Commentary: missing targets on drugs-related deaths, and a Scottish paradox.

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Keywords: *drugs-related deaths; injector epidemics; age-group; current injectors; country or region.*

Abstract

The 10-year drug strategy for England and Wales was published in February 2008. It dropped drugs-related deaths (DRDs) as a key performance indicator. Scotland retained a necessary strong focus on DRDs. Scotland's DRDs numbered 1,006 in 2000-02 and 1,009 in 2003-05. The previous Scottish administration's claim that its number of current injectors had decreased substantially between 2000 and 2003 implied, paradoxically, that their DRD rate would have to have increased. Worse was to come: Scotland's DRDs had increased to 876 in 2006+2007.

We analyse UK's DRDs by sex and age-group to reveal temporal trends (2000-02 versus 2003-05 versus 2006+2007) with different public health and epidemiological implications. We also address the above Scottish paradox and assess, by age-group, how consistent Scotland's 876 DRDs in 2006+07 are with Scottish injectors' DRD rate in 2003-05 of around 1 per 100 injector-years.

Public health success in the UK in reducing DRDs at younger ages should not be overshadowed by the late consequence (older-age DRDs) of UK's injector epidemics: in the early 1980s in Scotland, and late 1980s in England and Wales. Targets for reducing DRDs should pay heed to UK's injector epidemics. [188 words]

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Introduction

A new drug strategy for England and Wales (2008-18) was published in February 2008 (HM Government, 2008). Drugs-related deaths (DRDs) were dropped as a key performance indicator, perhaps because the previous target – to reduce DRDs by 20% between 1999 and 2004 – had been missed (Morgan et al., 2006; Report, 2007). Only a 9% reduction could be claimed (Morgan et al., 2006) when DRDs were defined in accordance with recommendations by the Advisory Council on the Misuse of Drugs (2000) (ACMD).

Scotland's new drugs strategy, Road to Recovery, was published in May 2008 (The Scottish Government, 2008a). In the wake of Scotland's confidential inquiry into DRDs in 2003 (Zador et al., 2005) and specific recommendations in 2007 by a National Forum on Drug-Related Deaths (2007), DRDs have remained firmly in focus with the Scottish Government (2008a, 2008b). A newly designed national database was launched in

January 2009 for collecting and analysing standardised information on all Scotland's DRDs.

According to ACMD's recommended definition, Scotland's DRDs numbered 1,006 and 1,009 in the 3-year periods of 2000-02 and 2003-05 respectively; but 876 in the most recently published *two* years (2006+2007), which gave a total of 2,891 for the 8-year period of 2000-07 (Information Services Division, 2008). For England and Wales, according to the same definition but by the registration year of deaths, DRDs at all ages were 5,022 in 2000-02, lower at 4,534 in 2003-05; and 3,177 in the most recently published *two* years (2006+07), which gave a total of 12,733 for 2000-07 (Report, 2008).

Most DRDs are opiate-related, and they mostly occur in injecting drug users (IDUs). We therefore delve deeper – firstly, to analyse by age-group because the epidemic history of injection drug use in the UK requires it (Bird et al., 2003) and, secondly, to address a Scottish paradox about injectors' DRD rate having apparently increased in 2003-05.

By analysing within age-group (Bird et al., 2003), we show, first, that the above 3-year totals obscure public health success, in terms of very significant reductions in UK's DRDs at younger ages. However, we also reveal the late epidemiological consequence of UK's national epidemics of injecting drug use in the 1980s. Morgan et al. (2008) recently, and rightly, called for a better international understanding of the mechanisms that underlie overdose mortality statistics than mere age-standardisation to a common

European population allows (Morgan et al., 2006). Age-standardisation masks, rather than reveals, trends which are importantly different by age.

The differences by age that we reveal have their origin in the epidemic nature of injecting drug use. The number of current IDUs was estimated to have increased 6-fold in Scotland between 1980-89 (Hutchinson et al., 2006). The corresponding increase in England was at least 4-fold between 1987-96 (De Angelis et al., 2004), and so somewhat delayed. These time periods, while not exact and subsuming of sub-national variation, are sufficiently different for us to anticipate that any sharp 1980s-related increase in DRDs in older-age IDUs may be relatively delayed in England compared to Scotland (and possibly also less sharp). The Health Protection Agency (2005) refers also to an earlier (smaller) IDU epidemic prior to 1970 in England and Wales.

The Scottish paradox arose as follows. Because DRDs are mainly opiate-related and occur mostly in IDUs, there is reason to estimate DRDs rates per 100 current IDUs (Bird et al., 2003), a relevant denominator, as recommended by ACMD (2000). Capture-recapture estimates of Scotland's current IDUs in 2000 (see Hay et al., 2001; King et al., 2005; Bird et al., 2003) and again in 2003 (Hay et al., 2005; King et al., 2008) were publicly reported (Scottish Government News Release, 2005) as suggesting that the prevalent number of IDUs had decreased from 25,000 in 2000 to nearer 19,000 by 2003. Since Scotland's DRDs had been 1,006 in 2000-02 and 1,009 in 2003-05, we were concerned by the ***apparent paradoxical implication*** that Scotland's DRD rate per 100 current IDUs should have ***increased*** in 2003-05, and this despite enhanced access to

methadone maintenance, including in prisons (Information Services Division, 2006; The Scottish Government, 2008).

To address this Scottish paradox, we here set Scotland's markedly increased DRDs in 2006+2007 against the backdrop of previously-published, credibly-estimated DRD rates, by sex and age-group, for Scottish injectors in 2003-05 (King et al., 2008). The rates were derived from a Bayesian capture-recapture approach to estimating the number of Scotland's current IDUs in 2003, which had given a higher central estimate of around 26,000 IDUs (King et al., 2008).

Our Approach

Scotland's DRDs in 2000-02 and 2003-05 are summarised in eight pre-defined (Bird et al., 2003; King et al., 2005) subgroups (sex by age-group by region) as in our Scottish work hitherto. Thus, prior to Bird et al. (2003), the age-group (15-34 years; 35+ years) and regional subdivisions (Greater Glasgow; elsewhere in Scotland) were specifically selected on the basis of knowledge of Scotland's IDU epidemic. They have been used by us since then to demonstrate that, as anticipated by Scotland's IDU epidemic history, Scottish DRD trends are markedly different, notably by age-group.

We summarise DRDs registered in England and Wales without taking cognizance of regional IDU epidemics and only according to publicly-available age-groups (under 30 years, 30-39 years, 40+ years), see Report (2008). We do so to check for a similar downward trend in DRDs for the youngest age-group.

Next, corresponding national data for the two years, 2006+2007, are presented; and compared to age-specific expectations from 2003-05.

Finally, we exploit results from our published Bayesian capture-recapture analysis of Scotland's data-sources on IDUs in 2003 (King et al., 2008) to estimate Scottish IDUs' DRD rate in 2006+2007. We do this by assuming *both* no important change in the numbers of current IDUs since 2003 *and* that, irrespective of sex, Scottish IDUs' DRDs per subgroup of interest can be approximated by counting them as 80% of the subgroup's DRDs under 45 years of age plus a substantially lower proportion, 20%, of DRDs at 45+ years of age.

For each of the eight subgroups of interest, we compare Scottish IDUs' thus-estimated DRD rate in 2006+2007 with the 95% credible interval for their DRD rate in 2003-05: see King et al. (2008) for more detail, or **Appendix** for a precis.

Analysis addressing three questions

Does Scotland's historical injector epidemic determine its age-related increase in DRDs?

Table 1 shows that DRDs under 35 years of age decreased very significantly ($p = 0.005$) between eras: by 15%, from 672 in 2000-02 to 572 in 2003-05. But DRDs at 15-34 years rose again to 466 in 2006+2007, significantly up on the expectation of 381.3 based on 2003-05 ($p < 0.001$). A similar rise, see below, was not evident for the youngest age-group in England and Wales

Epidemiologically unsurprisingly is that Scotland's DRDs at 35+ years of age have increased dramatically between eras: by 31%, from 334 in 2000-02 to 437 in 2003-05. And they rose still higher to 410 DRDs in 2006+2007, that is: by 41% versus expectation of 291.3 based on 2003-05, $p < 0.001$.

During 2000-05, Greater Glasgow accounted for a higher proportion of DRDs at 35+ years of age than at 15-34 years ($p = 0.02$). Males accounted for a significantly lower proportion of DRDs at 35+ years of age (77%) than at 15-34 years (84%). Both observations held true for 2006+07.

Table 1 here

*Are England and Wales following Scotland?*By age-group and sex, **Table 2** summarises 5,022 DRDs registered in 2000-02 and 4,534 DRDs in 2003-05 for England and Wales. Between eras, there was a marked 27% reduction in DRDs under 30 years of age, which was sustained in 2006+2007 when there were 899 DRDs (consistent with 927.3 expected on the basis of 2003-05). The 30-39 year age-group showed no evidence of a rise in DRDs as a consequence of the later-timed injector epidemic in England and Wales (De Angelis et al., 2004). Meanwhile, the oldest age-group showed a very highly significant increase to 1,109 DRDs from 943.3 DRDs expected at 40+ years of age on the basis of 2003-05 (chi-square on 1 degree of freedom = 29.1). Most of this increase was accounted for by DRDs in 40-49 year olds.

Table 2 here

The Scottish paradox – is the rate of DRDs increasing among Scottish injectors? For the eight subgroups of interest, **Table 3** reproduces the model-averaged central estimates of King et al. (2008) for Scotland's current IDUs in 2003; and approximate numbers of IDU-related DRDs in 2006+2007 under our 'best guess' 80:20 assumption about injector status (see **Methods**). Also shown are 95% credible intervals for injectors' DRD rate per annum in 2003-05 from King et al. (2008); and our derived injector-related DRD rates for 2006+2007, see **Appendix**.

Except for females aged 15-34 years, who had lower rates, estimates for 2003-05 were broadly consistent with a 1% annual DRD rate for injectors.

Six out of eight point estimates for injectors' DRD rate in 2006+2007 were at or above the upper bound of the corresponding 95% credible interval from 2003-05.

Table 3 here

Discussion

Major sources of uncertainty hinder a full understanding of injectors' DRD rates, namely: which DRDs actually pertain to IDUs, toxicology (whether opiate-related or not; and co-presence of other drugs), and how influential the demographic factors of sex, older age

and region actually are on DRD rates (Bird et al., 2003; Morgan et al., 2008; King et al., 2005; Bargagli et al., 2006).

For England and Wales, as well as for Scotland, there was good news in 2000-05. Public health measures were beginning to make a difference by reducing DRDs at younger ages – to an even greater extent in the under 30s in England and Wales than in Scotland's under 35s ($\chi^2 = 5.18$, $p \sim 0.02$).

However, the UK's target to reduce DRDs by 20% between 1999 and 2004 took no apparent cognizance (Bargagli et al., 2006; Bird et al., 2005) of the (different) epidemiology of injecting drug use in Scotland (Hutchinson et al., 2006) and England (De Angelis et al., 2004). Prevalent current IDUs had increased by around 6-fold in Scotland during 1980-89 and 4-fold in England during 1987-96. These time periods, although inexact, were sufficiently different for us to anticipate that a sharp increase in older-age IDU-related DRDs might be both delayed and less accentuated in England compared to Scotland. As yet, neither in 2003-05 nor in 2006+2007 have the 30-39 year old DRDs for England and Wales signalled an increase, as already seen in Scotland between 2000-02 and 2003-05 for DRDs at 35+ years and a forteriori in 2006+2007 (see **Table 1**). Of course, competing age-related trends within the 30-39 year old age-group (for decrease; for increase) could potentially cancel each other out.

No forward projections have been made from UK's IDU epidemics in the 1980s to the likely numbers of DRDs among older IDUs in the 21st century for either Scotland or

England and Wales. There is therefore no reference-projection against which to compare, for example, Scotland's 410 older DRDs in 2006+2007. Are they more numerous, or fewer, than would have been plausibly projected from Scotland's historical IDU epidemic? We don't know. Age-group specific projections for injector-related DRDs in England and Wales over the next five years would be a boon.

Apparently higher DRD rates in 2006+2007 for Scotland's IDUs, as in **Table 3**, could be due to our having used – as the only available denominator – Scotland's estimated numbers of older IDUs in 2003 (Hay et al., 2005 and King et al., 2008). Some further increase in older IDUs in Scotland between 2003 and 2006 is, however, likely as a residual consequence of Scotland's IDU-epidemic in the early 1980s; and would imply some over-estimation by us.

Scottish DRDs under 35 years of age decreased by 15% between 2000-02 and 2003-05, but the 2006+2007 total of 466 represented a significant, and worrying, 22% recrudescence. Notably, DRDs at a younger age for England and Wales in 2006+2007 (Report, 2008) did not mirror the rise in Scotland. Any genuine rise in DRDs at younger ages has a range of interpretations, all of them disquieting. They include: i) increase in prevalence of younger current IDUs, ii) more risky injecting patterns by younger IDUs, iii) differential purity in the available heroin to which less experienced IDUs may be most vulnerable, iv) changed predisposition to DRDs by young people's more risky coincident use of other drugs including alcohol, or v) lower referral rate for drugs rehabilitation.

Public health scientists have tended to follow the trail of DRDs (Morgan et al., 2008) rather than anticipate their trajectory by making projections, as is done for the sequelae of other injection-related epidemics such as hepatitis C virus (Hutchinson et al., 2005). Ideally, targets on DRDs should be epidemiologically-informed by plausible forward projections. The absence of such projections may explain the UK governments' reluctance to set revised DRD targets (HM Government, 2007; The Scottish Government, 2008) for 2008-18. Separate recognition is now needed of older-age opiate-related DRDs as a late consequence of the UK's historical IDU epidemics, the timing of which differed between (and also within) Scotland and England and Wales. More nuanced analyses of DRDs are therefore needed, which take account of their demography and toxicology simultaneously, rather than severally (Report, 2008).

We urge that public health success in the UK at reducing younger-age DRDs, which are a consequence (mainly) of heroin injection, should be neither overlooked nor made hostage to fortune by disproportionate focus on rarely-lethal drugs such as cannabis (Advisory Council on the Misuse of Drugs, 2008). By contrast, the lethal harm from injecting heroin is stark, well-quantified, and well-attributed: let young lives be not lost by their, or our, ignorance (Surveys, Design and Statistics Subcommittee, 2008). [word count 2,268]

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Postscript: Scotland has recently published details of its 574 DRDs in 2008, 303 of them were aged 15-34 years and 271 were 35+ years of age. The increase in DRDs in the younger age-groups is of particular concern. See http://www.gro-scotland.gov.uk/press/2009/drug-related-deaths-in-scotland-2008.html As yet, only provisional data for 2008 are available for England and Wales.

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Appendix

Our Bayesian capture-recapture analysis of Scotland's data-sources on IDUs in 2003 (King et al., 2008) incorporated the belief that around 80% of DRDs under 45 years of age pertain to IDUs but a substantially lower proportion, around 20%, do so of DRDs at 45+ years of age.

Sensitivity analysis was used to check inferences against alternative choices which ranged from 75% to 85% and from 15% to 35% (King et al., 2008).

The 80:20 prior belief was loosely informed by a separate capture-recapture estimation of injector status for Scotland's DRDs in 2003; the age distribution of IDUs; and the proportion of DRDs at 45+ years with no mention of opiates.

Our 'best guess' 80:20 assumption was applied in deriving subgroup-specific 95% credible intervals for Scottish IDUs' DRD rate in 2003-05 , as shown in **Table 3**, together with the Bayesian model-averaged posterior mean number of current injectors in 2003 for eight subgroups of interest.

A 95% credible interval, as above, is the shortest interval which encompasses 95% of the posterior probability for the DRD rate in question. The reported credible intervals reflect uncertainty about the best-fitting capture-recapture models for estimating numbers of current injectors in 2003 as well as random variation in numbers of DRDs in 2003-05.

However, they do **not** take into account that the numbers of current IDUs in 2003 could under-estimate the prevalent numbers from 2006 onwards, especially so for older IDUs. For the eight subgroups of interest, we also applied our 'best guess' assumption in approximating the subgroup's number of IDU-related DRDs in 2006+2007.

Injectors' DRD rate in 2006+2007 was then estimated using the Bayesian model-averaged posterior mean for the ratio of "IDU-related DRDs to number of current injectors in 2003". [word count 286]

Table 1. Drugs-related deaths in 2000-02 and 2003-05; and in *2006+2007* ***{versus expectations based on 2003-05}***: Scotland

Era	Scotland (male, female)	Greater Glasgow	Elsewhere in Scotland
2000-05: 15 - 34 years of age - public health success?			
2000+01+02	**672 (558, 114)**	**210**	**462**
2003+04+05	**572 (482, 90)**	**161**	**411**
Demography: young DRDs in 2000-05	Males accounted for 84% of DRDs (95% CI: 81% to 86%)	Greater Glasgow accounted for 30% of DRDs (95% CI: 27% to 33%)	
2006+2007	*466 (402, 64)*	*130*	*336*
2003-05 based expectations for 2006+2007	***381.3*** *(321.3, 60.0)*	***107.3***	***274.0***
2000-05: 35+ years of age - late sequelae of Scotland's injector epidemic in 1980s?			
2000+01+02	**334 (269, 65)**	**116**	**218**
2003+04+05	**437 (322, 115)**	**151**	**286**
Demography: older DRDs in 2000-05	Males accounted for 77% of DRDs (95%CI: 74% to 80%)	Greater Glasgow accounted for 35% of DRDs (95% CI: 31% to 38%)	
2006+2007	*410 (325, 85)*	*145*	*265*
2003-05 based expectations for 2006+2007	***291.3*** *(214.7, 76.7)*	***100.7***	***190.7***

Table 2. Drugs-related deaths in 2000-02 and 2003-05; and in *2006+2007* ***{versus expectations based on 2003-05}***: England and Wales

Era	England and Wales	Males	Females
2000-05: Under 30 years of age - public health success?			
2000+01+02	**1,903**	**1,599**	**304**
2003+04+05	**1,391**	**1,130**	**261**
Demography of DRDs under 30 years in 2000-05		Males accounted for 82.8% of DRDs (95% CI: 81.6% to 84.1%)	
2006+2007	*899*	*742*	*157*
2003-05 based expectations for 2006+2007	***927.3***	***753.3***	***174.0***
2000-05: 30 - 39 years of age - late sequelae of injector epidemic in 1980s?			
2000+01+02	**1,753**	**1,508**	**245**
2003+04+05	**1,728**	**1,457**	**271**
Demography of DRDs aged 30 – 39 years in 2000-05		Males accounted for 85.2% of DRDs (95% CI: 84.0% to 86.4%)	
2006+2007	*1,169*	*979*	*190*
2003-05 based expectations for 2006+2007	***1,152.0***	***971.3***	***180.7***
2000-05: 40+ years of age – late sequelae of injector epidemic in 1980s?			
2000+01+02	**1,366** of whom 826 **< 50 yrs**	**941** of whom 653 **< 50 yrs**	**425** of whom 173 **< 50 yrs**
2003+04+05	**1,415** of whom 824 **< 50 yrs**	**967** of whom 622 **< 50 yrs**	**448** of whom 202 **< 50 yrs**

Demography of DRDs aged 40+ years in 2000-05		Males accounted for 68.6% of DRDs (95%CI: 66.9% to 70.3%)	
2006+2007	*1,109 of whom 687* ***< 50 yrs***	*816 of whom 566* ***< 50 yrs***	*293 of whom 121* ***< 50 yrs***
2003-05 based expectations for 2006+2007	***943.3***	***644.7***	***298.7***

Table 3. Using 80:20 best guess approximation for injector-related DRDs by age (see **Appendix**), injectors' drugs-related deaths by age-group, sex and region of Scotland and 95% credible intervals for injectors' DRD rate in 2003-05 are shown, together with derived DRD rates for 2006+2007 *(in italics).*

Region	**Greater Glasgow**		**Elsewhere in Scotland**	
Sex & Age-group	Injector-related DRDs: *2006+2007 totals in italics*	**IDUs' estimated annual DRD rate per 100 current IDUs (95% credible interval[18] for 2003-05);** *DRD rate in 2006+2007*	Injector-related DRDs: *2006+2007 totals in italics*	**IDUs' estimated annual DRD rate per 100 current IDUs (95% credible interval[18] for 2003-05);** *DRD rate in 2006+2007*
Males: aged 15-34 years				
Current injectors in 2003[18]: model-averaged estimate	**3 300**		**10 060**	
2003-05	108.0	**1.11 (0.9, 1.4)**	277.6	**0.93 (0.8, 1.2)**
2006+2007	*84.8*	*1.3*	*236.8*	*1.2*
Males: aged 35+ years				
Current injectors in 2003[18]: model-averaged estimate	**2 320**		**3 450**	
2003-05	78.6	**1.14 (0.9, 1.5)**	127.4	**1.26 (1.0, 1.7)**
2006+2007	*67.0*	*1.4*	*131.8*	*1.9*
Females: aged 15-34 years				

Current injectors in 2003[18]: model-averaged estimate	**1 600**		**4 890**	
2003-05	20.8	**0.44 (0.3, 0.6)**	51.2	**0.36 (0.3, 0.5)**
2006+2007	*19.2*	*0.6*	*32.0*	*0.3*
Females: aged 35+ years				
Current injectors in 2003[18]: model-averaged estimate	**700**		**1 040**	
2003-05	20.6	**1.00 (0.7, 1.4)**	39.6	**1.30 (1.0, 1.7)**
2006+2007	*19.6*	*1.4*	*29.8*	*1.4*