Reviewer’s report

Title: Injury death certificates without specification of the circumstances leading to the fatal injury - the Norwegian Cause of Death Registry 2005-2014

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Reviewer: James Harrison

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General comments

How, and to what extent, residual categories are used when applying the ICD can have important effects on data and interpretation. In the context of coding injury deaths using ICD-10, X59 is the most important residual category in deaths data for many countries. ("Undetermined intent" [Y10-Y34] predominates in some other countries, and the overall ICD-10 residual categories [R95-R99], which might include injury cases, are used often enough to warrant attention in some countries.)

As Ellingsen et al. point out in this manuscript, other authors have examined aspects of the "X59 problem", and some have redistributed X59 cases to other categories, notably in burden of disease projects. Ellingsen et al. provide a quantitative approach to assessing predictors of X59 (binary logistic regression) and redistributing the cases (multinomial LR; split sample of Norwegian deaths data). Separate follow-up with certifiers of some cases coded to X59 confirmed what was found by the modelling.

I like the approach. I can imagine using it, or something similar, to provide a more formal basis than my current method for dealing with X59 in the national mortality data that I use, noting that differences in available variables would have some impact on the set of covariates that I could use. The work reported here provides a stronger basis for redistribution of X59 than other reported methods.

My (relatively minor) reservations are that:

1. Too little attention is given to the X59 as part of the ICD, and implications of that.

2. The paper gives an unwarranted impression of homogeneity in the use of UCOD X59.

3. More should be offered on the generalizability of the method and (separately from that) generalizability of the particular findings of its use in Norway.
1. X59 in the ICD

The authors do not fully describe the meaning and place of X59 in ICD-10 and do not explain the change to the category made in the 2006 edition of ICD-10, which is very relevant to their project. It is noteworthy that one of the new sub-categories introduced in 2006, X59.0, is very similar to the ICD9 category E887, "Fracture, cause unspecified", which was placed in the accidental falls part of the external causes chapter. Closer attention to these details is warranted because it makes clear that, by design, X59 is the code that one should expect to be used if a death is due to an injury, but without specification of the external cause. Moreover, the framing of E887 and its successor X59.0 reflect the long-standing recognition that cases like the ones that account for the bulk of X59 codes in Norway occur and need to be coded. These categories are the means provided in the ICD to allow this poorly-specified type of case to be recorded statistically.

A related point that could usefully be made more clearly is that the fall/fracture in old age type of X59 case, so dominant in Norway, is far from being the only type of case that can properly be coded to X59. Indeed any death due to an external cause (which is taken to include all deaths due to injury) should be coded to X59 if this is all that is known about it. The circumstances that can result in this particular degree of knowledge about the cause of a death (i.e. it is due to injury, but that's all we know) may vary widely. Hence, while the finding that X59 cases in Norway were nearly all fall/fracture cases is not surprising, it is possible that X59-coded records elsewhere could predominantly refer to other types.

2. Variation in use of X59

The authors report that X59-coded cases in Norway are numerous and nearly all are deaths in old age following an injurious fall. They reached that conclusion by modelling Norwegian unit-record deaths data and by consulting with the doctors who certified the X59 cases. The authors cite work done in several other countries, which used various other methods but came to the same conclusion: in those countries, too, the bulk of deaths with UCOD X59 followed fractures in old age and were largely attributed to falls.

They mention a couple of studies that found variation between countries in use of X59 (8,9). However, they do not consider directly the extent to which the performance of their modelling method might be affected by such variation. The authors could, with some justification, argue that this doesn't matter, since their study focuses on only one country. I would counter by saying that much of the value of this paper, and the main reason to publish it in an international journal, is that it has implications for work in other countries and for international work such as GBD. Hence, I think that the authors should give more attention to whether the method is likely to be robust in the face of patterns of use of X59 that differ from that in Norway.
What are the patterns, and how could the authors find out about them? The papers cited as references 8 and 9 go some way, but the more direct route is to examine national cause of death data freely available from the WHO Mortality Database. I looked at the most recent annual set for all countries for which data were available at ICD-10 3-character (e.g. X59) or 4-character (e.g. X59.0) level. I downloaded data for 107 territories and assessed the proportion of all external causes deaths that had been coded to X59. I did that for deaths at all ages, and separately for deaths at 0-74y and 75+y. Given the circumstances, this had to be a quick look, not a thorough analysis.

A couple of hours’ work revealed a lot that contextualises the findings of the manuscript. For example, considering all-ages external causes deaths, Norway ranked high (5th; 25.9%) in prevalence of X59. In 10/107 territories prevalence was >20% and in 31/107 it was less than 2%. Prevalence varied widely in countries near Norway: Sweden 18.7%, Denmark 12.0% and Finland 1.4%. Considering the 90/107 territories for which data were available for both of the age bands considered, the prevalence of X59 was higher (often much higher) in the older group in most places, but the opposite was so in a few countries. Norway ranked 11th, one of 13/90 places in which more than half of all external causes deaths at 75+ were coded to X59. At the other extreme, in 20/90 place the proportion was below 2%, including Finland, New Zealand and Estonia. While the prevalence of X59 among external deaths at ages younger than 75 was low in most places (below 2% for 32/90) it was 10% or higher in 13/90.

Such wide variation in the use of X59 suggests differences in data sources, quality and processing. That might well result in differences in the proportion of included cases that are of the fall/fracture type. More could be learned from this source. I didn't look at the use of other residuals, both within the external causes chapter, and elsewhere in the ICD. Nor did I check systematically for use of the post-2006 ICD-10 version of X59, though I did notice that the Norwegian data for the year that I examined (2014) appeared to be coded in that way.

3. Generalizability

Flowing from the previous points is the question of generalizability, about which I hope that the authors will say more. I see two aspects to this.

First, are the specific findings of this study safely generalizable to other places? These authors provide compelling evidence that nearly all X59 deaths in Norway are fall/fracture cases. Is it safe to conclude that the same is true of X59 coded cases elsewhere? My notes on the two previous points are my argument against that being a safe generalisation. I think that the authors should state their view on this matter in the discussion.

Second is the _method_ presented here safely generalizable? By that I mean: if it is practicable to apply the same method, or a very similar one, in any other place - including places in which
available data indicate very different use of X59 to the use in Norway - is there reason to think that it will perform reliably?

I don't see a strong reason why it should not perform well in a fairly wide range of circumstances, but I would not be confident to say that it does until it has been used in at least a few other places, including some where use of X59 appears to differ from use in Norway. What do the authors say?

To summarise: this good paper would be strengthened by saying more on what X59 is in the ICD, pointing out more clearly that fall/fracture deaths in old age is not the only type of case that can wind up with this UCOD code and that the extent of (and perhaps reasons for) use of the code varies greatly between countries. Pending successful application of the authors' method in some situations in which other types of case contribute substantially to the total of X59 cases, caution is warranted on generalization.

Specific comments

Table 1, External causes: Range X40-X49 is incorrectly included in group 4 (and correctly in 3).

Table 1, Nature of injury: category number 2 is repeated. Categories T71 and T75.1 are incorrectly included in group 8 (and correctly in 7)

Lines 108-10: Consider expending on the model-building logic. E.g. on what grounds were all of the independent variables included in the final model? Is the final model well-specified?

Line 117: The choice of this particular set of target categories is not explained.

Line 126-7: Are overall accuracy and kappa suitable measures here? (I don't know, and no source is given on this point).

Line 142: Statistical analysis: There is no mention near here of the binary logistic regression.

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