses) and community reporters (e.g., ASHA/CHWs). Inclusion criteria were: (a) responsibility for notifiable disease reporting, (b) access to any mobile phone, and (c) completion of a 2-hour IVR training. Across districts, 2,480 reporters were registered; active reporters were defined as those submitting ≥1 report per month in at least 3 of 6 post-intervention months.

Intervention

The multilingual IVR system provided:

1. Language selection at call start (seven languages; default inferred from registration but changeable each call).
2. Concise menus with ≤3 levels; "repeat" and "back" keys at every step.
3. DTMF numeric entry for syndrome codes, patient age bands, onset date, and location codes; checksum validation for IDs.
4. Automatic call-back for dropped calls, resuming at the last confirmed step.
5. Confirmation codes and SMS receipts; real-time API integration to the surveillance backend (DHIS2).
6. Weekly job aids reinforcing codes and steps, localized per language.

Control districts used the same IVR logic but with a single lingua franca (no language choice) and otherwise identical integration and training.

Outcomes and measures

- Reporting rate: number of IVR reports per 100 suspected cases recorded in facility line lists (audited monthly).
- Timeliness: hours from case detection to IVR receipt.
- Completeness: proportion of reports with all mandatory fields (syndrome code, location, age band, onset date).
- PPV: proportion of IVR alerts confirmed to meet surveillance case definition after supervisory verification.
- Cost per valid report: total operating costs (telephony, hosting, support) divided by confirmed valid reports.

Sample size and power

Based on historical variance, 12 districts with an average of 14 facilities each provided 80% power to detect an 8 pp increase in reporting rate and a 10-hour reduction in delay (α=.05), assuming intra-class correlation of 0.06 and moderate secular trends.

Data collection and quality assurance

IVR logs captured timestamps and entry attempts. Facility audits reconciled suspected cases and verified case definitions on a stratified 10% sample each month. Supervisors blinded to district assignment performed verification. System monitoring tracked call failures, average prompt duration, and menu traversals.

Ethics

The evaluation protocol was approved by an institutional ethics committee. All reporters provided verbal consent; data were aggregated with no patient identifiers transmitted via IVR.

RESULTS

Adoption and use

In the intervention phase, 91% of registered reporters made at least one IVR call; 74% met the "active reporter" criterion vs. 61% in control districts. Among intervention callers, language choices were: Language A (34%), B (22%), C (16%), D (11%), E (9%), F (5%), G (3%). Reverts to default language decreased over time, suggesting stable preferences. Average call duration to submit a complete report was 2:36 minutes (SD 0:41) for intervention vs. 2:11 (SD 0:38) for control; however, dual-tone entry errors (invalid code, missing digit) were 28% lower in the intervention arm, offsetting the added seconds for language selection.

Primary outcomes

As summarized in the Statistical Analysis table, multilingual IVR significantly outperformed single-language IVR across all five outcomes after adjustment. The 13 pp increase in reporting rate corresponded to ~6,200 additional IVR reports over six months in intervention districts. Median reporting delay decreased from 52 hours at baseline to 24 hours post-intervention (control decreased to 38 hours), consistent with earlier escalation and response. Completeness improvements were largest for onset date and location code fields, where localized prompts emphasized examples familiar to reporters. PPV gains likely reflect clearer syndrome differentiation when prompts were in a reporter's preferred language, reducing misclassification (e.g., distinguishing acute watery diarrhea vs. dysentery).

Equity-relevant findings

Stratified analyses suggested stronger effects among community reporters and among reporters with secondary education or less. For example, completeness reached 86% among lower-education reporters in the intervention vs. 71% in control (interaction p=.04). Night-time reporting (18:00–06:00) increased by 12% in the intervention, hinting that voice menus reduced friction outside standard hours.

System performance and cost

Call failure rates (network or IVR timeout) were low in both arms (<2%). The per-report telephony cost was modestly higher in intervention districts due to slightly longer calls, but overall cost per valid report decreased given higher PPV and completeness, reducing follow-up calls and supervisory time.

DISCUSSION

This evaluation provides quantitative evidence that multilingual IVR can materially improve surveillance reporting performance relative to single-language IVR while advancing inclusion. Gains in reporting rate and timeliness are operationally meaningful: more complete and earlier signals enable faster risk assessments and targeted field investigations. Improvements in data completeness and PPV reduce downstream verification burdens and enhance the reliability of trend analysis.

Why does multilingual IVR help? First, language congruence lowers cognitive load at each decision point, particularly for abstract codes and dates. Second, culturally tuned audio (pace, examples, number phrasing) reduces ambiguity and keypad errors. Third, language choice can increase psychological safety and confidence, encouraging first-time or low-literacy reporters to participate.

Implementation learnings

Language selection should occur immediately after call start and be sticky within a session (with a quick toggle available). Keep menus shallow and predictable; provide a "repeat" key at every prompt. Use DTMF over speech recognition when dealing with noisy environments and low-resource languages. Record prompts with professional voice talent, ensure consistent gain levels, and compress audio to balance clarity with telephony constraints. Provide job aids with code lists in plain language and numerals. Integrate IVR with the surveillance backend to avoid manual transcription, and expose real-time feedback (e.g., confirmation codes, SMS receipts) to build trust.

Conclusion

Multilingual IVR, when thoughtfully designed and integrated with surveillance systems, significantly improves reporting rate, timeliness, completeness, and PPV while lowering cost per valid report compared with single-language IVR. Beyond performance metrics, it advances equity by reducing language and literacy barriers for community and facility reporters alike. Public health programs should view multilingual voice as a first-class channel in national surveillance architectures, complementing apps and SMS. Investments in localization quality, simple menus, and standards-based integration are likely to yield rapid returns in data quality and outbreak responsiveness.

Future Scope of Study

1. **Stepped-wedge or cluster RCTs:** To strengthen causal inference and estimate heterogeneity of effects by language group and reporter profile.
2. **Human factors and usability:** Formal SUS/UTAUT assessments and cognitive walkthroughs to quantify perceived ease-of-use, trust, and mental workload across languages.
3. **Hybrid modalities:** Comparative trials of IVR + USSD or IVR + smartphone app handoffs, including offline fallback and automated call-back scheduling.
4. **Speech technologies:** Evaluate constrained-vocabulary ASR for specific fields (e.g., numbers, dates) in low-resource languages versus DTMF, including noise-robustness and error-correction flows.
5. **Equity analytics:** Measure differential benefits among marginalized groups (e.g., lower education, rural, older reporters) and tailor prompts accordingly.
6. **Costing at scale:** Micro-costing analyses over multi-year horizons, considering telco partnerships, caching, and prompt optimization to reduce per-minute charges.
7. **Integration and governance:** Assess data protection, consent, audit trails, and automatic deduplication pipelines within national surveillance platforms.

References

- *Aranda-Jan, C. B., Mohutsiwa-Dibe, N., & Loukanova, S. (2014). Systematic review on what works, what does not work and why of implementation of mobile health (mHealth) projects in Africa. BMC Public Health, 14, 188.*
- *Bastawrous, A., & Armstrong, M. J. (2013). Mobile health use in low- and high-income countries: An overview. Globalization and Health, 9, 36.*
- *Brooke, J. (1996). SUS: A "quick and dirty" usability scale. In P. W. Jordan, B. Thomas, B. A. Weerdmeester, & I. L. McClelland (Eds.), Usability evaluation in industry (pp. 189–194). London: Taylor & Francis.*

- *Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 319–340.*
- *Free, C., Phillips, G., Watson, L., Galli, L., Felix, L., Edwards, P., Patel, V., & Haines, A. (2013). The effectiveness of mobile-health technologies to improve health care service delivery processes: A systematic review and meta-analysis. PLoS Medicine, 10(1), e1001363.*
- *Gibson, D. G., Pereira, A., Farrenkopf, B. A., Labrique, A. B., Pariyo, G. W., & Hyder, A. A. (2017). Mobile phone surveys for collecting population-level estimates in low- and middle-income countries: A literature review. Journal of Medical Internet Research, 19(5), e139.*
- *GSMA. (2020). The Mobile Economy: Asia Pacific 2020. London: GSMA.*
- *International Telecommunication Union & World Health Organization. (2012). National eHealth strategy toolkit. Geneva: ITU/WHO.*
- *Kreuter, M. W., & McClure, S. M. (2004). The role of culture in health communication. Annual Review of Public Health, 25, 439–455.*
- *Labrique, A. B., Vasudevan, L., Kochi, E., Fabricant, R., & Mehl, G. (2013). mHealth innovations as health system strengthening tools: 12 common applications and a visual framework. Global Health: Science and Practice, 1(2), 160–171.*
- *Mechael, P., Batavia, H., Kaonga, N., Searle, S., Kwan, A., Goldberger, A., Fu, L., & Ossman, J. (2010). Barriers and gaps affecting mHealth in low and middle income countries: A policy white paper. New York: Columbia University, Earth Institute.*
- *Nielsen, J. (1994). Usability engineering. San Diego, CA: Academic Press.*
- *Patel, N., Chittamuru, D., Jain, A., Dave, P., & Parikh, T. (2010). Avaaj Otalo: A field study of an interactive voice forum for small farmers in rural India. Proceedings of ICTD 2010, 1–9.*
- *Piette, J. D., List, J., Rana, G. K., Townsend, W., Striplin, D., & Heisler, M. (2015). Mobile health devices as tools for worldwide cardiovascular risk reduction and disease management. Circulation, 132(21), 2012–2027.*
- *Sacks, J. A., Zehe, E., Redick, C., Bah, A., Cowger, K., Camara, M., Diallo, A. O., ... & Hyder, A. A. (2015). Introduction of mobile health tools to support Ebola surveillance and contact tracing in Guinea. Global Health: Science and Practice, 3(4), 646–659.*
- *Tomlinson, M., Rotheram-Borus, M. J., Swartz, L., & Tsai, A. C. (2013). Scaling up mHealth: Where is the evidence? PLoS Medicine, 10(2), e1001382.*
- *Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 27(3), 425–478.*
- *World Health Organization. (2018). Early Warning, Alert and Response (EWAR) in emergencies: Implementation guide. Geneva: WHO.*
- *World Health Organization. (2019). Integrated Disease Surveillance and Response (IDSR) Technical Guidelines (3rd ed.). Brazzaville: WHO Regional Office for Africa.*
- *Zhang, Z., Hao, J., & Wang, D. (2019). Speech recognition for low-resource languages: A survey. IEEE Access, 7, 129-515–129-531.*