

PEER REVIEW HISTORY

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ARTICLE DETAILS

TITLE (PROVISIONAL)	Paediatric Early Warning Systems for detecting and responding to clinical deterioration in children: a systematic review
AUTHORS	Lambert, Veronica; Matthews, Anne; MacDonell, Rachel; Fitzsimons, John

VERSION 1 - REVIEW

REVIEWER	Damian Roland Leicester University, UK Some of my work is referenced in this review and I was approached by the authors to review some of this work in advance of local dissemination. I am part of a study group looking a PEWS (The PUMA Study). We have also completed a systematic review that has been submitted to PROSPERO.
REVIEW RETURNED	18-Oct-2016

GENERAL COMMENTS	<p>Thanks for the opportunity to see this paper which I think began as a report from the Irish Government. I have made a few comments below. I am aware this is an open access review and need to highlight conflicts as I am also involved in a similar systematic review funded by the NIHR. There has also been a recent review by Chapman et al. in Resuscitation so it is becoming a crowded field!</p> <p>Introduction "Paediatric Early Warning Systems (PEWS) are bedside tools" - I think it might be important to delineate between scores and systems at this point. Many would feel a PEWS is a system around a child which goes beyond the bedside tool and includes response teams etc. If PEWS system is being used as a score then I think it is important to be clear about this (in fact the points made later in the paragraph regarding the 4 components seem to imply PEWS is more than a bedside tool..)</p> <p>Results I think it might be useful for the reader to break down the research questions into their specific parts. For example maybe using a table to highlight availability, composition, activation and effectiveness of PEWS separately. The differences are lost in the current overarching approach.</p> <p>I am slightly conflicted as I am part of a team that is looking at socio-contextual factors of PEWS (protocol has been published). There is a rich amount of literature available but not directly regarding paediatric systems. It is not unreasonable to limit a search strategy as the authors have done but it is important to recognise there is a large amount of literature on situational awareness, human factors work</p>
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	<p>etc which is likely to be relevant to the PEWS work. Importantly the differentiation between a MET and a non-MET approach needs to be made (a cost effectiveness study in a MET may not translate to a PEWScore only type study)</p> <p>There is a Paediatric ED Paper that was published over the summer in a similar vein to the Maconochie/Bradman paper that doesn't appear to have been included http://www.scirp.org/journal/PaperInformation.aspx?PaperID=67309</p> <p>Discussion "This review is the first to systematically examine and synthesise evidence on PEWS as a comprehensive system comprised of detection, response and implementation components" - I think the recent Chapman review in resuscitation did something similar (although I appreciate maybe didn't cover implementation)</p> <p>"Additionally, PEWS have been shown to enhance multidisciplinary team working, communication and confidence in recognising and making clinical decisions about clinically deteriorating children" Was it the PEWS that did this or other systems/approaches around the child? I think this needs to be pulled out more in the results if it is going to be a core conclusion.</p>
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REVIEWER	<p>Gerri Sefton Alder Hey Children's NHS Foundation Trust</p> <p>My publication is included in the literature review. I sought clarification with the editorial team and they are happy for the review to continue with an acknowledgement here re: potential conflict of interest</p>
REVIEW RETURNED	14-Nov-2016

GENERAL COMMENTS	Nicely written paper. well done
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REVIEWER	<p>Henriette A Moll ErasmusMc Sophia kinderziekenhuis Rotterdam the netherlands</p>
REVIEW RETURNED	17-Nov-2016

GENERAL COMMENTS	<p>This systematic review summarized 1) evidence of composition and clinical effectiveness of PEWS ,2) PEWS response mechanism (availability, composition, activation and effectiveness),3) evidence on the process of implementation. These 3 questions are very relevant for the use of PEWS at large scale. But are not properly searched and discussed in this manuscript. all data are described but a better structure of the review is needed</p> <p>These questions are very broad and are described in large detailed tables and text. They are difficult to summarize as not the result of the study is the way to order results but the alphabetic ranking of auteurs.</p> <p>I really miss a interpretable summary of the results and I suggest to narrow the research questions and to define the inclusion more strict.</p> <p>Research question1; what is the effectiveness of the different</p>
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	<p>PEWS. In a figure with on the y1-as the level of evidence , inner y2 – as thepercentage 0-100% to depict the sensitivity and specificity , on the x-s the different PEWS (for every study a sensitivity and specificity in different colors) In an overview you can interpreted the results. The table 1 can be add as an appendix. Exclude from this figure special units if only one study is published and also the studies who do not report on effectiveness and only report on inter and intra-rater agreement studies. Exclude studie with less than 100 cases.</p> <p>Research question 2: table 2 is just all details about the studies on PEWS response mechanism, first a summary about effectiveness on different outcomes (table 2) and on y-as also the level of evidence. Second , which activation teams were available. If I understand well nearly all had rapid response team and just a few other strategies. There is a large overlap in the research question, just define clear that the question is what is the effectiveness of the PEWS response mechanism and which intervention was used.</p> <p>Research question 3 is answered bij table 3 . the ordering is alphabetic on auteur, just make an ordering based on the most important topic : implementation strategy/implementation intervention or outcome</p> <p>Table 4 and 5 are just general description of barriers and facilitators, a summary of these factors based on the systematic review would be very informative.</p> <p>The discussion is describing diversity, difficulty to interpret the studies etc. I really miss discussion difficulty in effectiveness studies, defining outcome for research question2, what we can learn from this extensive review.</p>
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REVIEWER	Sarah Rubin Children's Hospital Los Angeles, USA
REVIEW RETURNED	23-Nov-2016

GENERAL COMMENTS	<p>I am glad the authors conducted this systematic review of PEWS as this is a timely and pertinent topic.</p> <p>1) Regarding Data sources and search strategy: I would expect reviewers to contact reference study authors to identify additional studies for evaluation. While this may have been done, it was not explicitly stated in the submitted article. Please clearly state whether or not this step was taken.</p> <p>2) Regarding the screening and selection process: based on the list of references I assume authors did include "Paediatric/Pediatic early warning/alert criteria" in their literature search (ref #7). I believe authors would benefit from including this term in their methods section to ensure readers understand their literature search was adequately comprehensive.</p> <p>3) Regarding the Data extraction and synthesis section: If discrepancies were resolved with a 3rd reviewer, instead of saying "Any discrepancies were resolved through consultation with other reviewers" it would be best to day "Any discrepancies were resolved with a 3rd reviewer", as this would lend more credence than if discrepancies were discussed with a non-specific "other reviewer".</p> <p>Overall, this is an extremely important article, as it provides the first comprehensive review of Pediatric Early Warning Systems for the General Pediatric and Pediatric Critical Care community. While there are clear limitations, including lack of standardized PEWS scores among Pediatric Centers, lack of standardized outcomes when</p>
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	comparing published PEWS studies, and uncertainty around the PEWS education and implementation processes at different institutions, the strengths and applicability of this study outweighs these limitations. In addition, this study draws attention to the fact that multiple different PEWS scores are being used with little evidence to support one score vs. another. Moreover, previously published PEWS literature fails to highlight the need for PEWS to be implemented only as part of a larger multi-faceted safety framework, as this study does.
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REVIEWER	Jennifer Reese MD University of Colorado School of Medicine USA
REVIEW RETURNED	26-Nov-2016

GENERAL COMMENTS	<p>This is a thorough review, with unfortunately few conclusion that can be drawn that affect practice. I'm not sure how much of an impact the publication of this manuscript will offer. Overall it is useful to see that there are no conclusive data from which to derive evidence based practice, and to encourage more organized multisite coordination and study around definition of PEW scoring, systems usage, implementation, and outcomes measures.</p> <p>A few minor suggestions:</p> <ol style="list-style-type: none"> 1. Page 9 line 1-17 don't use "we" as a pronoun 2. Table 2 first article listed refers to a single case study in out patient setting. Why was this article included if inclusion criteria only included inpatient setting? 3. For all 3 research questions, no conclusive answers are able to be made 4. Page 40 line 36-37 the word 'fora' is used, is this a typo? 5. Including tables 4-5 don't necessarily add much to the study
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VERSION 1 – AUTHOR RESPONSE

Reviewer 1 Comments

Introduction: "Paediatric Early Warning Systems (PEWS) are bedside tools" - I think it might be important to delineate between scores and systems at this point. Many would feel a PEWS is a system around a child which goes beyond the bedside tool and includes response teams etc. If PEWS system is being used as a score then I think it is important to be clear about this (in fact the points made later in the paragraph regarding the 4 components seem to imply PEWS is more than a bedside tool)

Response: In the introduction section, reference to early warning scores and systems has been reworded to delineate between a score and a system.

Results: I think it might be useful for the reader to break down the research questions into their specific parts. For example maybe using a table to highlight availability, composition, activation and effectiveness of PEWS separately. The differences are lost in the current over-arching approach.

Response: In the findings section under review question 2, a Table has been included to provide an overview of the evidence on PEW rapid response interventions, including their availability, composition, activation, outcomes and effectiveness, in line with the type of study and level of evidence. Also, in line with reviewer 3 comments, review question 2 has been refined.

I am slightly conflicted as I am part of a team that is looking at socio-contextual factors of PEWS (protocol has been published). There is a rich amount of literature available but not directly regarding paediatric systems. It is not unreasonable to limit a search strategy as the authors have done but it is important to recognise there is a large amount of literature on situational awareness, human factors work etc which is likely to be relevant to the PEWS work. Importantly the differentiation between a MET and a non-MET approach needs to be made (a cost effectiveness study in a MET may not translate to a PEWScore only type study)

Response: Thank you for this comment, as suggested reference has been made in the limitations section of the manuscript to other potential literature that might be of relevance to PEWS but was beyond the scope of this review. Reference has also been made to the named protocol above as emerging work in this field in the context of PEWS. We have also integrated some reference to the potential contribution of this field into the discussion. We have noted in the findings under review question 3 that the findings relating to cost-effectiveness of a MET-RRS may not translate to PEW detection scoring systems and/or broader safety structures that enhance the implementation of PEW systems.

There is a Paediatric ED Paper that was published over the summer in a similar vein to the Maconochie/Bradman paper that doesn't appear to have been included
<http://www.scirp.org/journal/PaperInformation.aspx?PaperID=67309>

Response: Thank you for this reference, it has now been cited in the review.

Discussion: "This review is the first to systematically examine and synthesise evidence on PEWS as a comprehensive system comprised of detection, response and implementation components" - I think the recent Chapman review in resuscitation did something similar (although I appreciate maybe didn't cover implementation)

Response: Thank you for this reference, the recently updated Chapman et al. review was published after submission of this draft and has now been also cited in this review. It supports the findings of this review and in reference to the point above wording has been amended in the discussion section of the revised manuscript with reference also made to Chapman et al. findings.

"Additionally, PEWS have been shown to enhance multidisciplinary team working, communication and confidence in recognising and making clinical decisions about clinically deteriorating children" Was it the PEWS that did this or other systems/approaches around the child? I think this needs to be pulled out more in the results if it is going to be a core conclusion.

Response: The text has been amended under review question 3 to extract findings in support of the above statement. This statement was also reworded in the conclusion to reflect the comment above.

Reviewer 2 Comments

No comments to address

Reviewer 3 Comments

This systematic review summarized 1) evidence of composition and clinical effectiveness of PEWS, 2) PEWS response mechanism (availability, composition, activation and effectiveness), 3) evidence on the process of implementation. These 3 questions are very relevant for the use of PEWS at large scale. But are not properly searched and discussed in this manuscript. All data are described but a better structure of the review is needed. These questions are very broad and are described in large detailed tables and text. They are difficult to summarize as not the result of the study is the way to

order results but the alphabetic ranking of auteurs. I really miss a interpretable summary of the results and I suggest to narrow the research questions and to define the inclusion more strict.

Response: We have taken on board the reviewer comments above and have restructured the paper according to the suggestions given below in relation to each research question. We have also noted at the outset of the manuscript that the review questions were set in the tender document by the Department of Health who commissioned the review. We have developed new tables as recommended and moved the larger detailed tables to the online supplementary materials.

Research question1; what is the effectiveness of the different PEWS. In a figure with on the y1-as the level of evidence , inner y2 –as thepercentage 0-100% to depict the sensitivity and specificity , on the x-s the different PEWS (for every study a sensitivity and specificity in different colors) In an overview you can interpreted the results. The table 1 can be add as an appendix. Exclude from this figure special units if only one study is published and also the studies who do not report on effectiveness and only report on inter and intra-rater agreement studies. Exclude studie with less than 100 cases.

Response: Research question one has been revised to “What is the available evidence on the effectiveness of different PEW detection systems?” A figure has been added after research question one to illustrate the performance criteria of PEW detection systems from 11 studies in line with the suggestion to exclude studies from specialist units if only one study is published, studies that only report on inter and intra-rater agreement as opposed to effectiveness, studies with less than 100 cases and where data on both sensitivity and specificity were not reported. The text in the body of the manuscript under review question 1 has also been amended to reflect these changes.

Research question 2: table 2 is just all details about the studies on PEWS response mechanism, first a summary about effectiveness on different outcomes (table 2) and on y-as also the level of evidence. Second , which activation teams were available. If I understand well nearly all had rapid response team and just a few other strategies. There is a large overlap in the research question, just define clear that the question is what is the effectiveness of the PEWS response mechanism and which intervention was used.

Response: In line with reviewer 1 comments, in the findings section under review question 2, a table has been included to provide an overview of the evidence on PEW rapid response interventions, including their availability, composition, activation, outcomes and effectiveness, in line with the type of study and level of evidence. Review question 2 has been refined to “What evidence exists on the effectiveness of different PEW response mechanism, and what interventions are used?” The text in the body of the manuscript under review question 2 has also been amended to reflect these changes.

Research question 3 is answered bij table 3 . the ordering is alphabetic on auteur, just make an ordering based on the most important topic : implementation strategy/implementation intervention or outcome

Response: In the findings section under review question 3, a table has been included to provide an overview of the evidence on PEWS implementation strategies/interventions, including outcomes and effectiveness, in line with the type of study and level of evidence. Review question 3 has been refined to “What evidence exists on PEWS implementation strategies/interventions?” The text in the body of the manuscript under review question 2 has also been amended to reflect these changes.

Table 4 and 5 are just general description of barriers and facilitators, a summary of these factors based on the systematic review would be very informative.

Response: These tables have been deleted and the key information presented in them is now

reflected in the text and in the new table 2 - overview of evidence on PEW implementation strategies/interventions

The discussion is describing diversity, difficulty to interpret the studies etc. I really miss discussion difficulty in effectiveness studies, defining outcome for research question2, what we can learn from this extensive review.

Response: Thank you for this, we have restructured the discussion, in line with other revisions made in the paper. In doing so, the main limitations of the evidence and the key learning from this review have been focused on.

Reviewer 4 Comments

I am glad the authors conducted this systematic review of PEWS as this is a timely and pertinent topic.

1) Regarding Data sources and search strategy: I would expect reviewers to contact reference study authors to identify additional studies for evaluation. While this may have been done, it was not explicitly stated in the submitted article. Please clearly state whether or not this step was taken.

Response: Yes we did contact reference study authors to identify additional studies for evaluation, and we have now added a statement to this effect in the 'data sources and search strategy' section, and this is further referred to in the results section 'overall search and selection results'.

2) Regarding the screening and selection process: based on the list of references I assume authors did include "Paediatric/Pediatric early warning/alert criteria" in their literature search (ref #7). I believe authors would benefit from including this term in their methods section to ensure readers understand their literature search was adequately comprehensive.

Response: Yes we did include paediatric/pediatric early warning/alert criteria in our search terms and have reflected this in our PICO's, which informed our search terms/strategy, in supplementary appendix 1.

3) Regarding the Data extraction and synthesis section: If discrepancies were resolved with a 3rd reviewer, instead of saying "Any discrepancies were resolved through consultation with other reviewers" it would be best to say "Any discrepancies were resolved with a 3rd reviewer", as this would lend more credence than if discrepancies were discussed with a non-specific "other reviewer".

Response: Yes, any discrepancies were resolved with a 3rd reviewer and this has been reworded/clarified in the data extraction and synthesis section.

Overall, this is an extremely important article, as it provides the first comprehensive review of Pediatric Early Warning Systems for the General Pediatric and Pediatric Critical Care community. While there are clear limitations, including lack of standardized PEWS scores among Pediatric Centers, lack of standardized outcomes when comparing published PEWS studies, and uncertainty around the PEWS education and implementation processes at different institutions, the strengths and applicability of this study outweighs these limitations. In addition, this study draws attention to the fact that multiple different PEWS scores are being used with little evidence to support one score vs. another. Moreover, previously published PEWS literature fails to highlight the need for PEWS to be implemented only as part of a larger multi-faceted safety framework, as this study does.

Response: We thanks reviewer 4 for these valuable comments which we have ensured are borne out in the manuscript.

Reviewer 5 Comments

This is a thorough review, with unfortunately few conclusion that can be drawn that affect practice. I'm not sure how much of an impact the publication of this manuscript will offer. Overall it is useful to see that there are no conclusive data from which to derive evidence based practice, and to encourage more organized multisite coordination and study around definition of PEW scoring, systems usage, implementation, and outcomes measures.

Response: We thanks reviewer 4 for these valuable comments which we have ensured are borne out in the manuscript.

A few minor suggestions:

1. Page 9 line 1-17 don't use "we" as a pronoun

Response: This section has been reworded to avoid the use of 'we' as a pronoun

2. Table 2 first article listed refers to a single case study in out-patient setting. Why was this article included if inclusion criteria only included inpatient setting?

Response: Thanks you, this article has been removed from the review.

3. For all 3 research questions, no conclusive answers are able to be made

Response: This is correct and this point has been made at the beginning of the discussion.

4. Page 40 line 36-37 the word 'fora' is used, is this a typo?

Response: This text has been edited.

5. Including tables 4-5 don't necessarily add much to the study

Response: These tables have been deleted.

Finally, all reference numbers have been amended in line with revisions made to the manuscript.

We thank you for taking the time to review this revised submission.

VERSION 2 – REVIEW

REVIEWER	Damian Roland Leicester University I have published papers quoted in this review and am also part of a grant funded project undertaking a similar exercise.
REVIEW RETURNED	26-Jan-2017

GENERAL COMMENTS	Thank you for your thorough responses to the questions posed in the initial review.
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REVIEWER	Henriette Moll ErasmusMC Sophia, Rotterdam , the netherlands
REVIEW RETURNED	26-Jan-2017

GENERAL COMMENTS	The manuscript has improved significantly after including the reviewers comments. This is a very important paper to publish in BMJ open.
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