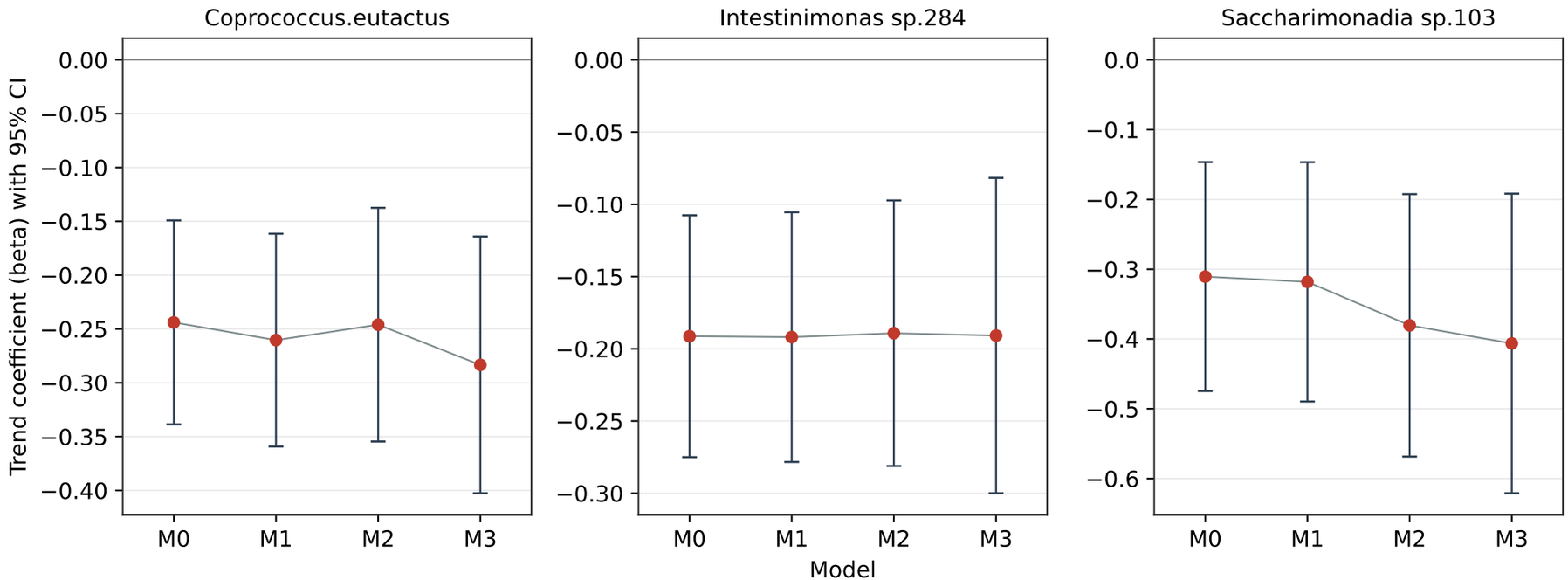
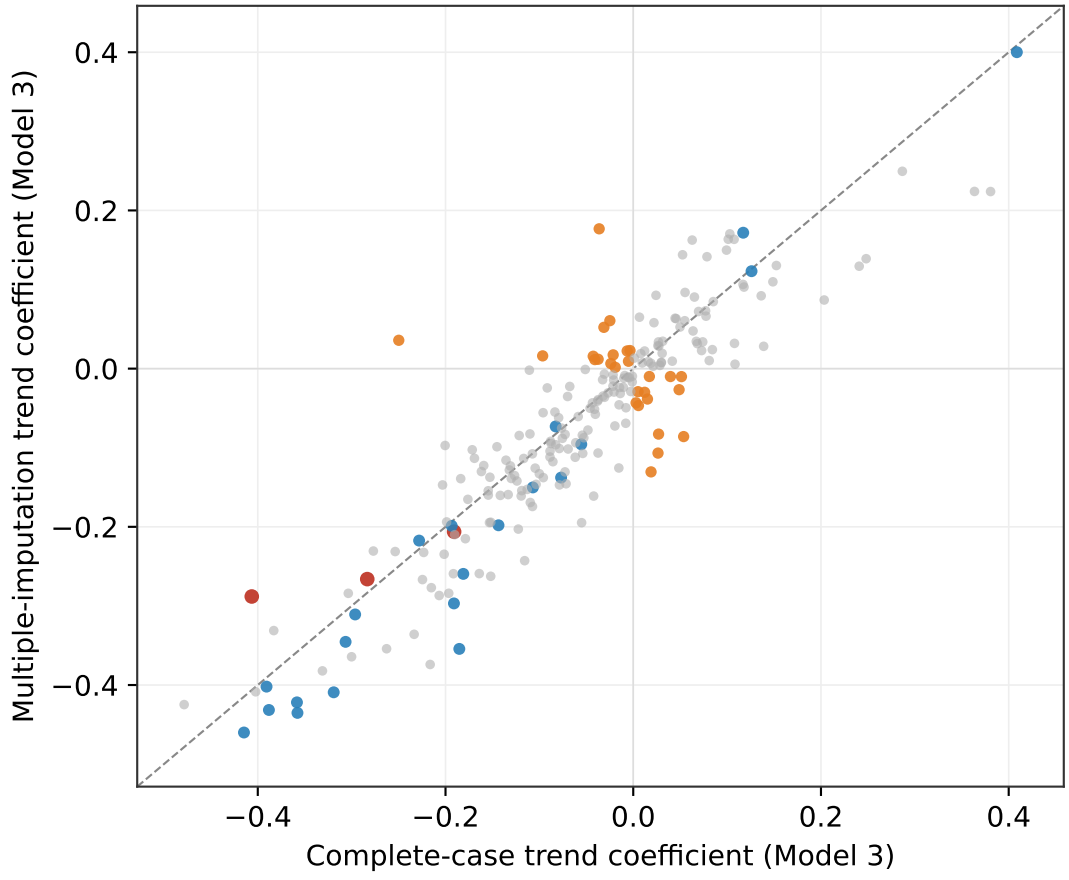
Figure S1. Associations of the three primary bacterial features across sequentially adjusted models (M0–M3)



Complete-case sample sizes differ because of covariate missingness (M0 n = 1,339; M1 n = 1,282; M2 n = 1,123; M3 n = 1,023).
Changes in beta between models may reflect both covariate adjustment and the change in the analysed sample; the four models are not four independent validations. All three features reach BH-FDR q < 0.05 at every model (family = 230 features per model).

Figure S2. Complete-case versus multiple-imputation estimates
(Model 3, all 230 bacterial features)



Level 1 — complete-case FDR-positive (core result) (n = 3)
Level 2 — MI-only exploratory sensitivity finding (n = 21)
Level 4 — direction inconsistent (unstable) (n = 27)
Level 3 — not FDR-positive in either analysis (direction consistent) (n = 179)

Level 1 = complete-case FDR-positive with MI in the same direction (core result). Level 2 = not FDR-positive in the complete-case analysis but FDR-positive under MI (exploratory sensitivity only; must not be promoted to a main finding). Level 3 = not FDR-positive in either analysis, direction consistent (no clear association can be claimed). Level 4 = complete-case and MI estimates differ in sign (unstable; a direction difference alone does not prove true effect heterogeneity). Both analyses use the same pre-specified Model 3 covariates; MI (20 imputations of Model 3 covariates only; Rubin's rules) is a sensitivity analysis and depends on the missing-at-random assumption and on the imputation model.

Figure S3. Detection−rate distribution of the 230 public bacterial features

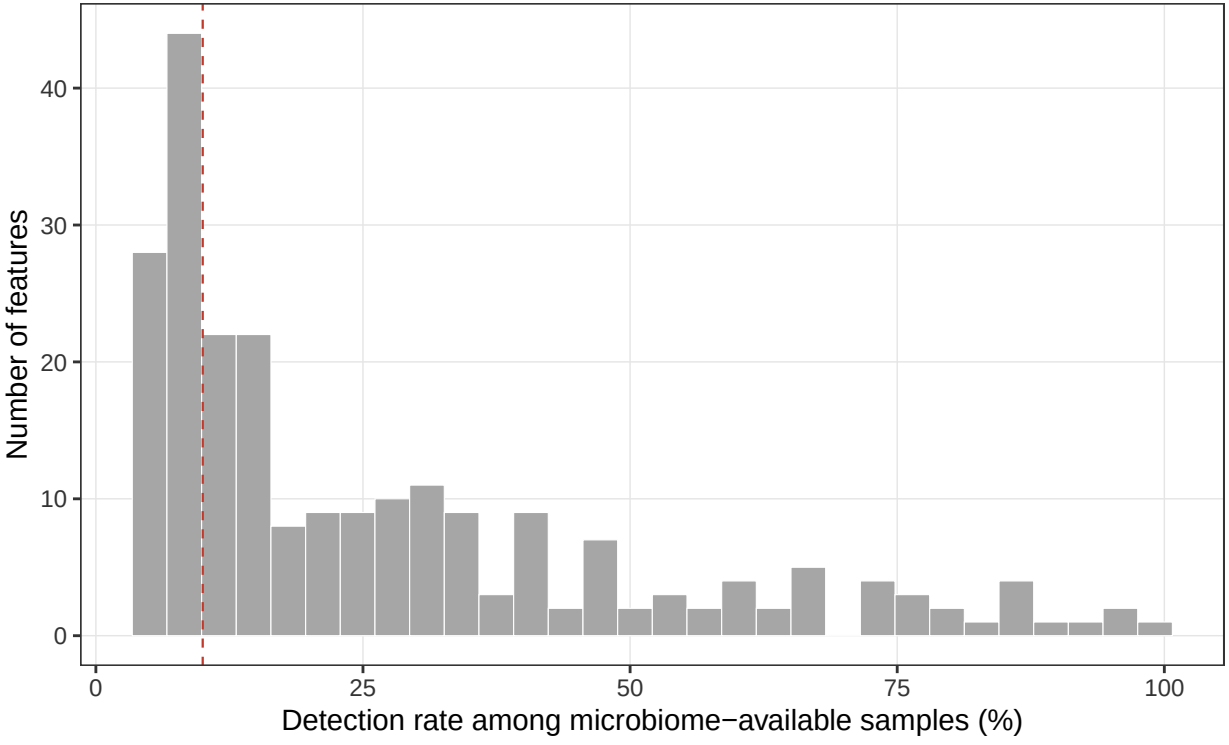
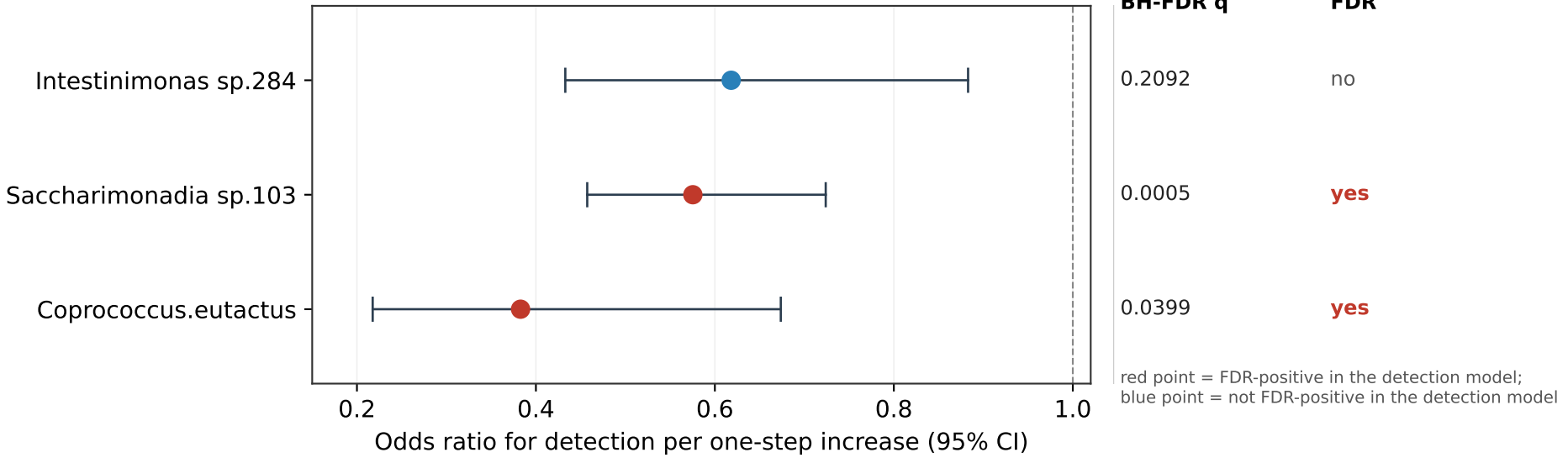


Figure S4. Presence/absence detection models (Model 3) for the three primary features



M3 complete cases, n = 1,023. Outcome: detection (bac_public > 0). Exposure: ordinal penicillin-treated infection burden 0 / 1 / 2. OR per one-step increase; BH-FDR q applied within the pre-specified detection-model family of 230 features. Coprococcus eutactus and Saccharimonadia sp.103 are FDR-positive; Intestinimonas sp.284 is not FDR-positive in the detection model. An OR below 1 indicates lower odds of detection and must not be read as a percentage decrease in detection probability. This detection analysis does not change the FDR-positive status of the three features in the primary continuous-outcome trend model.