



## Technical Guide

# Calculating Directly Standardised Rates

## Introduction

Public Health England (PHE), along with NHS Digital and other organisations, routinely produce many indicators calculated and presented as directly standardised rates (DSRs), including mortality rates, cancer incidence rates, hospital admission rates. [APHO Technical Briefing 3](#)<sup>1</sup> describes how DSRs and their confidence intervals are calculated.

## Background

There has been a concern that a calculated DSR is not valid when it is based on a 'small' number of events. This is a consequence of instability in the variance, which is also likely to make approximations for the confidence intervals unreliable. However, there has been very little literature on this other than statements that DSRs are not appropriate when either a) there are 'several' cells with zero counts or b) the total number of events is 'small'. But there appears to have been no clear evidence to help define 'several' or 'small'. One rule of thumb quoted is that the total count should not be less than 25.<sup>2</sup> In the absence of other evidence, this guideline was applied within PHE to production of DSR indicators until 2017.

In addition, three different methods of calculating confidence intervals for DSRs have commonly been used and it has not been clear which of the latter two provide the most accurate confidence intervals:

- Normal approximation
- Tiwari modified gamma method
- Dobson method

<sup>1</sup> APHO Technical Briefing 3: Commonly used public health statistics and their confidence intervals. ([http://fingertips.phe.org.uk/documents/APHO Tech Briefing 3 Common PH Stats and CIs.pdf](http://fingertips.phe.org.uk/documents/APHO_Tech_Briefing_3_Common_PH_Stats_and_CIs.pdf))

<sup>2</sup> Curtin LR, Klein RJ. Statistical Notes Number 6: Direct Standardization (Age-Adjusted Death Rates). Centers for Disease Control 1995. <http://www.cdc.gov/nchs/data/statnt/statnt06rv.pdf>

In 2017 PHE commissioned research to clarify these two issues. The results of this research, which has been submitted for publication,<sup>3</sup> provide much clearer guidance which is summarised below and should be applied to all DSR indicators.

## Guidance

<b>Small numbers</b>
<b>Directly standardised rates should not be calculated when the total count across all age groups is less than 10</b>
The number of age or age/sex strata does not matter
Cells with zero counts do not matter, however many of them there are

<b>Confidence intervals</b>
<b>The Dobson method should be used for the calculation of DSR CIs</b> However, there is no technical reason to change existing calculations that use the Tiwari method This guidance is based on the following:
The normal approximation method gives reasonable confidence intervals when the count is at least 25, but it is not as accurate as either of the other methods
Both Dobson and Tiwari methods provide extremely accurate confidence intervals when the count is at least 10
The Dobson method gives confidence intervals consistently (but marginally) closer to the stated 95% coverage while the Tiwari method is consistently (marginally) more conservative (ie coverage is slightly higher than the stated 95%)
The Dobson method is simpler to apply than the Tiwari method

## PHE Technical Guides

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<sup>3</sup> Reference to be provided when available