Supplementary File 2

Outcome definitions, measurement schedule and data-collection instruments

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Companion to: Implementing a competency-based Advanced Field Epidemiology Training Programme in Sierra Leone: protocol for a mixed-methods pilot evaluation

1. Measurement principles

- Definitions, denominators, timing, evidence source and analysis role are fixed before enrolment.
- The IRET owns research instruments, independent fidelity measurement, source verification, adjudication, data locks, analysis and dissemination. Programme delivery and assessment personnel provide records but do not score fidelity or view confidential voluntary responses.
- Overall implementation fidelity at Month 24 is the single primary outcome. Field-practice attainment, retention, acceptability, appropriateness, perceived feasibility and primary-data completeness are key secondary outcomes. Other measures remain secondary, exploratory, process or non-negotiable conditions.
- Implementation, educational, service, economic, equity and safety outcomes remain distinct.
- Resident academic records and voluntary research responses use separate access permissions.
- No authentic outbreak or resident-project patient identifier enters the evaluation dataset.
- Small groups are protected through suppression and careful quotation review.
- Every instrument receives a version, owner, administration guide, scoring rule and change log.

2. Outcome dictionary

Code	Outcome	Operational definition	Source	Timing	Role
O01	Reach	Number enrolled divided by number eligible and offered a place; distribution by geography, profession, sector, gender and other approved equity variables.	Recruitment and enrolment register	Pre-launch/Month 0	Secondary implementation outcome
O02	Site adoption	Number of eligible sites accredited and active divided by number invited; reasons for non-adoption or withdrawal.	Site register and interviews	Pre-launch; Month 12; Month 24	Secondary implementation outcome
O03	Overall fidelity	Number of due and applicable components independently verified as meeting their prespecified standard divided by due and applicable components at Month 24; all 20 components and every critical component reported separately.	IRET Instrument I07 fidelity assessment and verification package linked to registered programme source records	Prelaunch readiness; quarterly; final Month-24 lock	Primary implementation outcome
O04	Field-practice attainment	Proportion of residents completing at least 68 qualifying supervised field-practice weeks by Month 24 or approved completion window.	Verified field-week log	Monthly; Month 24	Key secondary feasibility outcome
O05	Retention	Proportion of enrolled residents active at Months 12 and 24; reasons and timing of interruption or withdrawal.	Cohort register	Continuous; Month 12; Month 24	Key secondary feasibility outcome
O06	Acceptability	Mean and distribution of the four-item AIM score among residents, mentors, supervisors and faculty.	AIM survey	Months 6, 12, 18 and 24	Key secondary implementation outcome
O07	Appropriateness	Mean and distribution of the four-item IAM score among residents, mentors, supervisors and faculty.	IAM survey	Months 6, 12, 18 and 24	Key secondary implementation outcome
O08	Perceived feasibility	Mean and distribution of the four-item FIM score among residents, mentors, supervisors and faculty.	FIM survey	Months 6, 12, 18 and 24	Key secondary implementation outcome
O09	Data completeness	Available required primary-data fields divided by expected required fields, by instrument and timepoint.	Data-quality dashboard	Quarterly	Key secondary study-process outcome
O10	Instructional dose	Sessions and practical exercises delivered divided by planned; resident participation and low-bandwidth substitutions.	Session and exercise register	Monthly/quarterly	Fidelity component
O11	Mentorship dose	Completed documented mentor contacts divided by planned monthly contacts; quarterly review completion and feedback timeliness.	Mentor log and portfolio system	Monthly/quarterly	Fidelity and secondary outcome
O12	Progression review fidelity	Formal progression reviews completed on time with required evidence and documented decisions.	Progression records	Months 6, 12, 18 and 24	Fidelity component

Code	Outcome	Operational definition	Source	Timing	Role
O13	Portfolio completion	Proportion completing all eight field-product categories with every critical criterion at competent level or above.	Portfolio and rubric database	Months 18, 24 and completion window	Educational outcome
O14	Field-product quality	Criterion and total scores on the common four-point rubrics; distribution by product, site and review point.	Assessor rubrics	Continuous; Months 12, 18 and 24	Educational outcome
O15	Outbreak evidence	Number of authentic investigations per resident; proportion completing two; proportion leading at least one analytic investigation; quality and timeliness.	FP2 evidence map and outbreak records	Continuous; Month 24	Key educational/service outcome
O16	Research milestone attainment	Proportion meeting each of 13 research, thesis/dissertation and publication milestones within the permitted window.	Milestone register	Months 5–24	Key educational outcome
O17	Thesis/dissertation completion	Proportion receiving independent approval after defence and corrections by Month 24 or approved completion window.	Examination and repository records	Months 23–24	Key graduation outcome
O18	Internal/national publications	Number and proportion producing two accepted or published articles through defined internal or national editorial channels from distinct field products.	Editorial and publication records	Months 12, 18, 24 and 30	Key dissemination outcome
O19	Peer-reviewed manuscript	Proportion with a lead-author manuscript independently certified and submitted; acceptance/publication status through Month 30.	Manuscript, submission and journal records	Months 22, 24 and 30	Key dissemination outcome
O20	Policy and scientific dissemination	Proportion completing a policy/decision brief and an oral or poster presentation; audience feedback.	Portfolio and event records	Months 18–24	Dissemination outcome
O21	Competency change	Change in scenario-based applied knowledge/reasoning score and calibrated workplace entrustment ratings from baseline.	Applied assessment and competency record	Months 0, 12 and 24	Exploratory educational outcome
O22	Assessor agreement	Weighted kappa for ordinal critical-criterion decisions and two-way random-effects absolute-agreement ICC for composite scores on double-rated products.	Paired assessor rubrics	Calibration and throughout	Exploratory assessment-quality outcome
O23	Recommendation uptake	Resident recommendations accepted, initiated or completed within six months, divided by recommendations with a named decision owner and follow-up plan.	Management response and verification log	Continuous; Month 24 and 30	Service outcome
O24	Verified system contribution	Count and description of independently verified changes to surveillance, response, programmes, policy, data systems or workforce linked to resident work.	Document review and decision-maker interviews	Months 24 and 30	Service contribution outcome
O25	Implementation and programme cost	Total and component cost; cost per enrolled resident, retained resident, graduate, completed product, outbreak investigation, publication and thesis/dissertation.	Time and cost ledger	Monthly; Months 12, 24 and 30	Economic outcome
O26	Equity of exposure and outcomes	Descriptive differences in field opportunities, mentor contact, product completion, progression and completion across approved equity strata; small cells suppressed.	Linked programme and survey data	Quarterly; Month 24	Cross-cutting equity outcome
O27	Safety, safeguarding and integrity	Number, type, severity, response time and resolution of field-safety, privacy, coercion, retaliation, assessment-integrity or scientific-integrity events.	Incident and safeguarding log	Continuous	Non-negotiable condition, not a graded outcome
O28	Sustainability readiness	Domestic financing, local faculty share, mentor retention, governance integration, field-site continuation, curriculum maintenance and graduate deployment readiness.	Sustainability scorecard and interviews	Months 18, 24 and 30	Secondary implementation outcome

3. Data-collection schedule

Source	Population	Baseline/ M0	M6	M12	M18	M22-23	M24	M30	Outcomes
Recruitment/eligibility register	Programme applicants and residents	Pre-launch/Month 0							O01
Resident baseline profile and applied assessment	Residents	Month 0		Month 12			Month 24		O01, O21, O26
Field-week, deployment and attendance logs	Residents/sites	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Month 30 verification	O03, O04, O05, O10, O15
Mentor and supervisor contact logs	Residents/mentors/supervisors	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly		O03, O11
AIM/IAM/FIM and experience survey	Residents, mentors, supervisors, faculty		Month 6	Month 12	Month 18		Month 24		O06–O08, O26

Source	Population	Baseline/ M0	M6	M12	M18	M22-23	M24	M30	Outcomes
Field-product rubrics and portfolio evidence	Residents/assessors	Continuous	Month 6	Month 12	Month 18	Continuous	Month 24	Month 30 follow-up	O13–O20, O22
Research/thesis/publication milestones	Residents/supervisors	Month 5 onward	Month 6	Month 12	Month 18	Month 22–23	Month 24	Month 30	O16–O20
CFIR-informed interviews	Purposive stakeholders	Pre-launch	Month 6	Month 12	Month 18		Month 24	Month 30	O02, O06–O08, O24, O28
Focus groups	Residents/mentors/supervisors			Month 12			Month 24		O06–O08, O11, O26
Independent fidelity assessment, source verification and adaptation audit	IRET using programme source records; programme staff respond only to factual queries	Pre-launch	Quarterly	Quarterly	Quarterly	Quarterly	Month 24	Month 30	O03, O10–O12, O27, O28
Cost and resource-use ledger	Programme/evaluation team	Pre-launch	Monthly	Monthly	Monthly	Monthly	Monthly	Month 30 close-out	O25
Management response/system contribution verification	Decision-makers/products			Continuous	Continuous	Continuous	Month 24	Month 30	O23, O24
Safety, safeguarding and integrity log	All stakeholder groups	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Month 30 close-out	O27

Residents who interrupt or withdraw remain in cohort-flow and programme-record denominators. Later surveys, interviews or recontact occur only when prior consent, safety and ethics arrangements permit; refusal or withdrawal from research does not alter programme status.

4. Instrument catalogue

ID	Instrument	Respondent/source	Content	Timing
I01	Eligibility and enrolment form	Applicants/residents	Baseline demographics, professional background, geography, prior skills, access and equity variables	Month 0
I02	Applied knowledge and reasoning assessment	Residents	Scenario-based surveillance, outbreak, study design, analysis, ethics, communication and leadership reasoning	Months 0, 12, 24
I03	AIM/IAM/FIM survey	Residents, mentors, supervisors, faculty	Validated four-item acceptability, appropriateness and feasibility measures; 1–5 agreement response	Months 6, 12, 18, 24
I04	Resident experience, workload and support survey	Residents	Protected time, field opportunity, mentorship, access, wellbeing, safety, equity and remediation experience	Months 6, 12, 18, 24
I05	Mentor/supervisor delivery survey	Mentors and supervisors	Caseload, contact dose, feedback timeliness, support, barriers, opportunity and programme fit	Quarterly
I06	Field-site readiness/accreditation checklist	Sites and programme quality team	Twelve criteria with critical pass/fail and scored domains	Pre-launch, Month 12, Month 24
I07	Fidelity assessment and verification package	Independent Research and Evaluation Team using registered programme source records	Twenty-component assessment form, source-evidence register, independent second-review form, discrepancy/adjudication log, programme factual-query record, quarterly data lock and dashboard	Prelaunch readiness; quarterly; final Month-24 lock; Month-30 follow-up verification
I08	Field-product rubric set	Residents/assessors	Common and product-specific four-point criteria, critical fail rules and resident ownership	Throughout
I09	Research/thesis/publication milestone form	Residents/supervisors/committee	Thirteen milestones, evidence, decision, delay reason and recovery plan	Months 5–24
I10	CFIR interview guide	Residents, mentors, supervisors, faculty, managers and decision users	Determinants, mechanisms, adaptations, benefits, harms, equity, sustainability and scale-up	Pre-launch, Months 6, 12, 18, 24, 30
I11	Focus-group guide	Residents, mentors and supervisors	Shared experience of delivery, field opportunity, workload, learning, support and improvement	Months 12 and 24
I12	Adaptation log	Programme adaptation focal point; IRET verifier	FRAME/FRAME-IS fields completed by programme staff and independently verified against core-function and fidelity records	At change; quarterly review
I13	Safety, safeguarding and integrity event form	All stakeholders	Type, severity, immediate protection, notification, investigation, corrective action and closure	Continuous

ID	Instrument	Respondent/source	Content	Timing
I14	Recommendation and system-contribution verification form	Decision-makers; IRET verification team	Recommendation owner, decision, implementation status, evidence and contribution narrative	Continuous; Months 24 and 30
I15	Time and cost log	Programme/finance actors; IRET health economist	Actor, activity, duration, resource, quantity, unit cost, payer and cost classification	Monthly

5. Instrument I01: eligibility and enrolment form

Section	Required fields
Administrative	study resident code; programme resident code held separately; application status; offer; enrolment date; site; mentor; supervisor.
Professional	profession/discipline; highest qualification; years of relevant experience; employer; sector; current role; supervisory responsibility.
Geography and equity	usual work location; region/district category; sex/gender variables approved by ethics; disability/accommodation need; language; other nationally approved equity variables.
Baseline capability	descriptive epidemiology; spreadsheet use; statistical software; scientific reading/writing; presentation; surveillance; outbreak experience; research experience; publication experience.
Readiness	employer agreement; protected time; deployment permission; field site; secure device; connectivity/offline plan; data access; mentor; bridging plan.
Research participation	consent status for surveys, interviews, record linkage and recontact, recorded separately from programme admission.

6. Instrument I02: applied knowledge and reasoning assessment blueprint

Domain	Applied task	Weight
Surveillance/intelligence	Interpret signals, data quality, thresholds, bias and action; design an improvement.	20%
Outbreak investigation	Set objectives, case definition, design, analysis, control, communication and safety.	20%
Study/evaluation methods	Select design, sampling, causal approach, bias control, implementation and interpretation.	15%
Analytics/GIS/informatics	Choose methods, diagnose errors, communicate uncertainty, protect reproducibility and privacy.	15%
Laboratory/One Health/preparedness	Integrate testing, specimens, sectors, risk assessment and incident functions.	10%
Ethics/equity/governance	Distinguish practice/research, apply proportionality, privacy, fairness and scientific integrity.	10%
Leadership/communication/teaching	Manage teams, translate evidence, respond to misinformation and give feedback.	10%

Administration: two equivalent forms, 90-120 minutes, open-resource only when specified, scored by a keyed analytic rubric. The assessment supports change estimates and learning diagnosis; it cannot replace workplace evidence.

Assessment development and validity

Instrument I02 is blueprint based on the 102 terminal outcomes and the programme competency architecture. Two equivalent scenario forms receive expert content review, cognitive testing and pilot administration with non-cohort users before launch. The assessment supports diagnosis and change estimates but cannot replace authentic workplace evidence. Field-product and thesis decisions use common and product-specific rubrics, direct observation, resident-contribution evidence, oral defence, assessor calibration and independent double rating. The validity argument examines blueprint coverage, task authenticity, scoring, generalization, extrapolation and decision consequences [44-46].

7. Instrument I03: AIM, IAM and FIM administration

Use the original validated four-item Acceptability of Intervention Measure, Intervention Appropriateness Measure and Feasibility of Intervention Measure unchanged and cite the validation source [28]. Each item uses a five-point agreement response. Compute each measure as the mean of answered items when at least three of four items are present; otherwise set the score missing. Report item distributions, scale means and internal consistency by stakeholder group and wave. Do not merge the three constructs into one score.

The programme object should be named consistently in the survey: “the Advanced Field Epidemiology Training Programme as delivered in this pilot.” Add one open question after each scale: “What most influenced your rating?”

8. Instrument I04: resident experience, workload and support survey

Protected time and workload

1. I receive the protected field and study time in my agreement.
2. Routine duties leave enough time for programme requirements.
3. The workload is manageable without unsafe or persistently excessive hours.

4. Research and thesis work receive protected time during year 2.

Field opportunity

5. My site provides meaningful surveillance or public health intelligence work.
6. I receive fair access to outbreak or urgent investigation opportunities.
7. I can present recommendations to decision-makers.
8. I can complete the required field products at my placement or through arranged rotations.

Mentorship and feedback

9. My technical mentor is accessible when needed.
10. Feedback is timely, specific and linked to standards.
11. My workplace supervisor protects access and service responsibility.
12. I can obtain specialist support for complex methods or ethics.

Learning and assessment

13. Structured sessions prepare me for field work.
14. Assessment standards are clear before submission.
15. Assessors judge evidence consistently.
16. Remediation is supportive, documented and fair.
17. I can appeal a decision without retaliation.

Research and publication

18. My research question addresses a public health decision.
19. Data, approvals and supervision are available on time.
20. I understand authorship and publication expectations.
21. Internal editorial channels provide useful review.
22. The peer-reviewed manuscript pathway is feasible within available support.

Equity, safety and wellbeing

23. Opportunities are allocated fairly across residents and sites.
24. I can request reasonable accommodation.
25. I know how to report safety, privacy, coercion or retaliation concerns.
26. I trust the confidential reporting route.
27. The programme responds to wellbeing needs.

Response scale: 1 strongly disagree, 2 disagree, 3 neither, 4 agree, 5 strongly agree, plus not applicable. Additional fields: weekly hours by activity; days away from home; missed field opportunities; support requested; support received; one most helpful feature; one priority change; optional confidential follow-up request stored separately.

9. Instrument I05: mentor and supervisor delivery survey

28. Number of assigned residents and expected contact frequency.
29. Contacts planned/completed and median feedback turnaround.
30. Time spent in technical review, wellbeing support, administration and escalation.
31. Access to resident products, data and site decision-makers.
32. Adequacy of mentor preparation, specialist support and recognition.
33. Observed field opportunity, protected time and workload barriers.
34. AIM, IAM and FIM measures for the programme as delivered.
35. Any safety, integrity, authorship, equity or conflict concern and action taken.
36. One adaptation that protected core function and one unresolved delivery need.

10. Instrument I06: field-site readiness and accreditation checklist

Criterion	Minimum evidence	Class
Institutional mandate	Site performs surveillance, response, programme, laboratory, data or One Health functions relevant to Advanced field epidemiology.	Critical
Field opportunities	Site can provide routine surveillance work and access to authentic investigations, evaluations or rotations.	Critical
Named supervision	A qualified workplace supervisor accepts written responsibilities and protected contact time.	Critical
Data access and governance	Site can authorize resident access to appropriate data under approved privacy, security and sharing arrangements.	Critical
Decision-maker access	Residents can present findings and obtain documented management response or follow-up.	Critical
Safety and safeguarding	Risk assessment, field safety, incident reporting, non-retaliation and wellbeing procedures operate.	Critical
Research feasibility	Site supports research/thesis access, permissions and protected implementation time.	Scored
Laboratory and specialist linkage	Site can connect residents to necessary laboratory, GIS, informatics, One Health or other specialists.	Scored

Criterion	Minimum evidence	Class
Digital and physical infrastructure	Secure computing, data storage, connectivity or workable offline alternatives exist.	Scored
Equitable opportunity	Site allocates outbreak, leadership, publication and research opportunities transparently.	Critical
Operational support	Travel, communication, printing, specimen or field resources can be mobilized when required.	Scored
Quality participation	Site accepts monitoring, feedback, adaptation logging and accreditation renewal.	Critical

Scoring fields: evidence reviewed; score 0/1/2 for scored criteria or pass/fail for critical criteria; gap; owner; due date; verification; accreditation decision; review date; reviewer conflicts.

11. Instrument I07: independent fidelity assessment and verification package

ID	Component	Operational standard	Class
F01	Governance active	Steering, programme, assessment, research/thesis, independent research/evaluation and safeguarding functions have approved terms of reference; governance bodies meet at least quarterly and IRET conflicts remain resolved.	Critical
F02	Ethics and institutional authorization	Written SLESRC determination, NPHA authorization and approved amendments precede IRET research data collection.	Critical
F03	Financing and operational readiness	Core programme and independent evaluation costs for the first 12 months are committed before cohort launch, with a documented continuity plan.	Critical
F04	Field sites accredited	All eight placement sites meet every critical criterion and at least 80% of scored readiness criteria before resident placement.	Critical
F05	Resident and host agreements	Every resident and host institution completes protected-time, data-access, deployment, supervision and publication agreements.	Core
F06	Faculty and mentor preparation	At least 90% of assigned faculty, mentors, supervisors and assessors complete required preparation before role assumption.	Core
F07	Modules delivered	All 17 modules receive the planned facilitated, practice and field-transfer components or approved fidelity-preserving adaptations.	Core
F08	Sessions delivered	At least 85% of 70 planned sessions are delivered within the permitted schedule.	Core
F09	Exercises delivered	At least 85% of 36 planned practical exercises are completed with feedback.	Core
F10	Field-practice opportunity and supervision delivered	Every active resident receives an accredited placement, protected field time, qualifying assignments, named supervision and a verified field-week recording system throughout the planned period; gaps trigger programme corrective action.	Critical
F11	Named mentorship and supervision	Every active resident has a named technical mentor and workplace supervisor throughout placement.	Critical
F12	Mentor contacts	At least 80% of planned monthly mentor contacts and quarterly formal reviews are documented.	Core
F13	Progression reviews	At least 90% of due progression reviews occur within four weeks of the planned month and record evidence, decision and actions.	Core
F14	Portfolio assessment	Every resident receives rubric-based assessment for all products due by each progression point; critical failures trigger remediation.	Critical
F15	Outbreak opportunity and evidence	Every resident receives two authentic investigation opportunities or a documented programme-led corrective placement; at least one investigation permits resident analytic leadership.	Critical
F16	Research governance by Month 12	At least 80% of active residents receive protocol-defence approval and ethics/data-governance authorization by Month 12 or an approved recovery deadline.	Core
F17	Year-2 research protection	Residents receive planned protected time and access for implementation, analysis and writing during Months 13–23.	Core
F18	Publication pathway	Each resident receives publication mentorship, approved internal channels, journal-legitimacy screening and editorial tracking.	Core
F19	Assessment calibration	All high-stakes assessors complete calibration; every thesis/dissertation and at least 25% of other products receive independent double rating.	Core
F20	Adaptation, cost and quality tracking	Quarterly adaptation logs, cost ledgers, data-quality audits, independently verified fidelity datasets, signed data locks and programme feedback cycles are complete.	Core

Table S2.1. Component-level implementation fidelity measurement matrix

ID	Fidelity dimension	Unit/level	Numerator and denominator	Primary evidence/tool	Timing and independent verification
F01	Governance adherence and quality	Required governance bodies due	Bodies meeting with complete terms, minutes and decisions / bodies due	Approved terms, signed minutes, attendance and decision log	Quarterly; IRET extraction and two-reviewer verification
F02	Ethics adherence	Research authorization requirements	Required approvals and amendments present before collection / requirements due	SLESRC/NPHA letters, amendment register, research start log	Prelaunch and each amendment; two-source verification
F03	Readiness adherence	Programme level	Eligible first-year resources committed and continuity plan present / required package	Signed budgets, commitment records, continuity plan and ledger	Prelaunch; quarterly verification
F04	Reach and adherence	Eight field sites	Sites passing all critical and at least 80% scored criteria / 8 sites	I06 checklists, source evidence and accreditation decisions	Preplacement, M12 and M24
F05	Reach and adherence	Residents and host institutions	Complete agreements / 15 residents and all host institutions due	Signed agreement register and exception log	Preplacement; M6 and M12 review
F06	Reach, dose and quality	Assigned programme actors	Actors completing required preparation / actors assigned	Training register, attendance, knowledge check and calibration results	Before role; refresh M6, M12 and M18
F07	Content adherence and adaptation	17 modules	Modules with facilitated, practice and field-transfer elements or approved adaptation / 17	Module plans, materials, registers, field-transfer evidence and I12 ID	Quarterly
F08	Dose and timeliness	70 planned sessions due	Sessions delivered within schedule / sessions due	Session register, agenda, attendance or platform extract	Monthly; quarterly lock
F09	Dose and quality	36 practical exercises due	Exercises completed with recorded feedback / exercises due	Exercise archive, feedback record and completion register	Monthly; quarterly lock
F10	Adherence, dose and reach	Active resident-placement months	Resident-placement months with accredited placement, protected field time, qualifying assignments, named supervision and an operational verified field-week system / active resident-placement months due	Placement and workplan records, assignment letters, supervisor logs, field-week-system audit and corrective-action records	Monthly; quarterly IRET extraction and independent second review; final Month-24 verification
F11	Reach and continuity	Active residents	Residents with named mentor and workplace supervisor throughout period / active residents	Assignment letters, change register and contact logs	Monthly
F12	Dose and quality	Planned mentor contacts and reviews	Completed documented contacts and reviews / contacts and reviews due	Mentor log, feedback record and quarterly review form	Monthly; quarterly
F13	Timeliness and quality	Formal reviews due	Reviews within four weeks with evidence, decision and actions / reviews due	Progression forms, evidence checklist and minutes	M6, M12, M18 and M24
F14	Assessment adherence and quality	Products due for assessment	Due products receiving rubric assessment and remediation when required / products due	Portfolio platform, signed rubrics, ownership evidence and remediation log	Quarterly; progression points
F15	Reach and content adherence	15 residents	Residents with two authentic opportunities and one analytic leadership role / enrolled cohort	Deployment orders, role statements, protocols, analyses, reports and after-action records	Continuous; M24
F16	Reach and timeliness	Active residents at M12	Residents with protocol defence and ethics/data-governance authorization or approved recovery date / active residents	I09 milestone form, committee decision and authorization letter	Month 12
F17	Dose and quality	Active residents during M13-23	Residents receiving protected time and required access / active residents	Approved workplans, workload survey, supervisor log and access record	Monthly; quarterly
F18	Reach and quality	Active residents	Residents receiving publication mentor, internal channel, journal screen and editorial tracking / active residents	Mentor assignment, editorial log, journal screen and correspondence	Quarterly; M24
F19	Quality assurance	High-stakes assessors and products	Calibrated assessors / assigned assessors; independently double-rated products / products required	Preparation register, calibration results and paired rubrics	Before role; quarterly
F20	Adherence and quality control	Quarterly control cycles due	Complete adaptation, cost, data-quality, fidelity-lock and feedback cycles / cycles due	I12 log, cost ledger, data-quality dashboard, signed I07 lock and action log	Quarterly

Implementation fidelity is the extent to which the intervention and implementation strategies are delivered, received and documented as prespecified while approved adaptations preserve core functions [33,43]. I07 assesses adherence/content, dose/timeliness, reach/coverage, quality, responsiveness and fidelity-preserving adaptation. It contains the component assessment form, source-evidence register, independent verification form, discrepancy/adjudication log, programme factual-query record, signed quarterly lock and dashboard.

Each quarter, one trained IRET reviewer extracts the numerator, denominator, due/applicable status and evidence identifiers for every component. A second IRET reviewer independently verifies all 20 components. Reviewers resolve differences by source review; a third IRET adjudicator decides unresolved cases. Programme record owners receive five working days to correct factual extraction errors but do not select the score. Critical components require an official primary source and, when available, corroboration; self-report alone cannot establish them. Status values are met, partial, not met, unknown, not due and not applicable. Partial, unknown and disputed status count as not met in the primary analysis. Not-due items are excluded. Not-applicable status is rare and requires written IRET approval. The IRET lead signs and locks the dataset; later changes create an auditable new version.

Source evidence hierarchy and recording

Primary evidence consists of signed official records or secure system extracts created in the normal course of programme delivery. Corroborating evidence includes registers, minutes, portfolio records, logs or independently verified documents. Survey and interview accounts explain quality, responsiveness and context but do not alone establish a critical component. Each I07 row records quarter, component, dimension, programme or site level, due/applicable status, numerator, denominator, status, evidence IDs, source type, source date, reviewer 1, reviewer 2, adjudicator, discrepancy, adaptation ID, data-quality issue, programme factual response, corrective action, owner, due date, lock date and IRET sign-off.

12. Instrument I08: common field-product rubric

Criterion	Competent Advanced-level standard
Public health relevance	Addresses a defined priority and decision, involves the correct stakeholders and states intended use.
Technical validity	Uses a suitable design, data, methods, analysis and interpretation; identifies bias and uncertainty.
Reproducibility and documentation	Maintains protocols, dictionaries, code, decision logs, source evidence and version control where relevant.
Ethics, equity and governance	Uses the correct approval route, protects people/data, considers equity and manages conflicts or dual use.
Leadership and collaboration	Shows planning, role clarity, teamwork, supervision, accountability and resident ownership.
Actionability and use	Provides feasible recommendations, named decision owners and documented management response or follow-up.
Communication quality	Produces clear, accurate, audience-appropriate written, oral and visual outputs.
Reflection and improvement	Records limitations, feedback, changes, learning and implications for future practice.

Scale: 1 unsafe/invalid; 2 below standard and substantial revision needed; 3 competent for independent Advanced-level practice; 4 exemplary and suitable as a model. Each product declares critical criteria before assessment. A product passes only when every critical criterion scores at least 3 and evidence of resident ownership is credible.

FP2 additions: authenticity; timeliness; analytic leadership; response value; field safety; after-action learning. FP7 additions: editorial acceptance for two internal/national articles; distinct source products; legitimate-journal screen; lead authorship; reporting checklist; submission evidence; policy brief; scientific presentation; authorship and conflict disclosures.

13. Instrument I09: research, thesis and publication milestone form

Code	Target	Milestone	Evidence
R1	Month 5	Priority problem and concept note	Question, public health value, feasibility, initial design and named institutional user.
R2	Month 6	Supervision and field agreement	Research supervisor, field mentor, access plan, protected time, conflict and initial authorship discussion.
R3	Month 8	Evidence synthesis and framework	Reproducible search record, critical synthesis, gap statement and conceptual or causal framework.
R4	Month 10	Full protocol and statistical analysis plan	Objectives, design, variables, sampling, bias control, analysis, dissemination, timeline and budget.
R5	Month 12	Ethics and data-governance authorization	Written approval, waiver or classification; data-access, security, sharing, retention and incident plan.
R6	Month 12	Protocol defence	Multidisciplinary panel approval before field implementation.
R7	Month 15	Implementation and data-quality review	Progress, deviations, quality indicators, safety, corrective action and continued feasibility.
R8	Month 18	Reproducible primary analysis review	Locked dictionary, code, planned analyses, diagnostics, sensitivity work and interpretation log.
R9	Month 19	Results and interpretation seminar	Findings, limitations, equity, stakeholder interpretation and decision implications.
R10	Month 21	Complete thesis/dissertation draft	Full monograph, publication-based dissertation or integrated field-epidemiology thesis.
R11	Month 22	Peer-reviewed manuscript and policy package	Lead-author manuscript, reporting checklist, journal screen, policy brief and submission plan.
R12	Month 23	Independent examination and oral defence	Examiner reports, defence decision and corrections list.

Code	Target	Milestone	Evidence
R13	Month 24	Final approval, repository and publication handover	Corrections completed, final deposit, authorship confirmation and post-graduation editorial follow-up.

Additional fields: status not due/on time/delayed/completed; actual date; reason; dependency; safety or ethics issue; supervisor decision; committee decision; recovery action; owner; due date; verification; resident comment.

14. Instrument I10: CFIR-informed semi-structured interview guide

Domain	Core prompt
Context and priority	What problem does the programme need to solve here? What else competes for attention or resources?
Innovation characteristics	Which components are clear, complex, adaptable or burdensome? Which core functions must not change?
Outer setting	How do policy, accreditation, partner, labour-market, emergency and community conditions affect implementation?
Inner setting	How do leadership, culture, communication, staffing, data, laboratories, digital systems and financing shape delivery?
Individuals	What knowledge, motivation, confidence, role, power or workload affects participation?
Implementation process	How were people engaged, prepared, supported, monitored and given feedback?
Field opportunities	Who receives outbreak, leadership, research and publication opportunities? What explains differences?
Mechanisms and outcomes	How does the programme influence learning, decisions, services, relationships, burden or harm?
Adaptations	What changed, why, who decided, what core function remained, and what result followed?
Equity and safety	Who benefits or bears burden? Are there safety, privacy, coercion, retaliation or inclusion concerns?
Sustainability and scale-up	What resources, policies, roles and evidence are needed to continue or expand? What should stop?

Interviewer preparation, information power and trustworthiness

Interviewers complete preparation in the protocol, ethics, power dynamics, qualitative interviewing, distress response, confidentiality and reflexivity. They do not supervise, assess or vote on progression for their interviewees. Information power is judged from question specificity, sample specificity, dialogue quality, theoretical support and analytic strategy. Credibility uses longitudinal engagement, triangulation, negative cases and bounded stakeholder interpretation; transferability uses detailed context; dependability uses a versioned codebook and audit trail; confirmability uses reflexive records and independent review.

15. Instrument I11: focus-group guide

37. Describe one experience that best represents how learning occurs in the programme.
38. Which parts of the programme connect well to field responsibility, and which feel disconnected?
39. How fair is access to outbreaks, data, mentors, research time, publication and leadership?
40. What makes assessment credible or difficult to trust?
41. How do workload, travel, digital access, family responsibility, safety and wellbeing affect participation?
42. Which adaptation protected learning or service value? Which adaptation weakened a core function?
43. What should the programme keep, change, add or stop before another cohort?

16. Instrument I12: adaptation log fields

Field	Required entry
Identification	Adaptation ID, date detected, date decided, programme/site, component or strategy.
Nature	Planned/reactive; content/context/training/evaluation; addition, removal, substitution, shortening, extension or reordering.
Decision	Who proposed, who approved, people consulted, conflict declaration and urgency.
Rationale	Barrier, facilitator, safety, equity, cost, feasibility, policy, technology, resident need or field opportunity.
Core function	Core function affected; whether preserved; justification and required approval level.
Dose and reach	Who received the change, when, frequency, duration and site coverage.
Expected consequence	Fidelity, learning, service, equity, cost, safety or sustainability effect.
Observed consequence	Evidence, unintended effect, decision to retain/reverse and next review.

17. Instrument I13: safety, safeguarding and integrity event form

Section	Fields
Event	coded event ID; date/time; setting; type; people/records affected; immediate risk; reporter role; confidential route.

Section	Fields
Classification	field injury/exposure; security; harassment/discrimination; coercion/retaliation; wellbeing; privacy/security; assessment; authorship; fabrication/falsification/plagiarism; other.
Severity	near miss; minor; moderate; serious; life-threatening; material breach; unresolved integrity threat.
Immediate action	care/protection; stop activity; secure data; notify authority; preserve evidence; support person; alternative assessor/supervisor.
Review	responsible independent reviewer; conflict management; facts; policy; root cause; people consulted; confidentiality limits.
Corrective action	action, owner, due date, site/programme scope, non-retaliation check, verification and closure.
Reporting	ethics/NPHA/steering notification dates; protocol amendment; aggregate reporting; publication disclosure if required.

18. Instrument I14: recommendation and system-contribution verification

Field group	Required entries
Resident product	resident code; product; recommendation; date; evidence strength; affected programme/system.
Decision pathway	named owner; meeting/presentation; decision accepted/rejected/deferred; reason; resources; implementation lead.
Implementation status	not started, planned, initiated, partially implemented, completed, discontinued; dates and source evidence.
Contribution evidence	document, system extract, policy, revised tool, surveillance metric, response record, training evidence or independent interview.
Attribution caution	other contributors; external events; alternative explanation; resident role; confidence in contribution claim.
Follow-up	six-month status, sustainability, unintended effects and decision-maker verification.

19. Instrument I15: time and cost log

Field	Definition
Actor/resource	role, organization, paid/in-kind, programme or evaluation function.
Activity	implementation strategy, instruction, mentoring, assessment, field investigation, research, publication, governance, safeguarding or evaluation.
Time	date, minutes/hours, number of people, preparation, travel and delivery separated.
Material/service	description, quantity, unit, unit cost, currency, payer, invoice or valuation source.
Classification	recurrent/capital; fixed/variable; programme delivery/implementation strategy/research only; site or central.
Allocation	resident, site, product, outbreak, thesis or publication allocation rule.
Quality	source, verifier, missing estimate, imputation flag and uncertainty range.

20. Data-quality dashboard

Quarterly data-quality fields are expected records, records received, required-field completeness, duplicate rate, date/range errors, identifier mismatch, source-verification result, late forms, unresolved queries, instrument version, correction, owner and closure. The IRET records each query and resolution. Required fields are declared before launch; optional narrative items do not enter the completeness denominator. A locked dataset changes only through a versioned correction record with reason, approver and date.

Version record

1.1 - 21 July 2026: initial prospective protocol package. 1.2 - 17 August 2026: revised outcome hierarchy, assessment development, interviewer preparation, qualitative trustworthiness and costing fields. 1.3 - 17 August 2026: defined I07 as an independent fidelity measurement package; added component dimensions, units, numerators, denominators, evidence sources, two-reviewer verification, adjudication, status rules, data locking and recording fields. The corresponding author will reconfirm study status before upload. 1.4 - 17 August 2026: final audit aligned the key-secondary hierarchy, separated field-practice delivery from resident attainment, and synchronized the two-figure protocol and independent analysis plan.

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