Effect of rapid response systems on hospital mortality: a systematic review and meta-analysis

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Effect of rapid response systems on hospital mortality: a systematic review and meta-analysis

Audrey De Jong[1†], Boris Jung[1,2†], Aurelien Daurat[1], Gerald Chanques[1,2], Martin Mahul[1], Marion Monnin[1], Nicolas Molinari[3] and Samir Jaber[1,2*]

Dear Editor,

This article reports a meta-analysis and systematic review of studies of rapid response system (RRS) compared to no RRS including the recent study by Jung et al. [1].

We made a quantitative synthesis selecting the following study designs: randomized controlled trials, prospective observational studies (before and after treatment), and retrospective observational studies [see also Electronic Supplemental Material (ESM) 1 for selection criteria and data collection and analysis] [2]. The primary endpoint of this meta-analysis was the incidence of overall hospital mortality. The secondary endpoint was the incidence of unexpected mortality.

Data were extracted as they were reported in the original paper or based on the authors' answers to our queries (see ESM for further details). Odds ratios (ORs) were used as the summary measure for dichotomous outcomes. Statistical heterogeneity was quantified by the Q-Cochrane heterogeneity test [Q statistic with degree of freedom (df)] and the I^2 statistic [3]. In case of heterogeneity, a random effect model was performed. Predefined subgroups analysis and exclusion of outlying studies were performed to reduce heterogeneity for the primary outcome [4, 5]. To assess the effect of potential confounding factors we performed a meta-regression (see also ESM). A funnel plot (plot of treatment effect against trial precision) was created to determine the presence of publication bias, true heterogeneity, data irregularities, and choice of effect measure in the meta-analysis.

The updated literature search provided a total of 32 studies and 10,563,083 patients (see ESM Fig. S1). Of those, nine studies (1,045,364 patients) provided data on unexpected mortality and 32 studies (9,517,719 patients) reported overall mortality rate. The meta-regression did not reveal any significant effect of potential confounding factors (see ESM) for overall hospital mortality.

RRSs were associated with a significant decrease in both overall hospital mortality [OR 0.89; 95 % CI 0.85–0.93)] (Fig. 1a) and unexpected mortality [OR 0.51; 95 % CI (0.35–0.76)] (Fig. 1b). Funnel plots did not reveal publication bias for overall mortality or unexpected mortality (see ESM Figs. S2 and S3). Subgroups analysis performed according to the multiple center or single center design (Fig. S4), the prospective or retrospective design (Fig. S5), and the location of the studies (Fig. S6) showed consistent results, with a significant decrease of overall hospital mortality. After exclusion of outlying studies (Fig. S7), heterogeneity became low and a fixed model could be applied, showing identical results with a decreased incidence of overall hospital mortality [OR 0.92; 95 % CI (0.90–0.94)].

In this updated systematic review and meta-analysis, medical emergency team (MET) implementation was associated with a significant decrease in overall and unexpected mortality of hospitalized patients. One limitation was the large amount of statistical heterogeneity. Nevertheless, we considered that to combine data using a random effect meta-analysis would allow a more useful result than to include a small number of homogeneous studies as presented in Fig. S7 [5]. Moreover, subgroups analysis and exclusion of outlying studies allowing

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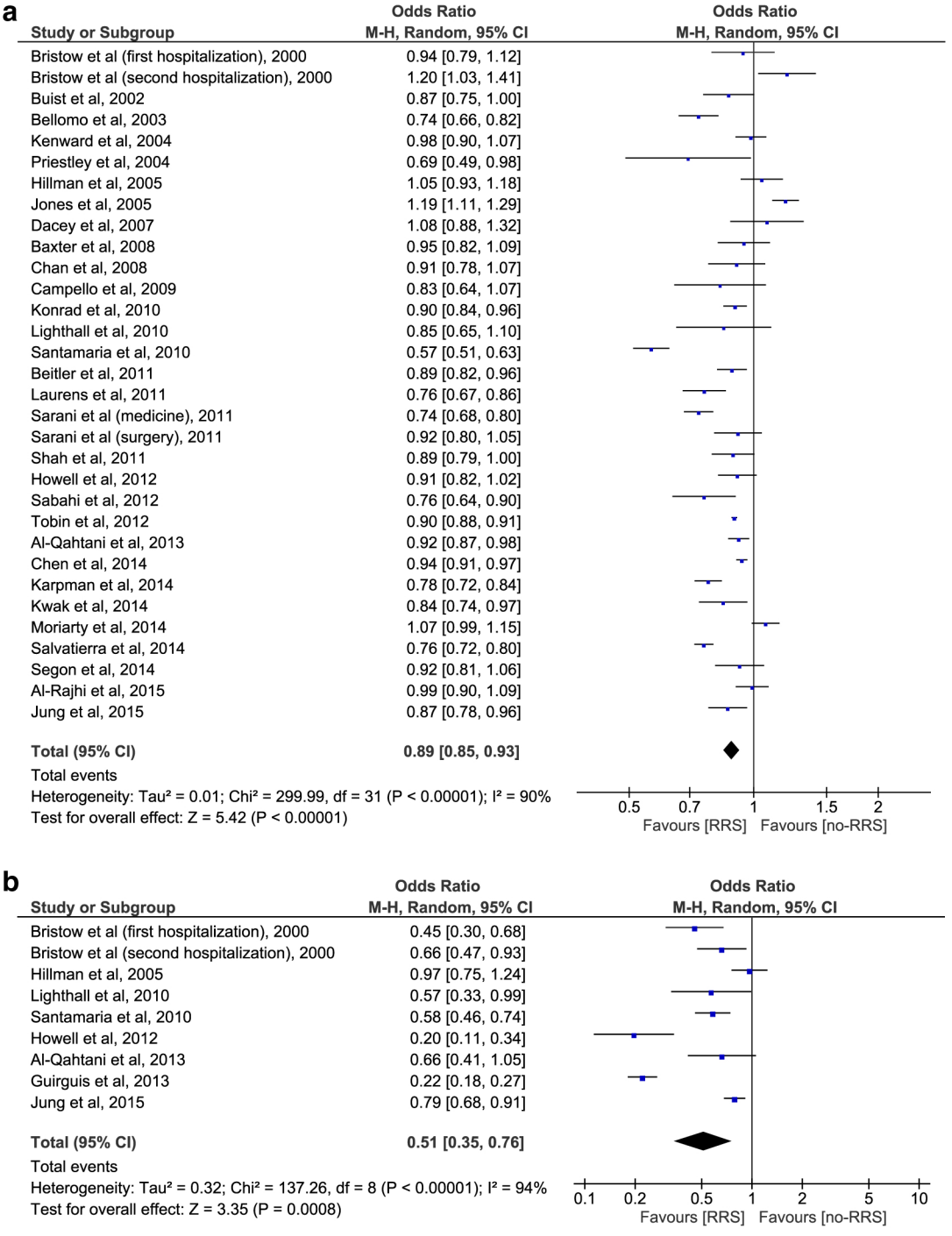

Fig. 1 Forests plots of **a** overall mortality and **b** unexpected hospital mortality. Study-specific odd ratios (95 % CI) are denoted by *black boxes* (*black lines*) for unexpected mortality. The combined odd ratios estimate for all studies is represented by a *black diamond*. Overall diamond width corresponds to 95 % CI bounds. Heights of boxes and diamonds are inversely proportional to the precision of the odds ratio estimate. The *p* value for heterogeneity of the odds ratio by study is shown (Q statistic with degree of freedom) and I^2 statistic

reduced heterogeneity showed similar results. The present updated meta-analysis strongly suggests a positive effect of RRS on overall and unexpected mortality.

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Compliance with ethical standards

Conflicts of interest
Boris Jung reports personal fees from Merck (Whitehouse Station, NJ) and Astellas (Tokyo, Japan) not related to the present study. Aurelien Daurat, Nicolas Molinari, Audrey De Jong, Martin Mahul, Marion Monnin, and Gerald Chanques have nothing to disclose. Samir Jaber reports personal fees from Maquet, Draeger, Hamilton Medical, Fisher Paykel, and Abbott not related to the present study.

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