STEPPED-WEDGE CLUSTER RANDOMIZED CONTROLLED TRIAL OF THE PROACTIVE COMMUNITY CASE DETECTION TOOL IN NORTHERN AND WESTERN UGANDA

SWT Analysis Plan

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Reviewed by all listed authors and signed by the following.

Name	Signature	Date
Prof. Dr Mark J.D. Jordans		15.09.2022
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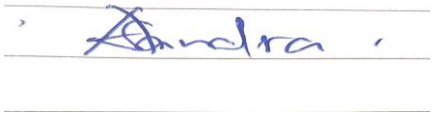
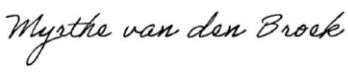
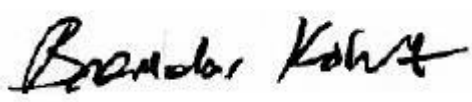
Sandra Agondeze		15.09.2022
Myrthe van den Broek		15.09.2022
Prof. Dr. Brandon A. Kohrt		22.09.2022
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This statistical analysis plan describes procedures for analyzing data from a stepped wedge cluster randomized trial of the Community Case Detection Tool on mental health service utilization among children and adolescents in five refugee settlements in Uganda. Relevant study design details are provided below followed by a detailed description of the statistical analysis approach. This analysis plan focuses on the quantitative aspects of the study.

1. Overview of research objectives and study design

1.1 Research objectives

The overall objective of this study is to examine whether the Community Case Detection Tool (CCDT) improves help-seeking and utilization of mental health services in Bidi Bidi, Rhino, Omugo, Kyaka II, and Kyangwali refugee settlements in Uganda. The research questions are as follows:

1. Does training gatekeepers in the CCDT improve the rate of mental health service utilization among children or adolescents in the study communities relative to practice-as-usual (I.e., pre-CCDT period)?
2. What proportion of probable cases detected using the CCDT seek mental health services?
3. Does training gatekeepers in the CCDT improve their attitudes towards mental health problems relative to their attitudes pre-training?

1.2 Study design

The study uses a pragmatic stepped-wedge cluster randomized trial (SW-CRT) to evaluate the research objectives in five refugee settlements in Uganda (Bidi Bidi, Rhino, Omugo, Kyaka II, and Kyangwali). Each settlement is divided into zones followed by villages, clusters, and blocks. There are 28 zones in total across these settlements that will be randomly assigned to an order for introducing the CCDT over a 9-month period. The unit of randomization and analysis for the primary research question is the zone. When introduced, gatekeepers within that zone will be trained in the CCDT and are estimated to cover a population of approximately 3000 residents. Zones will transition from practice-as-usual to CCDT (i.e., a 'step') in randomly assigned groups of four zones every month. By the end of the 9-month study period, all 28 zones will have trained gatekeepers to use the CCDT to detect probable cases of mental health problems.

1.3 Data collection and measurement

Data used for this study will be collected using the routinely administered case registration forms at local mental health services offered by TPO in the refugee settlements. The primary outcome for this study is the mental health service utilization rate. Secondary outcomes include proportion of people detected by the CCDT who sought services, social/distance and attitudes towards mental health problems, and a set of implementation outcomes (acceptability, appropriateness, feasibility, barriers/facilitators). The outcomes, how they are operationalized, and measured is described below.

- **Primary outcome:** Utilization of mental health services: Number of initial encounters with TPO's mental health services per month among children and adolescents 6-18 years old, or re-entry into TPO's mental health services for children and adolescents that have not been using services for 6+

months. These data will be extracted and tabulated monthly using TPO's routine mental health case registration form.

- **Secondary outcome:** Proportion of CCDT positives that sought help at TPO: Number of people detected through the CCDT who utilize services as divided by the total number of people detected through the CCDT. The numerator will be quantified using TPO's routine mental health case registration data, which includes a single intake question asking about the referral method (i.e., whether they were referred by a gatekeeper). The denominator will be extracted from the gatekeepers' logs, which document the number of children detected. These measures will be aggregated at the study-level, by month, and by gatekeeper.
- **Secondary outcome:** Positive predictive value of the CCDT will be estimated as the proportion of individuals detected through the CCDT who are considered as needing mental health services as defined by TPO providers.
- **Secondary outcome:** Attitudes towards mental health problems: We will evaluate social distance as reported by the gatekeepers at pre-, during- and post-training using the social distance scale.

Qualitative data will be collected on appropriateness, acceptability, and feasibility using supervision notes, focus group discussion and key informant interview guides. (Not included in this analysis plan.)

1.4 Brief overview of analysis approach

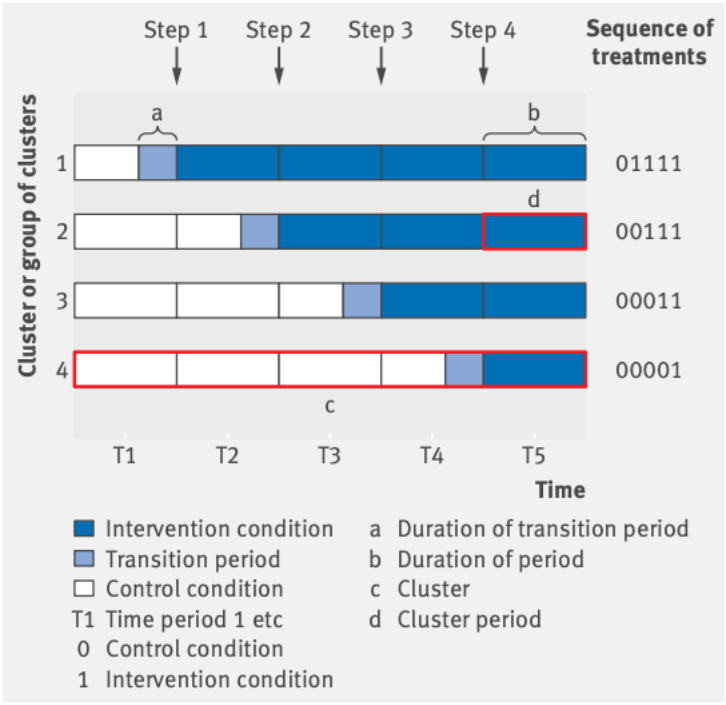
Primary analyses will estimate the difference in the utilization rate between settlements during the pre-CCDT to post-CCDT implementation periods. We will conduct additional analyses to determine whether observed differences display evidence of seasonality or temporal trends. We will conduct sensitivity analyses to evaluate the robustness of these results to external mental health programs (e.g., awareness campaigns). Secondary outcomes will be evaluated descriptively. We will explore the proportion of CCDT positives who utilize mental health services and attitudes towards mental health problems by gatekeeper type, location, and over time. No interim analyses will be conducted due to the nature of implementation.

2. CONSORT Checklist, Diagram, and Flow Chart

We will follow recommended guidelines for reporting stepped wedge trials using the CONSORT SWT extension (1).

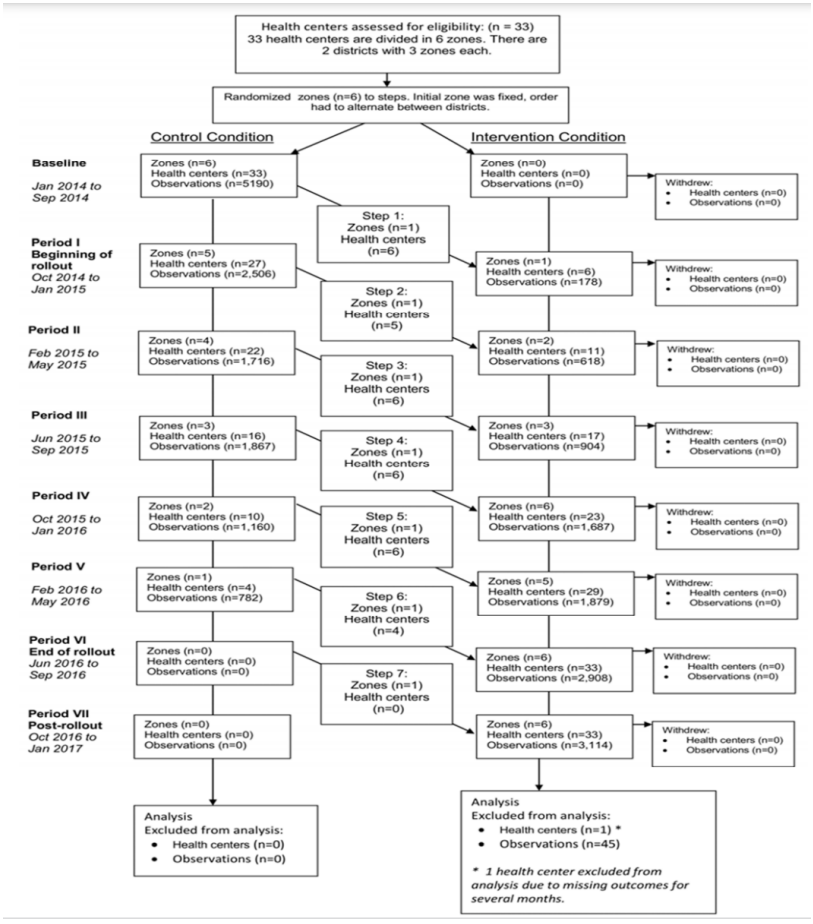
2.1 Study design pattern matrix

We will produce a design pattern matrix to visualize the stepped wedge trial design that includes information on key parameters such as the time period, duration of transition period and each step, the cluster, and study condition sequence (see example below).



2.2 Study flow diagram

We will produce a stepped wedge trial flow diagram that includes the number of clusters randomized, the number of clusters allocated to each sequence, the number of clusters that received the CCDT or were in the control condition by step, and the number of clusters that did not receive their allocated condition (CCDT vs. practice-as-usual) at each step, and average cluster size and variance in cluster sizes (see example below).



3. Data cleaning and management

3.1 Dataset

We will prepare both a long and wide final dataset. The long dataset will include a separate observation for each 1-month data collection interval per zone. The wide dataset will include one observation per zone with variables covering the entire study period. The final dataset will include the following variables:

- Zone identifier
- Settlement identifier
- Population size
- CCDT sequence allocation
- Date of gatekeeper training
- Month/dates of data collection (in 1 month intervals)
- Months since baseline
- Months since CCDT implementation
- Number of CCDT cases detected
- Number of people utilizing mental health services
- Number of people detected by the CCDT utilizing mental health services
- CCDT implementation status (*in wide dataset only*)

The dataset will be stored on the War Child Holland Sharepoint server. All laptops involved in data management and analysis are encrypted and password protected. Data will be imported into Stata Version 17 for data management and analysis.

3.2 Variable creation and coding

We will review the data and perform the following quality checks prior to beginning the analysis: 1) identify and input (if possible) any missing data; 2) review the distribution of all variables to identify any outliers or potential data entry errors; and 3) search for any data irregularities (e.g., if total utilization is less than CCDT utilization, if the dates are not logically sequenced, etc.). Any identified issues will be reviewed and reconciled with the research team. Once the dataset has been cleaned, we will proceed with creating and coding the variables required to answer the primary and secondary research questions. The variables used in the final analysis are described in the table below.

Variable name	**Variable description**	**Source**	**Variable type**	**Variable coding/values**
zone	Zone (numeric identifier) of residence	Study design records	Nominal	1: Zone 3 2: Zone 4 3: Zone 5 4: Bukere 5: Buliti 6: Bwiriza 7: Byabakora 8: Itambabiniga 9: Kaborogota 10: Kakoni 11: Mukondo

				12: Sweswe 13: Kavule 14: Kentomi 15: Kyebitaka 16: Maratatu A 17: Maratau B 18: Maratatu C 19: Maratatu D 20: Mombasa 21: Mukarange 22: Nyampindu 23: Zone II – Siripi 24: Zone III – Eden 25: Zone IV – Tika I & Olujobu 26: Zone V – Odobu 27: Zone VI – Ofua 28: Omugo
settlement	Settlement (numeric identifier)	Study design records	Nominal	1: Bidi Bidi 2: Rhino 3: Omugo 4: Kyaka II 5: Kyangwali
popsize	Population size *(*Note: total population because 5-17 population size only available at settlement level)*	Settlement records	Numeric, continuous	1-999,999
sequence	Randomly assigned order of CCDT implementation; corresponds to time of crossover, in months	Randomization results	Ordinal	1-7
traindate	Date of gatekeeper training	Study records	Date	DD-Mon-YY between January 31st-July 18th 2022
stepdatestart	Date that data collection started for the step	Study records	Date	DD-Mon-YY
stepdateend	Date that data ended for the step	Study records	Date	DD-Mon-YY
stepdays	Number of days in the step	Study records	Numeric, continuous	1-28
steppostbl	Number of steps (i.e., months) since baseline *Calendar time*	Study records	Numeric, continuous	0-9, *this should correspond to the study time variable (in months). If any deviations in the timeline are detected, we will create another variable titled 'months'*
steppostccdt	Number of steps (i.e., months) since CCDT implementation *Exposure time*	Study records	Numeric, continuous	0-8, *all pre-CCDT steps will be coded as 0; we will explore whether a non-linear time variable should be included to*

				improve model fit
ccdtdetect	Number of cases detected by the gatekeepers during a given step period	Gatekeeper logs	Numeric, continuous	0-999
ccdtutil	Number of initial encounters with TPO's mental health services per month among children and adolescents 6-18 years old, or re-entry into TPO's mental health services for children and adolescents that have not been using services for 6+ months who were referred by a CCDT gatekeeper during a given step period	TPO case registration forms	Numeric, continuous	0-999
totalutil	Number of initial encounters with TPO's mental health services per month among children and adolescents 6-18 years old, or re-entry into TPO's mental health services for children and adolescents that have not been using services for 6+ months during a given study period	TPO case registration forms	Numeric, continuous	0-999
truepos	Number of cases detected by the gatekeepers who were classified as true cases by mental health providers (i.e., positive predictive value)	TPO case registration forms	Numeric, continuous	0-999
sds	Gatekeeper attitudes toward mental health problems assessed using the Social Distance Scale	SDS Scale	Numeric, continuous	
ccdt	CCDT vs. control condition	Study records	Nominal	0: control (pre-CCDT) 1: CCDT

4. Exploratory data analysis

Using the wide dataset, we will describe the distribution of mental health service utilization by settlement and zone at baseline. We will report the mean utilization rate, median utilization rate, standard deviation of the utilization rate, inter-quartile range of the utilization rate, and the positive predictive value of the CCDT (see Table 1). Overall utilization rate greater than two standard deviations above or below the mean will be replaced with the zone's mean utilization value. This was decided a priori to account for the impact of other external initiatives (e.g., community awareness campaigns) that occurred during the study period

and were likely to influence utilization rates. We will estimate the intraclass correlation coefficient to explore the correlation of data from each zone nested within settlements.

To prepare for the primary analysis of the effectiveness of the CCDT on utilization, we will explore the trajectories of utilization post-CCDT implementation to determine whether a quadratic or other non-linear term should be used to accurately model trends in utilization over time. We hypothesize that initial increases post-CCDT may be followed by an attenuation over time in a non-linear manner.

5. Statistical analyses

5.1 Research Question 1: Does training gatekeepers in the CCDT improve the rate of mental health service utilization among children or adolescents in the study communities relative to practice-as-usual (I.e., pre-CCDT period)?

Using the long dataset we will construct mixed-effects Poisson regression models using a log link and random effects to account for clustering of zones within settlements and repeated measures within zones over time. The primary analysis will be conducted to estimate the incidence rate ratio comparing the utilization rate between zones where and when the CCDT has been implemented to zones where and when the CCDT has not been implemented. The outcome is the number of children or adolescents utilizing mental health services through TPO (see definition in table above). We will include the following fixed effects in our model: CCDT implementation (*ccdt*), calendar time to account for temporal trends (*stepspostbl*), and exposure time to account for time since introducing the CCDT (*stepspostccdt*). The primary effect of interest will be exposure time (*stepspostccdt*). We will explore whether we should also include a quadratic term for these time variables using model fit indices. We will include an offset for population size (log). We will consider multiple covariance structures and the inclusion of quadratic terms for time and select the best fitting model based on the lowest Bayesian Information Criterion (BIC) value. This modelling structure is based on recommended approaches, including simulation studies that suggest this approach reduces bias and improves precision in parameter estimates in stepped wedge cluster randomized trials (2, 3).

We will report the effect of CCDT as an incidence rate ratio (IRR, 95% CI). If the assumptions of Poisson regression are not fulfilled (e.g., equidispersion), we will estimate a mixed-effects negative binomial model. All analyses will be conducted based on an intent-to-treat approach and consider $p<.05$ as statistically significant. See Table 2.

Subgroup and sensitivity analyses (Supplemental Tables)
We will conduct the following series of subgroup and sensitivity analyses to estimate the robustness of our study data:

- Per protocol sensitivity analysis: We will remove data from zones during instances where there were other events in the settlements that may have interfered with our outcomes (e.g., a mental health awareness campaign, TPO school screening initiatives) and replicate the analysis of the primary outcome.
- Full intent-to-treat sensitivity analysis: We will replicate the analysis of the primary outcome including all data as originally collected (including outliers greater than 2 standard deviations from the mean).

- Step-specific subgroup (i.e., vertical) analysis: We will estimate vertical intervention effects (i.e., difference in utilization by CCDT vs. control within a step) for all time points and compare these to the overall intervention effect model (4).
- Gatekeeper subgroup analyses: We will examine whether the gatekeeper's attitudes post-training (i.e., 3-months) toward mental health problems, gender, or type of gatekeeper modify the effect of the CCDT on service utilization using stratified analyses.

5.2 Research Question 2: What proportion of probable cases detected using the CCDT seek mental health services?

We will calculate the proportion of children and adolescents detected by a gatekeeper using the CCDT that utilized TPO's mental healthcare across all zones during the CCDT implementation period. We will report the number of children who utilized care, the total number of children detected by the CCDT, and the percent of children detected by the CCDT who utilize care. We will explore whether these proportions vary by calendar time, exposure time, zone, settlement, gatekeeper attitudes (SDS scores at post-training; SDS change from pre- to post-training) and gatekeeper type using generalized linear regression models. We will report the cumulative proportion and standard deviation across zones, settlements, and gatekeepers over time. See Table 3.

Sensitivity Analysis: We will estimate the proportion of children detected by the CCDT who utilize care differs among gatekeepers with complete data to explore how robust these data are to missingness. Similar to the primary analysis for Research Question 2, we will also explore whether the proportion differs as a function of calendar time, exposure time, zone, settlement, gatekeeper attitudes (SDS scores at post-training; SDS change from pre- to post-training), and gatekeeper type using generalized linear regression models.

5.3 Research Question 3: Does training gatekeepers in the CCDT improve their attitudes towards mental health problems relative to their attitudes pre-trainings.

We will examine whether gatekeepers' attitudes toward mental health (measured using the Social Distance Scale, SDS) significantly differ from pre- to post-training periods. We will estimate pairwise differences between SDS total scores at pre-training, 3-months post-training, and 6-months post-training using paired samples t-tests. If SDS scores are not normally distributed, we will compare these scores using non-parametric tests. See Table 4.

6. Data cleaning

Data has been collected and entered on a routine basis. As quality measure, all data will be checked for completeness and to prepare the data set. After the final step of the SWT three steps will be taken to prepare the data set (1) collection of logbooks, (2) data entry, and (3) data quality check.

(1) Collection of logbooks

- In the next supervision meeting after the final step (15th of September, 2022), WCH's project officer (PO) will ask gatekeepers to bring their logbooks, and temporarily hand them in.
- PO's will hand out temporarily paper-log books with a file to protect the data, which will be used as the logbooks are withdrawn for continuation of data collection for project purposes.
- PO's will check a list of all logbooks that were handed out at the beginning of the research.

- All logbooks will be handed over to the M&E officer in each location, who keeps it in the locked cabinet – while entering the data.

(2) Data entry

- M&E/PO opens the data entry files on the server, and filters on the gatekeeper ID – e.g., MV-28, to compare the hardcopy logbooks/data per gatekeeper with the data already entered.
- M&E/PO makes corrections, in case of any missing/wrong entry, as per the pink logbook form.
- For all checked/corrected data, it will be highlighted green – meaning the data is checked by M&E, and is verified.
- Verified/corrected data in logbook (i.e., each paper) will be marked by the M&E person. E.g., a tick /initials in the upper right corner of each paper – meaning the data is entered/verified.
- Process will be repeated for all the logbooks.
- All cells in the data entry file that are not marked green/verified will need to be checked by the research team to decide on way forward.
- The M&E/PO will not delete any form/data, after making corrections/verifying.

(3) Data quality check:

- Level 1 quality check (primary review) of 20% of the logbook entries on the server per location will be checked by the research coordinator
- The teams are asked to keep the logbooks for +/- 8 weeks – make sure that data entry is done in 4 weeks.
- The RC will aim to travel to all locations in 4 weeks following entry to do physical checks.
- After verification, logbooks will be returned to the gatekeepers, and the paper-based logbooks will be handed in and data entered on the server.
- Level 2 quality check (secondary review) of 10% by the Researcher, R&D will be done to make sure there is no missing data/no errors in data entry.

TABLE SHELLS

Table 1. Description of the utilization rates and characteristics of settlements at baseline

	Mean (SD) Utilization	Median (IQR) Utilization	Population size
Overall (n=28 zones)	*M (SD)*	*Median (IQR)*	*M (SD)*
Settlement			
Bidi Bidi	*M (SD)*	*Median (IQR)*	*M (SD)*
Rhino	*M (SD)*	*Median (IQR)*	*M (SD)*
Omugo	*M (SD)*	*Median (IQR)*	*M (SD)*
Kyaka II	*M (SD)*	*Median (IQR)*	*M (SD)*
Kyangwali	*M (SD)*	*Median (IQR)*	*M (SD)*

Table 2. Effect of implementing the CCDT on mental health utilization rates in refugee settlements in Uganda, IRR (95% CI)

Fixed Effects:	Mental health utilization rates
CCDT (vs. pre-CCDT)	*IRR (95% CI)*
Calendar time (i.e., months since baseline)	*IRR (95% CI)*
Exposure time (i.e., months since CCDT)*	*IRR (95% CI)*
Random Effects:	
Settlement	*Var (95% CI)*
Zone (repeated measures)	*Var (95% CI)*

**Primary fixed effect of interest*

Table 3. Proportion of *[total number of children*] children detected using the CCDT who utilize mental health treatment

		Utilization (n=XX)	Coefficient (95% CI)
Overall		*n(%) or M(SD)*	--
Covariates of interest (e.g., settlement, zone, gatekeepers, etc.)			
	Category 1	*n(%) or M(SD)*	*REF*
	Category 2	*n(%) or M(SD)*	*B (95% CI)*
	Category 3	*n(%) or M(SD)*	*B (95% CI)*

Table 4. Gatekeeper attitudes toward mental health problems over time

	Mean SDS	Mean difference (95% CI)	
		3-months post-training	6-months post-training
Pre-training	*M(SD)*	*Mean Diff (95% CI)*	*Mean Diff (95% CI)*
3-months post-training	*M(SD)*	--	*Mean Diff (95% CI)*
6-months post-training	*M(SD)*	--	--

Supplemental Table A. Sensitivity analyses of the effect of implementing the CCDT on mental health utilization rates in refugee settlements in Uganda, IRR (95% CI)

	Per protocol analysis	**Full intent-to-treat analysis**	**Vertical analysis**
Fixed Effects:			
CCDT (vs. pre-CCDT)	*IRR (95% CI)*	*IRR (95% CI)*	*Median IRR (Min - Max)*
Calendar time (i.e., months since baseline)	*IRR (95% CI)*	*IRR (95% CI)*	--
Exposure time (i.e., months since CCDT)*	*IRR (95% CI)*	*IRR (95% CI)*	--
Random Effects:			
Settlement	*Var (95% CI)*	*Var (95% CI)*	--
Zone (repeated measures)	*Var (95% CI)*	*Var (95% CI)*	--

Supplemental Table B. Subgroup analyses of the effect of implementing the CCDT on mental health utilization rates in refugee settlements in Uganda by gatekeeper characteristics, IRR (95% CI)

	Attitudes toward mental health problems		**Gender**		**Type of gatekeeper**
	Low	High	Female	Male	*[Insert categories ,e.g., teacher]*
Fixed Effects:					
CCDT (vs. pre-CCDT)	*IRR (95% CI)*	*IRR (95% CI)*	*IRR (95% CI)*	*IRR (95% CI)*	*IRR (95% CI)*
Calendar time (i.e., months since baseline)	*IRR (95% CI)*	*IRR (95% CI)*	*IRR (95% CI)*	*IRR (95% CI)*	*IRR (95% CI)*
Exposure time (i.e., months since CCDT)*	*IRR (95% CI)*	*IRR (95% CI)*	*IRR (95% CI)*	*IRR (95% CI)*	*IRR (95% CI)*
Random Effects:					
Settlement	*Var (95% CI)*	*Var (95% CI)*	*Var (95% CI)*	*Var (95% CI)*	*Var (95% CI)*
Zone (repeated measures)	*Var (95% CI)*	*Var (95% CI)*	*Var (95% CI)*	*Var (95% CI)*	*Var (95% CI)*

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