SNAP Statistical Implementation Guide

Version 4.0

11 March 2024

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Versions

Version 0.1

Initial draft developed by the SNAP Analytic Team prior to being unblinded.

Version 1.0

Version 1.0 for scheduled analysis 1. Unchanged from version 0.1, except:

- amendment of label for Methicillin-resistant S.aureus (changed from PSSA to MRSA) and clarification of intervention identifiers in section 2.2
- includes dates of the data cut for scheduled analysis 1 and subsequent DSMC meeting
- further clarification of intervention identifiers for decision quantities in section 5.2 and representation of decision rules on the untransformed scale

Version 2.0

Version 2.0 for scheduled analysis 2. Unchanged from version 1.0, except:

- includes dates of the data cut for scheduled analysis 2 and subsequent DSMC meeting

Version 3.0

Version 3.0 for scheduled analysis 3. Unchanged from version 2.0, except:

- includes dates of the data cut for scheduled analysis 3 and subsequent DSMC meeting
- includes further dates defining the epochs (derived by the analyst)

Version 4.0

Version 4.0 for scheduled analysis 4. Unchanged from version 3.0, except:

- includes dates of the data cut for scheduled analysis 4 and subsequent DSMC meeting

1 Introduction

The *Staphylococcus aureus* Network Adaptive Platform (SNAP) Statistical Implementation Guide (SIG) supplements the SNAP Statistical Appendix. Whereas the SNAP Statistical Appendix prescribes the SNAP trial analyses in general, the SIG provides additional explanation regarding the trial status and specific analytical approaches that should be implemented at a scheduled analysis. While the SNAP Statistical Appendix is a largely immutable document that requires ethics approval to be modified, the SIG is updated for each scheduled analysis by the Statistical Subcommittee, and pushed to a GitHub repository as a specific release.

The purpose of the SIG is to, at each scheduled analysis:

1. summarise the trial status
2. instruct analysts in terms of specific modelling requirements

2 Trial status

2.1 Key dates

Table 1: Key analytical events

Event	Date	Notes
Recruitment opens	16 Feb 2022	–
Scheduled analysis 4		
- Data cutoff	23 Apr 2024	–
- Data available	07 May 2024	–
- Report due	04 Jun 2024	–
- DSMB meeting proposed	05 Jun 2024	–

2.2 Domains

At the time of writing, the following domain are either currently available, being planned or have previously been available:

1. Backbone antibiotic domain, comprising the:
    - Methicillin-susceptible *S. aureus* (MSSA) subdomain
    - Penicillin-susceptible *S. aureus* (PSSA) subdomain
    - Methicillin-resistant *S. aureus* (MRSA) subdomain
2. Adjunctive antibiotic domain
3. Early oral switch (EOS) domain
4. PET-CT domain

The following tables summarise the current domain status. The following definitions apply:

- **Open**: domain/intervention is active and recruiting
- **Paused**: domain/intervention is active but not recruiting
- **Closed**: domain/intervention is no longer active (i.e. permanently closed)
- **Pending**: domain being developed for future enrolments (for information only)

Table 2: Domain status

Domain	Status	Open date	Stop date	Notes
Backbone antibiotic				
- MSSA	Open	16 Feb 2022	–	–
- PSSA	Open	16 Feb 2022	–	–
- MRSA	Open	16 Feb 2022	–	–
Adjunctive antibiotic	Open	16 Feb 2022	–	–
Early oral switch	Open	16 Feb 2022	–	–
PET-CT	Pending	–	–	–

2.3 Backbone antibiotic interventions

Table 3: Backbone antibiotic status

Intervention	Status	Open date	Stop date	Notes
MSSA				
- Flucloxacillin (d_{11})	Open	16 Feb 2022	–	–
- Cefazolin (d_{12})	Open	16 Feb 2022	–	–
PSSA				
- Flucloxacillin (d_{11})	Open	16 Feb 2022	–	–
- Penicillin (d_{13})	Open	16 Feb 2022	–	–
MRSA				
- Vancomycin (d_{14})	Open	16 Feb 2022	–	–
- Vancomycin + cefazolin (d_{15})	Open	16 Feb 2022	–	–

2.4 Adjunctive antibiotic interventions

Table 4: Adjunctive antibiotic status

Intervention	Status	Open date	Stop date	Notes
No clindamycin (d_{21})	Open	16 Feb 2022	–	–
Clindamycin (d_{22})	Open	16 Feb 2022	–	–

2.5 Early oral switch domain

Table 5: Early oral switch status

Intervention	Status	Open date	Stop date	Notes
Usual care (d_{31})	Open	16 Feb 2022	–	–
Early oral switch (d_{32})	Open	16 Feb 2022	–	–

2.6 PET-CT domain

Table 6: PET-CT status

Intervention	Status	Open date	Stop date	Notes
Usual care	Pending	–	–	–
Intervention	Pending	–	–	–

3 Planned analysis

3.1 Analyses

Planned analyses are summarised below. Details of the estimands for the Core Protocol can be found in the Statistical Appendix. Details for the domain-specific appendices estimands can be found within the relevant domain-specific appendix.

Estimand	Type	Subset	Outcome	Model	Notes
1	Primary	All	90-day mortality	Binary	-
10	Secondary	Adjunctive	Micobiological treatment failure	Binary	-
11	Secondary	Adjunctive	Diagnosis of new foci	Binary	-
A1.7	Secondary	Backbone PSSA/MSSA	Change of treatment due to lack of efficacy	Binary	-
X	Secondary	Backbone PSSA/MSSA	Positive blood culture (day 5)	Binary	-
X	Secondary	Backbone PSSA/MSSA	SAR (PSSA to MRSA/MSSA) (day 5)	Binary	-

3.2 Included variables

See SNAP Statistical Appendix for modelling details.

3.2.1 Eligibility

Currently, eligibility (to be randomised) is modelled for all three domains (backbone, adjunctive, and early-oral switch domains). Ineligibility could be for any reason (for participants in the platform) including site unavailability, non-consent or, as in the early-oral switch domain, failure to qualify for randomisation to a domain.

3.2.2 Interactions

Table 7: Included interactions

Silo	Domains	Status	Open date	Stop date	Notes
MRSA	Backbone, Adjunctive	Open	16 Feb 2022	–	

3.2.3 Regions

Regions are included in the current model (see below). Note that where a region contains less than 5 observations, it may be combined with the most relevant neighbouring region at the analysts discretion.

Note that the `region` variable is not collected and must be derived and assigned by the analyst.

Table 8: Included regions

Region	Status	Open date	Stop date	Notes
Africa and the Middle East (ex. Israel)	Open	21 Aug 2023	–	–
East Asia	–	–	–	–
Europe (inc. Israel)	Open	14 Dec 2022	–	–
Oceania	Open	16 Feb 2022	–	–
North America	Open	01 Apr 2022	–	–
South and Central America	–	–	–	–
South-east Asia	Open	24 Nov 2022	–	–
South Asia	–	–	–	–

3.2.4 Countries

Countries are included (see below), nested within regions (see above) within the current model. Note that where a country contains less than 5 observations, it may be combined with the most relevant country within the nesting region (if possible), at the analysts discretion.

Note that the `region` variable is not collected and must be derived and assigned by the analyst.

Table 9: Included countries

Country	Region	Status	Open date	Stop date	Notes
Australia	Oceania	Open	16 Feb 2022		
Canada	Nth America	Open	01 Apr 2022	–	
Israel	Europe	Open	14 Dec 2022	–	
Netherlands	Europe	Open	26 Oct 2023	–	
New Zealand	Oceania	Open	20 Feb 2022	–	
Singapore	SE Asia	Open	24 Nov 2022	–	
South Africa	Africa & M.East	Open	21 Aug 2023	–	
United Kingdom	Europe	Open	27 Nov 2023	–	

3.2.5 Covariates

Age group is included as a covariate within the current model (see below). Note that where an age group contains less than 5 observations, it may be combined with the most relevant neighbouring category at the analysts discretion.

Note that the age group variable is not collected and must be derived by the analyst.

Table 10: Included covariates

Covariate	Levels	Notes
Age group	30 days or less	
	31–365 days	
	1–4 years	
	5–11 years	
	12–17 years	
	18–39 years	
	40–59 years	
	60–79 years	
	80 years and over	

3.2.6 Epochs

Note that the epoch variable is not collected and must be derived by the analyst.

Table 11: Included epochs

Epoch	Notes
16 Feb 2022–17 Aug 2022	
18 Aug 2022–15 Feb 2023	
16 Feb 2023–17 Aug 2023	
18 Aug 2023–15 Feb 2024	
16 Feb 2024–17 Aug 2024	

4 Model implementation

4.1 Posterior computation

The posterior distributions of all models described in section 3.1 will be computed using Markov chain Monte Carlo (MCMC) methods via Stan. Convergence and mixing of chains must be assessed using standard diagnostics including, but not limited to, graphical inspection of the chains, and ensuring all $\hat{R}$ values are close to one. Posterior predictive distributions should be examined against the observed data, where possible, to evaluate the suitability of the proposed models.

4.2 Model code

The analyses specified in section 3.1 will be performed using Stan, impemented in the R programming environment. A snapshot of the R environment must be included along with any report.

4.3 Model deviations

All models and priors are specified in the Statistical Appendix. In the event that the pre-specified models do not converge or other modelling issues are encountered (e.g. divergent transitions in the Stan sampler), the analyst may choose to modify the model in order to proceed. Any and all deviations from the pre-specified model must be detailed along with the reported results.

5 Reporting

5.1 Posterior summaries

Model posteriors will be summarised and reported using mean, median, and 95% equal-tailed credible intervals. Treatment odds ratios will be reported in terms of decision rules.

5.2 Decision rules

Posterior probabilities of treatment efficacy will be summarised as described below (see 'Quantity'). Quantities are defined for silo (1=MSSA, 2=PSSA, 3=MRSA), subgroup (adult=1, child=0), and intervention within a domain are defined in section 2.2. Whether a decision rule is met must be based on the corresponding threshold, and this should be reported. Note that the same quantities must be described for the paediatric subgroup but currently no decision rules are defined.

Table 12: Backbone domain decision rules

Silo	Intervention	Decision	Quantity	Threshold
MSSA	Cefazolin	Non-inferiority	$P(exp(\beta_{1,1,d_{12}}) < 1.2)$	> 0.99
		Futility (ninf)	$P(exp(\beta_{1,1,d_{12}}) < 1.2)$	< 0.01
PSSA	Penicillin	Non-inferiority	$P(exp(\beta_{2,1,d_{13})} < 1.2)$	> 0.99
		Futility (ninf)	$P(exp(\beta_{2,1,d_{13}}) < 1.2)$	< 0.01
MRSA	Vancomycin + cefazolin	Superiority	$P(exp(\beta_{3,1,d_{15}}) < 1)$	> 0.99
		Futility (sup)	$P(exp(\beta_{3,1,d_{15}}) < 1/1.2)$	< 0.01

Table 13: Adjunctive domain decision rules

Silo	Intervention	Decision	Quantity	Threshold
All	Clindamycin	Superiority	$P(exp(\beta_{1,1,d_{22}}) < 1)$	> 0.99
		Futility (sup)	$P(exp(\beta_{1,1,d_{22}}) < 1/1.2)$	< 0.01

Table 14: Early-oral switch domain decision rules

Silo	Intervention	Decision	Quantity	Threshold
MSSA	Early-oral switch	Non-inferiority	$P(exp(\beta_{1,1,d_{32}}) < 1.2)$	> 0.99
		Futility (ninf)	$P(exp(\beta_{1,1,d_{32}}) < 1.2)$	< 0.01
PSSA	Early-oral switch	Non-inferiority	$P(exp(\beta_{2,1,d_{32}}) < 1.2)$	> 0.99
		Futility (ninf)	$P(exp(\beta_{2,1,d_{32}}) < 1.2)$	< 0.01

Silo	Intervention	Decision	Quantity	Threshold
MRSA	Early-oral switch	Non-inferiority	$P(exp(\beta_{3,1,d_{32}}) < 1.2)$	> 0.99
		Futility (ninf)	$P(exp(\beta_{3,1,d_{32}}) < 1.2)$	< 0.01

5.3 Response adaptive randomisation

Response adaptive randomisation is not planned at this stage.

5.4 Reports produced

A single closed report, describing results in terms of the unblinded treatment allocations, will be provided to the data safety and monitoring committee by the analysts directly. At no point should any blinded trial investigators be able to access the closed report.