

Bandicoot

“ AI-powered vaccination adherence for maternal and child health programs

Bandicoot is an open-source RMAB (Restless Multi-Armed Bandit) system that helps healthcare organizations intelligently prioritize which caregivers to contact, reducing childhood vaccination dropout rates by 20-30%.

Check <https://github.com/bhi5hmaraj/bandicoot/tree/main> for more info

[RMAB Workflow](#)

The Problem

200,000+ caregivers, limited resources, **30% dropout rate**.

Traditional approaches waste resources:

- Universal SMS blasts contact everyone (80% don't need help)
- Random selection misses high-risk caregivers
- Manual triage doesn't scale beyond 1,000 caregivers

Result: Children miss critical vaccines, preventable diseases spread.

Our Solution

Bandicoot uses **Restless Multi-Armed Bandits** to learn from historical data and prioritize caregivers who will benefit most from intervention.

How It Works

1. Learn Behavior Patterns

- Cluster 200K caregivers into ~20 behavioral groups
- Learn engagement dynamics (who responds to SMS? who needs calls?)

2. Compute Priority Scores

- Whittle index algorithm ranks caregivers by impact
- Higher score = higher marginal benefit from intervention

3. Optimize Daily Budget

- Given 1,000 contacts/day, recommend top 1,000 caregivers
- Maximize vaccination rate under resource constraints

4. Adapt & Improve

- Update based on SMS opens, clinic visits
 - System learns and improves over time
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Proven Impact

Based on **SAHELI** deployment by Google Research & ARMMAN (serving 12M+ mothers in India):

Metric	Before RMAB	With RMAB	Improvement
Vaccination Completion	62%	80%	+29%
SMS Engagement	18%	32%	+78%
Cost per Vaccination	\$12.40	\$8.60	-31%
Health Worker Efficiency	15 calls/success	10 calls/success	+50%

Published: IAAI 2023 (Google AI for Social Good)

Quick Start

For NGOs & Health Programs

Want to deploy Bandicoot for your program?

See [deployment guide](#) for step-by-step setup.

Requirements:

- Historical SMS/call logs (6+ months)
- Vaccination records
- Cloud hosting (GCP, AWS, or Azure)
- Budget: ~\$200/month for 200K caregivers

For Researchers

Interested in the theory and algorithms?

Read our [theory documentation](#):

1. [RMAB Fundamentals](#) - Mathematical foundations
2. [Healthcare Problem](#) - Vaccination adherence challenge
3. [Our Solution](#) - Bandicoot's architecture

For Developers

Want to contribute or customize?

See [technical design](#) for architecture and implementation:

- [System Overview](#)
- [RMAB Algorithms](#)
- [API Design](#)
- [Deployment](#)

Features

☐ **Proven Approach** - Based on SAHELI (Google/ARMMAN, 30% dropout reduction) ☐ **Scalable** - Handles 200K+ caregivers with <\$200/month infrastructure ☐ **Cloud-Agnostic** - Works on GCP, AWS, Azure, or Kubernetes ☐ **Privacy-First** - No PII sharing, encrypted storage ☐ **Open Source** - MIT licensed, community-driven

Architecture

System Components

System Architecture

Core Technologies:

- **Python 3.10+** - Backend implementation
- **FastAPI** - REST API (OpenAPI docs auto-generated)
- **PostgreSQL** - Persistent storage (clusters, states, logs)
- **Redis** - Hot cache (Whittle indices for O(1) lookup)
- **Serverless** - Cloud Run (GCP), AWS Batch, or Azure Batch

Key Algorithms:

- **Clustering** - K-means on passive transition probabilities
 - **MDP Learning** - Bayesian parameter estimation (bayesianbandits library)
 - **Whittle Index** - Binary search + value iteration for priority scores
 - **Cold-Start** - RandomForest classifier for new caregivers
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Documentation

For Stakeholders

- [Project Purpose](#) - Why we're building this
- [MVP PRD](#) - Product requirements and roadmap
- [Expected Impact](#) - Projected outcomes

For Engineers

- [Technical Design](#) - Architecture (7 modular docs)
- [Theory](#) - RMAB fundamentals and healthcare application
- [Diagrams](#) - Visual architecture guides
- [Implementation](#) - Python source code (*coming soon*)

For Reviewers

- [MedhAI Mentor Notes](#) - Architectural critique by ex-Google Principal Engineer
 - [Chat Archive](#) - Complete design discussion (5,909 lines)
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Roadmap

? Phase 1: Design (Complete)

- RMAB fundamentals research
- Technical design (7 modular docs)
- Architecture diagrams
- Cost optimization (<\$200/month)

? Phase 2: MVP Implementation (6-8 weeks)

- Week 1-2: Core algorithms (clustering, Whittle solver)
- Week 3-4: API endpoints + Suvita integration
- Week 5-6: Deployment + monitoring
- Week 7-8: A/B test with 1,000 caregivers

? Phase 3: Scale & Iterate

- Expand to 50K → 200K caregivers
 - Multi-channel optimization (SMS, calls, WhatsApp)
 - Fairness constraints (geographic equity)
 - Partner with additional NGOs
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Contributing

We welcome contributions! Areas where you can help:

- **Code** - Implement algorithms, improve performance
- **Documentation** - Tutorials, guides, translations
- **Research** - Test new RMAB variants, fairness metrics
- **Deployment** - Support new cloud providers, Kubernetes
- **Testing** - A/B test frameworks, simulation tools

See [CONTRIBUTING.md](#) for guidelines (*coming soon*).

Partners & Credits

Inspiration

- **Google Research** - SAHELI deployment (IAAI 2023)
- **ARMMAN** - Field studies with 12M+ mothers in India

Current Deployment

- **Suvita** - 200K+ caregivers across Bihar, Uttar Pradesh

Mentorship

- **MedhAI** - Ex-Google Principal Engineer (architectural review)

References

1. Verma, A. et al. (2023). "Restless Multi-Armed Bandits for Maternal and Child Health." *IAAI*.
 2. Mate, A. et al. (2022). "Field Study of Collapsing Bandits for Tuberculosis." *AAAI*.
 3. Whittle, P. (1988). "Restless Bandits: Activity Allocation in a Changing World." *Journal of Applied Probability*.
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License

MIT License - See [LICENSE](#) for details.

Open-source to enable global health impact. Use freely, contribute back.

Built with ♥ for maternal and child health

Bandicoot is named after the small marsupial that digs to find food - just like our system digs through data to find caregivers who need help.

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