Reviewer's report

Title: Modelling optimal location for pre-hospital helicopter emergency medical services

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Reviewer: Paul Biddinger

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General Comments

Overall, this is a well-written article that addresses an important question in helicopter emergency services (HEMS): How to optimally and expand HEMS coverage to rapidly treat and transport severely injured trauma patients in rural areas and decrease unnecessary morbidity and mortality. Their use of GIS modeling is an interesting approach to the problem of how to rationally expand access to high-level trauma care in rural areas. Unfortunately, I have several questions about the assumptions of the analysis that should be addressed prior to the article being published. In addition, the authors have made little attempt to provide clinical data to quantify the value of the expansion of HEMS beyond their generic assumption that increased patient arrival in a trauma center is a desirable outcome, and they have made little attempt to address the increased cost of care and risk to provider safety that accompanies expansion of HEMS assets.

Major Compulsory Revisions

1. The chief challenge of this article is its lack of an attempt to quantify the improvement in the trauma system that would result from expansion of HEMS assets. In the discussion section, the authors state that adopting an early activation/auto launch policy for HEMS in an expanded catchment area would "potentially mitigate higher rates of, mortality in rural and remote areas." There is no attempt to analyze what the subsequent reduction in mortality might be using existing trauma data. Given the increasing skepticism of the "golden hour" concept as applied to trauma patients in toto, the authors need to develop a methodology to predict the number of lives that might be expected to be saved with this expanded HEMS program. Further, because the authors are potentially manipulating two variables concurrently in their modeling: 1) expansion of HEMS resources and 2) expansion of the geography of a new early activation/auto launch policy, it is unclear which variable might be more likely to improve outcomes or (importantly) increase overuse of HEMS.

2. The authors assume that an expanded HEMS program must be based at one of the two regional trauma hospitals in their analysis. Many HEMS programs do not base their helicopters at a hospital, but at a launch point that is most rational for the geography that they are expected to cover. If, for political or other reasons, it is not possible to locate a new helicopter away from a hospital base in
this analysis, that question should be addressed by the authors. Otherwise, this analysis is flawed by limiting the assumptions of where a new helicopter could potentially be based.

3. The authors use patient home postal codes to estimate the population density, and presumably therefore the frequency of traumatic injuries in their GIS model. It stands to reason that only a small proportion of patients are actually injured in their homes with major trauma. More likely, most of the patients who would be transported by HEMS are injured away from their homes, especially on the roadways. It is beyond my understanding of GIS modeling to know whether home postal codes are a sufficient approximation of where traumatic injuries occur across a population, but the issue of a discrepancy between residence of patients and the location of their injuries in the modeling must be directly addressed in this article.

Minor Essential Revisions

1. In the background section, in the second paragraph, I believe that the authors overstate the definitiveness of the data behind the clinical and cost effectiveness of helicopter EMS programs. While there is indeed data that supports both assertions that has been cited by the authors, there is also contradictory published data and a substantial active controversy in the field. The authors should acknowledge this with appropriate citations and editing of their text.

2. In the last paragraph of the discussion section, the authors need to add to their assertion that “the potential for auto launch to decrease time to advanced resuscitation is ultimately more important to achieving better patient outcomes than the ability to improve transport times while in flight.” This statement is too bold without supporting data and further discussion.

3. In the methods section, the authors state that they assumed that stop signs would add 30 seconds to travel time. I believe that this is excessive, and believe that an appropriate penalty is much closer to 10 or 15 seconds. In addition, traffic lights were assumed to add a penalty of one minute to transit times. This is likely also an excessive penalty, as ground EMS services treat traffic lights generally similar to stop signs, with likely only a small increased burden of heavier traffic present at a traffic light as compared with a stop sign.

4. In the methods section, under trauma data, the authors state that they did not capture patients triaged to a non-trauma hospital or transported out of province. They should make some attempt to quantify this patient volume, as such patients might likely also be affected by any early launch policy of HEMS. At a minimum, they should try to identify patients transferred from non-trauma hospitals to the major trauma centers with significant traumatic injury.

Discretionary Revisions

None.

Level of interest: An article whose findings are important to those with closely
related research interests

Quality of written English: Acceptable

Statistical review: Yes, but I do not feel adequately qualified to assess the statistics.

Declaration of competing interests:

In the past 5 years, I have served as an unpaid associate medical director of a rotary and fixed wing medical transport program. Otherwise, I have no competing interests.