PEER REVIEW HISTORY

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ARTICLE DETAILS

TITLE (PROVISIONAL)	Medication double-checking procedures in clinical practice – a cross-sectional survey of oncology nurses' experiences
AUTHORS	Schwappach, David; Pfeiffer, Yvonne; Taxis, Katja

VERSION 1 - REVIEW

REVIEWER	Professor Maree Johnson Australian Catholic University, Australia.
REVIEW RETURNED	10-Feb-2016

GENERAL COMMENTS	This is a very interesting paper addressing a major concern in medication safety. The investigator(s) have conducted observational studies, followed by a survey using scenarios seemingly based on observational studies. Unfortunately little detail is provided on the observational study which would seem critical to the value of this work. Some details of the early study would provide a sound foundation for the survey work. The abstract in particular is poorly written and should be rewritten. Formatting issues are evident throughout the paper with headings requiring a Capital throughout. The paper would be improved by extended definitions of some of the terms used. In particular the reference to redundancy requires further explanation for the more general reader. For example Inanimate objects are unaware of each other .. will conduct a redundant check .. I was unable to interpret the meaning of this at all. There is no stated aim, research questions, so the results are somewhat unexpected. Details of the independent and dependent variables within the regression are unclear. A research question that provides some rationale for why this was conducted would be helpful. Also some discussion on how the data achieved the underlying assumptions of normality would be informing. In particular the dependent variable seems to be a 7 point scale and therefore is questionable. The topic and the results could make an important contribution but requires major rewriting to allow for replication by others. The inclusion of the regression may be simply too much being placed in the one paper, and in my opinion has limited added value to this paper. The discussion with further rewriting and being related to research questions could be enhanced to deliver good use of existing

	literature, while providing some direction for clinical practice.

REVIEWER	Wendy Carter Kooken Illinois Wesleyan University School of Nursing United States of America
REVIEW RETURNED	04-Mar-2016

GENERAL COMMENTS	This is an interesting and informative study. There are several comments which may improve the paper and lend strength to the findings. P. 3 of 22- The authors indicate double checking is the most frequently called for safety intervention- but there is not a reference to indicate - Who calls for this? Second paragraph- Would suggest tabling the various forms of DC procedures authors identified. Pg 4 of 22- The Swiss standards for chemo administration are somewhat confusing. What is meant by 'depending on the institutional policy'? For most professional organizations, they set the standards and it is up to the institution to comply or incorporate those standards. Do the Swiss nursing standards define what is meant by double check? At some point in the reading, it became clear that authors are not presenting the entirety of their study in this paper. On pg. 4 authors indicate they explored nurses experiences and views towards DC in chemo- but are those results presented in this paper? In the methods section that follows, authors then report the two part nature of the study and what was reported in the current article and what was not. If nurses experiences and views are not presented in this paper- authors could remove the 2-3 sentences before methods that go into detail about nurses experiences and remove those, because discussion of them in the current article confuses the reader. Pg. 5 of 22. The figures are first mentioned on this page. While the drawings were used as part of the survey (figure 2), they do not enhance the article in any way. Would suggest removing them. Pg. 6 pf 22- Change Anova to ANOVA. Under Results- Avoid beginning sentences with %. In reading the results, one thing that clearly stands out and seems frightening is that more than 10% of respondents did not know their med admin guidelines well. It was surprising that authors did not expand on this result. It would be interesting to see if there are any differences in the 11% who answered in this way and if their results when compared to errors etc differ significantly from others who did know their policies. Pg 7 of 22- Under characteristics of DC and violations 3rd line- remove the word 'only' before 24%. Only misleads the reader to believe not many people thought one person independently repeating the process was an important or unusual finding- when only 22% marked 2 person checks were essential for good DC. The significance of these findings is that 54% felt two persons checking meds together successively was the highest ranked. The concern

	with this finding is that without clear and agreed upon policies, based on best evidence, the majority of the nurses in this study chose one procedure that perhaps is not supported as a best practice. In this same section, authors mention nurses reporting different violations with medication safety rules- what are the safety rules to which nurses were referring? Was it an agreed upon group of rules per the survey or was it an assumed set of rules? Pg 8 of 22. Authors mention premedications. In what way are authors defining premedications? Under interruptions and barriers- When authors report factors frequently interfering with DC, could participants choose all that apply? Pg. 9 of 22. Authors mention they may be the first to perform such research. There are several articles that would be informative for authors to add to their references. Here is a brief list of such articles. Several are similar, although not asking exactly the same kind of questions. http://www.patientsafetysolutions.com/docs/October_16_2012_What_is_the_Evidence_on_Double_Checks.htm http://www.ihi.org/resources/Pages/Changes/ReduceAdverseDrugEventsInvolvingChemotherapy.aspx http://www.ahrq.gov/downloads/pub/advances2/vol2/Advances-David_13.pdf http://adc.bmj.com/content/early/2012/04/30/archdischild-2011-301093.short http://www.bmj.com/content/334/7590/407?variant=full-text Pg. 10 of 22. authors indicate that they advocate discussing true independence in double checking and how it can be achieved in clinical practice. This is somewhat confusing because authors never support the claim that independent double checking is the gold standard. Authors only indicate that there is confusion surrounding what DC means in practice and how it is carried out. pg. 11 of 22- Authors indicate there were between 45% and 25% of the answers- It is confusing the way this is worded. Is one of these figures from ward and the other ambulatory? It would be helpful to label the difference in respondents. Throughout the paper Please be consistent in use DC as the abbreviation for double checking. Sometimes authors write things like The DC or a DC - where the 'the' and the 'a' could be eliminated. It is distracting for the reader to have to think is DC double checking or double check.

VERSION 1 – AUTHOR RESPONSE

Reviewer: 1 Reviewer Name: Professor Maree Johnson	
This is a very interesting paper addressing a major concern in medication safety. The investigator(s) have conducted observational studies, followed by a survey using scenarios seemingly based on observational studies. Unfortunately little detail is provided on the observational study which would seem critical to the value of this work. Some details of the early study would provide a sound foundation for the survey work.	Thank you We now provide more details on the field observations for survey development (P 4-5).
The abstract in particular is poorly written and should be rewritten.	Thank you. We thoroughly revised the abstract.
Formatting issues are evident throughout the paper with headings requiring a Capital throughout.	We formatted the headings according to the author guidelines (http://journals.bmj.com/site/authors/preparing-manuscript.xhtml#manuscript): Main text separated under appropriate headings and subheadings using the following hierarchy: BOLD CAPS, bold lower case, Plain text, Italics.
The paper would be improved by extended definitions of some of the terms used. In particular the reference to redundancy requires further explanation for the more general reader. For example Inanimate objects are unaware of each other .. will conduct a redundant check .. I was unable to interpret the meaning of this at all.	Thank you. We now include a brief definition of redundancy in the introduction (P3), reading “In broad terms, redundancy means that a system component (e.g., mass storage) is duplicated and serves as a back-up in case of failure.” We also revised the section related to redundancy in the discussion which we hope is now easier to follow (P10, bottom para).
There is no stated aim, research questions, so the results are somewhat unexpected.	Thank you for this remark. This section of the introduction has been revised (P4 bottom to P5 top). In particular, we now clearly describe the main and specific questions and also why and what we expected.
Details of the independent and dependent variables within the regression are unclear. A research question that provides some rationale for why this was conducted would be helpful. Also some discussion on how the data achieved the underlying assumptions of normality would be informing. In particular the dependent variable seems to be a 7 point scale and therefore is questionable	Thank you. We clarified the research question in the introduction and also provide more details in the analysis section (P7 bottom). Regarding data analysis: The Likert scales used a 1-7 scaling and we thus found it acceptable to treat it as continuous (as many others). However, assumptions on normality are violated. Ordinal regression would be an alternative but given the relative high number of categories, the strong assumptions and the difficult interpretation of results, this approach does not seem to be an option here. We ran binary logistic regression with the DC appropriateness rating dichotomized. The results are essentially the same as with the multiple linear regression. We therefore decided to include the results of the logistic regression (table 4).
The topic and the results could make an	Thank you. Many sections have been revised for

important contribution but requires major rewriting to allow for replication by others. The inclusion of the regression may be simply too much being placed in the one paper, and in my opinion has limited added value to this paper.	clarity. To the authors, one major finding in this and other studies of DC routines is that various forms are implemented in practice. Many nurses have experiences with different types of checking procedures. We believe that it is a valuable opportunity to assess these experiences and nurses' judgments about the suitability of different DC procedures and the factors affecting their evaluations. The regression analysis does exactly this and therefore we prefer to keep this analysis in the paper. To our understanding, this analysis adds, in particular, that, even after adjusting for personal and work-related characteristics, a) nurses have clear judgments about the appropriateness of different DC procedures and b) they have a strong bias towards "the known", i.e. those procedures they currently use. Ceteris paribus, nurses attached higher appropriateness to those procedures they currently experience, irrespective of what this procedure is. We hope that our revision now makes this clearer.
The discussion with further rewriting and being related to research questions could be enhanced to deliver good use of existing literature, while providing some direction for clinical practice.	Thank you. We revised the introduction and discussion sections and hope that the changes made are satisfactory.
Reviewer: 2 Reviewer Name: Wendy Carter Kooken	
This is an interesting and informative study. There are several comments which may improve the paper and lend strength to the findings.	Thank you
P. 3 of 22- The authors indicate double checking is the most frequently called for safety intervention- but there is not a reference to indicate - Who calls for this?	P3, first para: We now include recommendations about DC from several expert organizations outside of oncology. P4, second par, now includes details of the American Standards for DC in chemotherapy administration.
Second paragraph- Would suggest tabling the various forms of DC procedures authors identified.	As this is an incomplete and not mutually exclusive list of examples, we would prefer to keep this information in the main text and not in a table.
Pg 4 of 22- The Swiss standards for chemo administration are somewhat confusing. What is meant by 'depending on the institutional policy'? For most professional organizations, they set the standards and it is up to the institution to comply or incorporate those standards. Do the Swiss nursing standards define what is meant by double check?	Yes, we agree. These standards are not binding for institutions. In addition, the document remains unclear about what a double-check is. It is likely that this ambiguity adds to variability and inconsistency in practice. We revise this section (P4, middle of second para), it now reads: The Swiss nursing standards on chemotherapy administration (which are not binding) state that, depending on the institutional policy, a double-check of the drug and the dose should be conducted during preparation and administration [26]. There is, however, no definition or explanation of a robust checking procedure given in the document or recommendations on how DC should exactly be performed.

At some point in the reading, it became clear that authors are not presenting the entirety of their study in this paper. On pg. 4 authors indicate they explored nurses experiences and views towards DC in chemo- but are those results presented in this paper? In the methods section that follows, authors then report the two part nature of the study and what was reported in the current article and what was not. If nurses experiences and views are not presented in this paper- authors could remove the 2-3 sentences before methods that go into detail about nurses experiences and remove those, because discussion of them in the current article confuses the reader.	Thank you. In this study, we report about the first part of the survey, which addressed “practice patterns and evaluations”. Nurses are asked to report their practices and personal experiences and evaluations concerning this practice. The introduction refers to this survey part and the corresponding results are reported. We slightly revised the wording to be more concise in this section (P4 bottom to P5 top). [The second part addressing “norms and beliefs”, not reported herein, used attitude-like statements. Participants had to rate these items according to their level of agreement with these statements.]
Pg. 5 of 22. The figures are first mentioned on this page. While the drawings were used as part of the survey (figure 2), they do not enhance the article in any way. Would suggest removing them.	We would prefer to keep the figure. We find it important that readers get an understanding of the level of detail in the process descriptions presented to participants. Otherwise, readers may assume that we used much more detailed flow-charts of DC procedures, which we intentionally did not.
Pg. 6 pf 22- Change Anova to ANOVA.	Changed accordingly.
Under Results- Avoid beginning sentences with %.	Changed accordingly.
In reading the results, one thing that clearly stands out and seems frightening is that more than 10% of respondents did not know their med admin guidelines well. It was surprising that authors did not expand on this result. It would be interesting to see if there are any differences in the 11% who answered in this way and if their results when compared to errors etc differ significantly from others who did know their policies.	Thank you. Yes, we agree that this finding is concerning. We now expand on this finding in the discussion (P12, top) and place it in context with sharing of responsibility. We found no association of guideline awareness with reported errors or perceived main characteristics of the double-check.
Pg 7 of 22- Under characteristics of DC and violations 3rd line- remove the word 'only' before 24%. Only misleads the reader to believe not many people thought one person independently repeating the process was an important or unusual finding- when only 22% marked 2 person checks were essential for good DC. The significance of these findings is that 54% felt two persons checking meds together successively was the highest ranked. The concern with this finding is that without clear and agreed upon policies, based on best evidence, the majority of the nurses in this study chose one procedure that perhaps is not supported as a best practice.	Yes, indeed, thank you. Word “only” removed.
In this same section, authors mention nurses reporting different violations with medication safety rules- what are the safety rules to which nurses were referring? Was it an agreed upon group of rules per the survey or was it an assumed set of rules?	Thank you. The rules were presented as three single items (reported in table 3). These rules are: Complete and appropriate performance of a scheduled double-check; medication administered by a professional involved in the DC (to increase chances that an error would be detected ultimately at bedside); administering the medication directly after the completed double-check to the individual patient, i.e., not performing checks in series, and

	then administering in series (e.g., to avoid that confusions of medications occur between completed double-checks and administration). These rules reflect best practices in the participating units (how it should be optimally done). We describe this in more detail in the methods (P6, top).
Pg 8 of 22. Authors mention premedications. In what way are authors defining premedications?	"Premedications" is a defined term in chemotherapy treatments. It mainly involves drugs to prevent side effects or hypersensitivity reactions associated with chemotherapy. P5 (first use of the term) now reads "…premedications (drugs given prior to chemotherapy to prevent side effects of treatment, e.g., antiemetic drugs and steroids)…"
Under interruptions and barriers- When authors report factors frequently interfering with DC, could participants choose all that apply?	Yes, as reported in this para (P8), this question was a multiple choice question ("multiple answers possible")
Pg. 9 of 22. Authors mention they may be the first to perform such research. There are several articles that would be informative for authors to add to their references. Here is a brief list of such articles. Several are similar, although not asking exactly the same kind of questions 1. http://www.patientsafetysolutions.com/docs/October_16_2012_What_is_the_Evidence_on_Double_Checks.htm 2. http://www.ihi.org/resources/Pages/Changes/ReduceAdverseDrugEventsInvolvingChemotherapy.aspx 3. http://www.ahrq.gov/downloads/pub/advances2/vol2/Advances-David_13.pdf 4. http://adc.bmj.com/content/early/2012/04/30/archdischild-2011-301093.short 5. http://www.bmj.com/content/334/7590/407?variant=full-text	Thank you for these suggestions. We are of course aware of the previous and ongoing research in this area. However, as far as we know, DC practices in oncology have not yet been addressed empirically before. A brief response why we did not included the suggested references: 1. Ref 1 is a brief summary (Patient Safety Tip of the Week) which reports the relevant studies. These studies have all been already included in our paper (e.g., Alsulami, Armitage, Tamuz, White, ISMP). 2. Ref 2 is a list of changes for safe chemotherapy administration recommended by the IHI, which includes the recommendation to include the double-check but not new data about its effectiveness, similar to ISMP 3. Ref 3 mentions the double-check as one risk reduction strategy in complex paediatric chemotherapy protocols. This is a valuable report but does not provide any evidence or details on how the check should be performed. 4. Ref 4 was already included in our paper. 5. Ref 5 reports about the implementation of safety practices related to oral chemotherapy at US cancer centres in 2005. The authors report at how many of the surveyed centres prescriptions have to be double-checked by a second clinician. We felt that these figures are a little outdated (10 years old) and as they are only relevant to prescriptions of oral chemotherapy not very close to our objective.
Pg. 10 of 22. authors indicate that they advocate discussing true independence in double checking and how it can be achieved in clinical practice. This is somewhat confusing because authors never support the claim that independent double	We agree that we did not claim independence as "gold standard". However, we pointed to the importance of independence in the introduction (P3, top (ISPM recommendation) and P4, top) and in the discussion. We revised these sections and hope

checking is the gold standard. Authors only indicate that there is confusion surrounding what DC means in practice and how it is carried out.	that the rationale is now clearer.
pg. 11 of 22- Authors indicate there were between 45% and 25% of the answers- It is confusing the way this is worded. Is one of these figures from ward and the other ambulatory? It would be helpful to label the difference in respondents.	Thank you. This range refers to the responses to the different scenarios. We slightly reworded to make this clearer. P12, bottom, now reads "Depending on the DC scenario presented, between 45% and 25% of participants indicated that at least several errors per month had been detected using this method."
Throughout the paper Please be consistent in use DC as the abbreviation for double checking. Sometimes authors write things like The DC or a DC - where the 'the' and the 'a' could be eliminated. It is distracting for the reader to have to think is DC double checking or double check.	Changed accordingly throughout the paper.

VERSION 2 – REVIEW

REVIEWER	Maree Johnson ACU Australia
REVIEW RETURNED	06-Apr-2016

GENERAL COMMENTS	This is a very interesting paper that addressing an important issue relating to patient safety. The authors have developed the argument for the importance of work. However, the specific aim and research questions were not clearly defined and this was then a problem when trying to assess the methods and findings. The organisation of the material in the Methods section should be reconsidered, commencing with the sample and setting, survey including a section of development of the survey and scenarios. Although most findings were descriptive in nature and in the main clear in presentation, some aspects remained difficult to understand. The use of logistic regression was unclear and why appropriateness was considered a dependent variable (dictomised form) was still unclear. The sample in the analysis was not noted. 'detangle judgments' (I was unable to ascertain the meaning of this). There were lengthy sections in the discussion which required fragmenting. Further clarity and organisation of the study would greatly improve the ability of reader to access the important findings that may be present.

REVIEWER	Wendy Kooken Illinois Wesleyan University USA
REVIEW RETURNED	23-Apr-2016

GENERAL COMMENTS	The paper has improved and authors have focused on improving most of the recommendations.

VERSION 2 – AUTHOR RESPONSE

Reviewer: 1 **Reviewer Name: Professor Maree Johnson**	
This is a very interesting paper that addressing an important issue relating to patient safety. The authors have developed the argument for the importance of work. However, the specific aim and research questions were not clearly defined and this was then a problem when trying to assess the methods and findings.	Thank you. We now provide a clear main aim, a primary research question and two secondary research questions together with arguments why we regard these questions as important. **P5-6 (cleared copy)**
The organisation of the material in the Methods section should be reconsidered, commencing with the sample and setting, survey including a section of development of the survey and scenarios.	We re-organized the methods section as suggested. We now include more subsections and think this chapter is now easier to follow. **P6-9 (cleared copy)**
Although most findings were descriptive in nature and in the main clear in presentation, some aspects remained difficult to understand. The use of logistic regression was unclear and why appropriateness was considered a dependent variable (dictomised form) was still unclear. The sample in the analysis was not noted. 'detangle judgments' (I was unable to ascertain the meaning of this).	We hope that the revisions made in the research questions and the analysis section make the rationale for the regression and the interpretation of results now straightforward. The sample size for this analysis is clearly explained in the analysis section. **P8-9 (cleared copy)** The results were slightly reworded to make them clearer. **P11 (cleared copy)** The main feature and purpose of the regression analysis is that we are able to quantify the degree of bias towards the known in the appropriateness ratings of DC procedures. While this bias in judgment is strong, as our results show, nurses have also clear ideas about DC appropriateness that go beyond their current experience.
There were lengthy sections in the discussion which required fragmenting. Further clarity and organisation of the study would greatly improve the ability of reader to access the important findings that may be present.	We completely re-organized the discussion and added sub-headings. Some sections were completely revised / rewritten. **P11-14 (cleared copy)**
Reviewer: 2 **Reviewer Name: Wendy Carter Kooken**	
The paper has improved and authors have focused on improving most of the recommendations.	Thank you very much!