



## Original Contribution

## Urban overdose hotspots: a 12-month prospective study in Dublin ambulance services

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## ABSTRACT

**Background:** Opioid overdose (OD) is the primary cause of death among drug users globally. Personal and social determinants of overdose have been studied before, but the environmental factors lacked research attention. Area deprivation or presence of addiction clinics may contribute to overdose.

**Objectives:** The objective of the study is to examine the baseline incidence of all new ODs in an ambulance service and their relationship with urban deprivation and presence of addiction services.

**Methods:** A prospective chart review of prehospital advanced life support patients was performed on confirmed OD calls. Demographic, geographic, and clinical information, that is, presentation, treatment, and outcomes, was collected for each call. The census data were used to calculate deprivation. Geographical information software mapped the urban deprivation and addiction services against the overdose locations.

**Results:** There were 469 overdoses, 13 of which were fatal; most were male (80%), of a young age (32 years), with a high rate of repeated overdoses (26%) and common polydrug use (9.6%). Most occurred in daytime (275) and on the streets (212). Overdoses were more likely in more affluent areas ( $r = .15$ ;  $P < .05$ ) and in a 1000-m radius of addiction services. Residential overdoses were in more deprived areas than street overdoses (mean difference, 7.8;  $t_{170} = 3.99$ ;  $P < .001$ ). Street overdoses were more common in the city center than suburbs ( $\chi^2(1) = 33.04$ ;  $P < .001$ ).

**Conclusions:** The identified clusters of increased incidence—urban overdose hotspots—suggest a link between environment characteristics and overdoses. This highlights a need to establish overdose education and naloxone distribution in the overdose hotspots.

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## 1. Introduction

Opioid overdose (OD) is the primary cause of death among drug users globally [1]. Despite an international trend of decreasing drug-related deaths in recent years, opioids remain the major cause of deaths in Ireland [2]. In European countries with widespread heroin use, such as Ireland, opioids are implicated in 75% of the drug-related deaths [3–5]. In 2011, at least 251 deaths occurred from poisoning with opioids among drug misusers in Ireland; this represents 69% of poisoning deaths in this population [6]. Drug overdose shortens the life expectancy of drug users compared with the general population. Most drug users witness an overdose, and many are victims of overdose themselves [7–9]. Risk of fatal drug overdose is higher immediately after release from prison or after opioid substitution treatment [10,11]. Acute OD poses a significant burden on frontline services, ambulance services, and emergency departments (ED), but limited evidence is available on the experience or role of those

services [12,13]. Understanding the risk factors and determinants of overdose is critical to help decrease the mortality, morbidity, and burden on health care and to maximize the potential contribution of emergency services.

Drugs are used in a context of social, personal, and environmental characteristics [14]. Contextual effects, such as drug, set, and setting, synergize and create higher chances for overdose [15]. The set represents individual risk factors, which have been well studied: male sex, age, long-term drug use, psychiatric illness, or transition to/from opioid substitution treatment [11]. The setting of drug use includes such understudied environmental factors as income distribution, family fragmentation, physical characteristics of urban areas (clean sidewalks or dilapidated houses), education, or allocation of health services [16–18]. All of these mediate the relationship between the setting and drug use. Building on this evidence base, this study examines 2 additional features of urban areas that could be related to ODs: deprivation and presence of addiction services, in the context of gathering incidence data on overdoses.

First, overdoses and overdose deaths are more frequent in areas of increased drug use and poverty [11]. For example, areas with unequal income distribution have higher rates of overdose deaths, independent of individual risk factors, such as sex or age [18].

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Second, areas around addiction services are historically long-established epicenters of drug use.

Addiction services have been traditionally set up in areas of high need [19], where drug dealing, using, and overdosing were already present or dealers may have been attracted to these areas, envisioning higher profits from drug sales and, subsequently, increasing the rates of use and overdose. The evidence from alcohol and tobacco research reveals a link between allocation of outlets and prevalence of tobacco or alcohol use [20]. This relationship has not been studied for addiction clinics or methadone services. Nevertheless, the experience of community-based methadone services suggests that up to 40% of people in recognized methadone treatment continue to inject heroin and may, therefore, bring drug selling and illicit use into the areas around drug treatment centers [7]. This increases the risk of fatal overdose. Moreover, methadone dispensing may have an effect on overdoses, as shown by a 32% increase in overdoses observed in Accidents and Emergency (A&E) in the 2-month period immediately after the introduction of a new methadone prescribing legislation in Ireland, with a subsequent drop (47%) 2 months later [13].

Very little data have been published on the experience of OD by emergency ambulance services, in Ireland or elsewhere. Merchant et al [21] published a 1997–2002 time series of such events from Rhode Island, in which they reported 1630 events evenly distributed over the period with most being males younger than 54 years and most events occurring in private homes. A 2002 Australian time series indicated an initial drop in the numbers of fatal ODs after a community overdose initiative, but the fall was not sustained [22]. In Dublin, emergency ambulance services are provided by Dublin Fire Brigade (DFB) and the Health Service Executive's National Ambulance Service (NAS), covering different geographic areas. Emergency ambulances are staffed by paramedics or advanced paramedics who have, since 2004, been trained and equipped to provide naloxone (standard dose 0.4 mg, repeated up to 5 times) in suspected OD using a standardized Clinical Practice Guideline [23].

This study had 2 aims. First, we established baseline incidence of all new overdoses reported to the ambulance services in Dublin over a 12-month period together with their presentation, treatment, and outcomes if known to the ambulance service. Second, we examined the relationship between geographical distribution of overdoses, deprivation, and presence of addiction clinics.

## 2. Methods

### 2.1. Setting

Two agencies provide ambulance services in Dublin: DFB and the Health Service Executive, NAS. Established in 1862, DFB is among the oldest ambulance services in the world. It attends to approximately 72 000 incidents in Dublin annually. In 2011, naloxone figured in 281 (4.2%) of all medication administrations [24]. National Ambulance Service attends to emergency calls in certain areas of Dublin and dealt with approximately 300 000 emergency calls nationally in 2013 [25].

### 2.2. Data collection

Characteristics and clinical data for all ODs reported to DFB and NAS, Dublin, in a 12-month period were collected by the ambulance staff on patient care report (PCR) forms. Patient care reports are completed in all cases by ambulance service staff, and copies are kept both in the receiving hospital and by the service itself. The study identified all PCRs indicating OD; trained DFB staff collected study data from DFB forms, and the researchers collected data from PCRs in NAS. Population data were derived from the 2011 census.

#### 2.2.1. Patient care report review

Patient care report is a paper-based system for recording prehospital care, assessment observations, interventions, and medi-

cations administered to patients by the emergency responders. Hard copies and scans of PCRs, coded under the "opioid overdose" category, were reviewed to extract the following:

- number of PCRs recording OD,
- clinical presentation,
- clinical care provided (pre-post arrival),
- number and percentage of patients receiving naloxone,
- response to naloxone,
- number of patients transported/refused transport, and
- deaths, if confirmed by the ambulance service on scene.

Accuracy of data entry was assessed by an external review of a 20% random sample of records.

No follow-up clinical data for care in the ED were collected for this study. Therefore, the clinical outcomes of the overdose events cannot be commented on, other than in respect of the small number of cases in which patients were confirmed to be dead by the ambulance service, using the criteria established by the relevant Clinical Practice Guideline.

#### 2.2.2. Geographical information

In 2012, the Central Statistics Office (CSO) published Small Area Population Statistics for the 2006 and 2011 censuses. Small areas (SAs) are national boundaries created by Ordinance Survey Ireland as a subdivision of preexisting electoral districts and are available for download from the CSO's Web site ([www.cso.ie/census](http://www.cso.ie/census)). As the smallest geographical areas for which census data are available, they provide the most accurate level for measurement. Small areas are standardized in size, with a minimum of 65 households and a mean of less than 100, thus effectively providing street-level information on the Irish population. Population statistics are now available for 18 488 SAs in Ireland.

#### 2.2.3. Deprivation index

The Pobal-Haase-Pratschke Deprivation Index is a composite score "measuring the relative affluence or disadvantage of a particular geographical area" using data compiled from 2006 and 2011 census [26]. Each area is scored from approximately  $-40$  (being the most disadvantaged) to  $+40$  (being the most affluent), with zero as the average national score from the 2006 census. Fourteen indicators in 3 dimensions of affluence/disadvantage comprise the deprivation index: demographic profile, social class composition, and labor market situation. For the purpose of this study, we categorized overdoses by their location into street, residential, or service overdoses. The residential category comprised house and hotel. The services included hostel/homeless shelter, treatment center, hospital, shop, bar/pub, or police station.

#### 2.2.4. Methadone clinics

As of October 2010, there were 9285 patients attending methadone treatment programs nationally, of which 3312 patients (36%) received care through general practitioners, 5368 (57.5%) in the 66 Health Service Executive clinics, and 604 patients (6.5%) were attending treatment in prison [27]. Fifty-three clinics were located in Dublin, serving 4783 patients. We added clinic locations to our geographical map. We compared presence of a clinic in the area, patient load and number of ODs in the (a) SA, (b) 500-m radius around clinic, and (c) 1000-m radius around clinic.

### 2.3. Data analysis

In accordance with the primary objective of this study, descriptive analysis was carried out on the key indicators: OD calls and clinical information on each call (frequencies, correlations,  $t$  tests, and  $\chi^2$  test). Information extracted from PCRs was entered into an MS Excel spreadsheet. Deidentified data were then exported into an IBM SPSS 20 database, IBM Corp. in Armonk, NY, from which the statistical

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