Author's response to reviews

**Title:** Increasing the frequency of hand washing by healthcare workers does not lead to commensurate reductions in staphylococcal infection in a hospital ward.

**Authors:**

Clive B Beggs (C.B.Beggs@bradford.ac.uk)
Simon J Shepherd (S.J.Shepherd@bradford.ac.uk)
Kevin G Kerr (kevin.kerr@hdft.nhs.uk)

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**Author's response to reviews:** see over
Response to reviewer’s comments

Reviewer 1

1. “A random contact structure is assumed between HCW and patients, which is not realistic. The organisation in hospital wards (and certainly in ICUs) is such that not all HCW will contact all patients. In fact, this level of cohorting as introduced by Austin et al has been determined by Grundmann and Nijssen et al (Arch Intern Med. 2003 Dec 8-22;163(22):2785-6) and was about 0.7 in both studies. This cohorting level may well decrease in situations of understaffing. It might be interesting to incorporate this aspect in the model.”

The reviewer is correct in asserting that our model does not incorporate cohorting - to do so would have required a much more complex model. However, the lack of cohorting should not change the findings of the study. This is because any cohorting reduces the total number of patient-to-patient contacts that will occur and thus should, in theory, reduce the handwashing compliance necessary to ensure $R_0 > 1$. Furthermore, we point out that we were not modelling an ICU – our model was of a general medical ward (i.e. one in which cohorting is likely to be much less rigorously applied).

2. “Another explanation why transmission control fails despite reasonable observed compliance levels would be the Hawthorne effect. Perhaps, the observations do not reflect real life, and true compliance levels are lower than what they tell us in studies.”

The text has been changes to incorporate this point. Nevertheless, the Hawthorne effect will not apply in a model.

Reviewer 2

1. “The manuscript is of value as efficacy of hand cleansing process is taken into account. The authors are right that overcrowding and high workload are important factors influencing infections. But the authors should not charge up hand hygiene compliance against nurse staffing. Good values in both are important and values of hand hygiene compliance below 50% are unacceptable.”

With respect, we are unclear as to the point the reviewer is trying to make here. As a general principal poor hygiene is unacceptable and high rates of compliance ought to be expected but in “real world” situations poor hand hygiene compliance rates are common.

2. “The title and the interpretation of the results of the study are misleading. In my view it is not a clear result of the study that increase of frequency of hand washing does not lead to commensurate reductions in staph infections. Results of a model are dependent of the set up of the parameter values in the model. The parameter values are the crucial points in a model. The values have to be taken from studies (not from other models like in this study but from results of real life studies). E.g. contact rate of > 10 is normal for ICUs (the authors cited Pitte’s study with 43 hand hygiene opportunities per hour, there are of course more than 10 patient contacts per day).”

With respect to the reviewer, the study does indicate that thresholds exist above which further hand hygiene compliance will have minimal effect. Indeed, this is the whole point of the paper. While it is true that parameters used are specific to our study and that in real-life conditions might be different, it doesn’t change the fact that the general shape of the ward prevalence curves will always the same (see Figure 1) – despite changes in parameters. This means that, in any given scenario, there will always be a $R_0$ threshold handwashing frequency, above which increases in compliance will have minimal effect. This is an important finding because it casts doubt on the often held belief that if we could only achieve >70%
handwashing compliance then all staphylococcal transmission would be likely to cease. Notwithstanding this, we do accept the reviewer’s point that it can be erroneous to apply thresholds (e.g. 40% hand hygiene compliance) determined from one theoretical study, to the broader context. Accordingly, we have modified the conclusions so that they now state: “Above a certain threshold, which varies depending on the dynamics of the given clinical scenario, the benefit of increased hand hygiene compliance appears to be minimal.” We have also restricted the mention of actual handwashing percentages to the specific study reported in the paper.

With respect to the number of contacts used in the study, we have justified our choice fully in the text. The values that we used in the study are very much in keeping with those of other researchers. Notwithstanding this, we point out that we modelled general medical ward and not an ICU.

3. “Therefore title and second sentence (and some more) of the discussion are not the accurate interpretation of the results.”

The title and the discussion have been changed accordingly.

4. “Abstract: It is not clear from the abstract that the important new is that the efficacy of the hand cleansing process is taken into account. This should be mentioned in a clearer way.”

The abstract has been amended to specifically mention the efficacy of the hand cleansing process.

5. “At the end of the manuscript environmental reservoirs are mentioned. This is another important point. Authors should give more background information from the literature or omit this part. (Of course has a higher compliance of hand hygiene a positive impact on transmission from environment to patient.)”

Although the paper is not specifically about environmental reservoirs, it is necessary to mention this issue because it is one possible explanation as to why MRSA is so prevalent despite improvements in hand hygiene. If the transmission of MRSA infection is not via the hands of HCWs, but through some other environmental vector, then this might explain why hand hygiene measures are failing. Having said this, to consider the subject of environmental contamination in more depth would be outwith the scope of the paper.

6) “Authors should discuss why they use a deterministic model and no stochastic model.”

A paragraph on this subject has been added at the end of the paper.