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The cost-effectiveness of naloxone programmes for the treatment of heroin overdoses ‘on the street’: A 2-year data collection by the street unit of the Villa Maraini foundation

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Summary

Introduction: The mortality rate of opioid users is 5 to 10 times greater than that of the general population, and the most common cause of death in that case is an overdose. When treated in a timely fashion with the opioid antagonist naloxone, an opioid overdose is rarely lethal. Unfortunately, many opioid overdoses occur in isolated, hidden, inaccessible locations. To circumvent this problem, the Villa Maraini Foundation in Rome has created a rescue team called ‘the Street Unit’ to provide basic life support and administer naloxone for the treatment of opioid overdose in urban environments. The aim of this paper is to review the cost-effectiveness of our Street Unit. **Methods:** We compared the cost of 90 overdose interventions provided by the Street Unit with the cost of those provided by the Accident & Emergency departments of the Italian National Health System. **Results:** The Street Unit not only successfully treated all overdoses, but also provided a dramatic reduction in costs, ranging from €123,367.05 (best-case scenario) to €203,377.05 (worst-case scenario). **Conclusions:** This finding suggests that the treatment of opioid overdose in the street context offers a safe, cost-effective strategy for the reduction of opioid overdose-related mortality.

Key Words: Overdose; naloxone; heroin; harm reduction; cost effectiveness

1. Introduction

The most harmful consequence of opioid abuse is a potentially lethal overdose. The mortality rate of European opioid users has been estimated to be 5 to 10 times greater than that of their peers of the same age and gender, and the most common cause of death in that case is an overdose [13, 17, 18]. It must, however, be pointed out that the actual number of deaths due to opioid overdose is not easy to estimate. In 2014, according to the UNODC, there have been more than 200,000 drug-related deaths worldwide, and one third to one half of these deaths were attributed to opioid overdose. The European Drug Report by the European Monitoring Centre for Drugs and Drug Addiction [14] estimates that opioid overdose accounts for about 2.5% of all deaths in Europeans aged 15-39

(about 80% of such deaths were in males).

Estimating the trend over time for the incidence of opioid overdose in Europe requires caution for a number of reasons, including systematic under-reporting in some countries and delays in the registration of cases. Countries with relatively robust reporting systems (e.g., Germany, Sweden, the UK) reported an increase in the number of overdoses in the past few years [14]. Another worrying trend is the increased number of overdoses due to opioids other than heroin. Methadone, buprenorphine, fentanyl (and its derivatives), and tramadol are now responsible for a substantial share of overdose deaths in some countries.

Even more dramatic is the increase in the incidence of opioid overdose in the last two decades in the USA, due to a steep increase in the abuse of both

heroin and prescription opioids [6]. Between 2000 and 2014, opioid overdoses were responsible for about 28,000 deaths in the USA and heroin overdoses have more than tripled since 2010 [21].

Only a small proportion of first-time opioid overdoses result in the death of the user [9]. The major reason for the relatively low mortality attributable to an opioid overdose is the widespread use of the opioid antagonist naloxone. Indeed, the administration of naloxone in cases of opioid overdose can be recognized as one of the most important life-saving interventions ever introduced in the Accident & Emergency (A&E) sector. In this clinical context, the treatment of the overdose is almost always successful. In contrast, the treatment of the overdose outside the hospital setting is still unsatisfactory in a great many cases [24]. Thus, a new approach has been promoted in the recent years, consisting in the training of non-medical staff (i.e. opiate users and their peers) for the administration of naloxone outside the clinical context. In this regard, in 2015, the EMCDDA published a systematic review of the effectiveness of take-home naloxone in a series of studies involving 2,912 opioid users at risk of overdose in 19 communities followed up for seven years. The review emphasized that educational and training interventions complemented by take-home naloxone lead to a fall in overdose-related mortality [14].

It must be added that heroin overdoses often occur in isolated, hidden, inaccessible locations, and the addict is often alone. Even when the addict is not alone, fatalities can occur in more than half of all cases, as the other addicts present on the scene are often unable to diagnose the event, or are themselves incapacitated by drug-taking, or are reluctant to seek help because they fear arrest [25, 8, 19]. In addition, naloxone is not always easily available for prompt use in cases of overdose. Based on data from the Villa Maraini Foundation (VMF, a non-profit organization affiliated to the Italian Red Cross with a 40-year experience in the treatment of substance abuse), in 90% of cases the substance is consumed at a short distance from the place where the purchase took place, usually in public areas such as city parks, gardens and streets. This circumstance lowers the chances of receiving prompt aid if an emergency occurs.

In order to cope with this issue, VMF developed a Street Unit to provide assistance to opioid users directly in the settings of drug use. In order to optimize this approach, branches of the Street Unit were located in areas of Rome with a high prevalence of drug use, particularly of heroin. In addition to its

main aim of providing first aid in case of overdose, the Street Unit also advises drug users on how to enrol in substance misuse services, distributes condoms and sterile syringes, and collects used syringes. These services play an important role in the National Health System in terms of cost-effectiveness.

The costs of sending people to hospital for the treatment of drug overdoses in Italy are monitored by the Dipartimento per le Politiche Antidroga (Department of Antidrug Policies), a special unit of the Ministry of Internal Affairs. Every year a special report on Italian drug addiction is published for Parliament [7]. These costs can be estimated on the basis of the fees charged by the relevant Diagnosis-Related Group (DRG), which in the case of an overdose are DRG-454 and DRG-455 (see below). According to data obtained from the Ministry of Health, in 2016 there were 44 cases of DRG-454 and 99 of DRG-455 in the region of Latium. Despite possible issues with their reliability [7], these data were useful for calculating the cost-effectiveness of the VMF Street Unit.

2. Methods

2.1. The Street Unit and study context

The Street Unit is a rescue team comprising a psychologist, social workers (former drug users), Red Cross volunteers, and a physician. The social workers are trained to perform basic life support and administer naloxone. In their new capacity as social workers, former addicts provide added value to the quality of team intervention, especially in the street context. They speak the same slang as drug users, are more trustworthy than professional staff, and have first-hand experience of all aspects of drug-taking. Over the years, these social workers have played a crucial role in contacting drug users and enrolling them in the therapeutic programmes of the VMF. The Street Unit reaches the high-risk city areas every day by means of a camper van equipped with first aid and cardiopulmonary resuscitation instruments and kits for intramuscular or intravenous naloxone administration.

Among the areas at highest risk for the prevalence of drug consumption in Rome, there are the Tor Bella Monaca district on the outskirts of the city, and the areas surrounding “Roma Termini” railway station located in the city centre. In this sense, the VMF Street Unit functions as a daily point of reference for drug users in these crucial areas. The service provided by the Street Unit functions as a reliable safeguard for the health of drug users for at least ten hours a

day. In addition to the fixed location provided by the camper, groups of two team members carry out onsite inspections of the entire area in order to identify, monitor and rescue any subjects who are alone when using substances. For each treated overdose, a Street Unit member collects data about the rescued subject, such as demographic data, conditions under which the overdose was taken, and current therapeutic programmes.

2.2. Costs calculation

Hospital costs are easy to calculate because they can be derived from the reimbursement mechanism adopted by the Italian National Health System (NHS), which, like most other European health systems, employs the DRG classification of hospital cases [3]. Opioid overdoses are classified as DRG-454 or DRG-455 (with and without complications, respectively) [16]. The cost for each admission is €1,704 for DRG-455 and €2,593 for DRG-454, regardless of the effective length of stay (up to a maximum of 21 days spent in hospital).

The calculation of the costs for the VMF Street Unit is more complex, as the service contract with the Regional Health Agency covers the entire activity of the Street Unit, not only the interventions implemented in treating an overdose. The actual financial worth of the intervention should be calculated by taking into account the financial value of the human and material resources used, the savings in terms of health care, and the social impact of reducing the damage caused by opioid-related deaths. Additional factors that should be taken into consideration are the reduction of the harm caused to others, in terms of interpersonal relationships (e.g., family and friends) and the risk of spreading infective diseases (e.g., HIV, HCV, HBV). On the other hand, any estimate of these gains would inevitably be based on a series of a priori assumptions on which there is no consensus. At present, the overall service provided by the VMF Street Unit includes (in addition to the treatment of street overdoses): prevention, information, training in safety measures, an alert system, deterrence of smugglers/pushers, control of the territory, providing first aid, along with other types of therapeutic intervention). The cost of the Street Unit is €83,125 for 180 days of service, equivalent to ten calendar months. The overdose interventions make up only a fraction of the total service. In estimating its overall financial value we used the following algorithm:

1. calculation of the cost of the human resources consists of
 - a) appraisal of the average time of intervention (from the emergency call to the moment of leaving the patient) by the professional profile obtained through interviewing the components of the team;
 - b) calculation of the hourly wage of each component based on the salary bill;
 - c) the total cost of the work done is equal to the sum of the hourly wage multiplied by the average time spent working weighted by the number of interventions carried out;
2. calculation of the cost of the materials and technical resources consists of
 - d) the quote of the work time engaged calculated with a) in the case of overdose events;
 - e) the difference between total budget and the correspondent cost of human resources;
 - f) the product of d) and e)
3. the financial appraisal of the quantity of VMF's resources used for the project consists of
 - g) the quote of the fund devoted to the street unit in the total budget;
 - h) the product of g) with the tangible assets and the intangible assets
4. the sum of 1, 2 and 3 provides the financial value of the service.

3. Results

It must be emphasized that the primary aim of VMF activity, consistently with its Red Cross affiliation, is that of saving lives. Thus, given the extremely difficult and potentially dangerous circumstances under which the VMF Street Unit operates, and the constraints to be faced in terms of available staff, the collection of data giving details about its activity has had to take a back seat relative to the need to provide life-saving interventions in a timely manner.

Bearing those facts in mind, in the period January 2015-October 2016 an effort was made to collect data with the precise aim of assessing the efficacy of the service according to the criteria established by the Regional Health Council of the Region of Latium. The most important data thus collected are presented in Tables 1-3.

First of all, it is important to point out that (as

Table 1. Demographics

Number of overdoses	90
Number of individuals	72
Sex	
Female (%)	10 (13.9%)
Male (%)	62 (86.1%)
Age	
Years (mean±SEM)	39.8±1.06
Education (MD=38)	
5-7 years (%)	1 (2.9%)
8-12 (%)	22 (64.7%)
≥ 13 (%)	11 (32.4%)
Marital status (MD=6)	
Singles (%)	43 (65.2%)
Married (%)	6 (9.1%)
Partner (%)	7 (10.6%)
Separated/divorced (%)	9 (13.6%)
Widowed (%)	1 (1.5%)
Nationality	
Italians (%)	70 (97.2%)
Foreigners (%)	2 (2.8%)
Age at first heroin use (MD=9)	
Years (mean±SEM)	19.8±0.69
Years of heroin use (MD=5)	
> 10 (%)	48 (71.6%)
6-10 (%)	11 (16.4%)
1-5 (%)	7 (10.4%)
< 1 (%)	1 (1.5%)
Frequency of heroin use (MD=6)	
> 1/day (%)	26 (39.4%)
1/day (%)	11 (16.7%)
> 1-6/week (%)	16 (24.2%)
< 1/week (%)	13 (19.7%)

Data are expressed as absolute or relative (%) frequencies or as means±SEMs.

MD = Missing Data

shown in Table 1) all 90 heroin overdoses were successfully treated. Eighteen individuals were treated for more than 1 overdose occurring on different occasions. Table 1 also provides basic information concerning the demographics of the sample. Tables 2 and 3 report the circumstances of the overdose, and the treatment programme in which the patients were then enrolled, respectively.

3.1. Cost-effectiveness of the VMF naloxone programme

Table 4 provides a synopsis of the criteria used for the analyses and Table 5 summarizes the comparison between the financial value of the 90 naloxone interventions provided by VMF Street Units and the

Table 2. Circumstances of the overdose

Physical setting (MD=2)	
Street (%)	66 (75.0%)
Park (%)	22 (22.7%)
Other (%)	2 (2.3%)
Social setting	
Alone (%)	26 (28.9%)
In company (%)	64 (71.1%)
Increase in dose (MD=6)	
Yes (%)	7 (8.3%)
No (%)	77 (91.7%)
Change in dealer (MD=10)	
Yes (%)	6 (7.5%)
No (%)	74 (92.5%)
Withdrawal syndrome (MD=8)	
Yes (%)	5 (6.1%)
No (%)	77 (93.9%)
Recent release from prison (MD=10)	
< 3 days (%)	2 (2.5%)
3-7 days (%)	0 (0.0%)
> 7 days (%)	13 (16.25%)
None (%)	65 (81.25%)
Poly-drug use (MD = 6)	
Benzodiazepine (%)	19 (22.6%)
Cocaine (%)	9 (10.7%)
Alcohol (%)	4 (4.7%)
Street Methadone (%)	3 (3.6%)
Cocaine + Benzodiazepine (%)	2 (2.4%)
Cocaine + Alcohol (%)	2 (2.4%)
Alcohol + Benzodiazepine (%)	1 (1.2%)
Amphetamine + Benzodiazepine (%)	1 (1.2%)
None (%)	42 (50.0%)

Data are expressed as absolute or relative (%) frequencies.

MD = Missing Data

cost of 90 hospital admissions for DRG-454 or DRG-455. For this comparison two scenarios were used. In the best-case scenario all interventions were without complications (i.e. only DRG-455 was considered). In the worst-case scenario all interventions were with complications (i.e. only DRG-454 was considered). The savings for the NHS varied from a minimum of €123,367.05 (best-case scenario) to a maximum of €203,377.05 (worst-case scenario).

4. Discussion

The VMF Street Unit provides an alternative to sending people to hospital for the treatment of heroin overdoses in the street context. Thus, it is vital to compare the cost-effectiveness of the two options.

There are at least two possible approaches to the evaluation of the cost-effectiveness of therapeutic

Table 3. Current therapeutic programme of the patients.

Structure/organization (MD=4)	
SerT (%)	30 (34.9%)
Therapeutic community (%)	5 (5.8%)
None (%)	51 (59.3%)
Therapeutic program (MD=7)	
Methadone decreasing doses	11 (39.3%)
Methadone maintenance	14 (50.0%)
Psychosocial	3 (10.7%)
Methadone dose (MD=12)	29.2 ±
Maintenance treatment (mean + SEM)	6.5123
Decreasing doses treatment	20.5 ±
	4.1130
Take-home naloxone (MD=16)	
Yes (%)	16 (21.6%)
No (%)	58 (78.4%)

Data are expressed as absolute or relative (%) frequencies or as means±SEMs. MD = Missing Data

tic programmes. One approach follows the theory of 'Welfarism' according to which, "the goodness of states of affairs depends ultimately only on the personal utilities in the respective states" [22]. Welfarism is based on the application of the marginalist theory of value to health-related phenomena, and requires a utilitarian function that measures the advantage of an additional monetary unit devoted to well-being compared with other targets. In our case, given that the counterfactual scenario of not administering naloxone is the death of the patient, we should calculate the utility function of saving the patient's life [2, 11, 10, 15]. On the practical plane, as a matter of principle we reject such a calculation because no market price can be sensibly quoted for human life.

The alternative 'non-welfarist' approach is currently the prevailing approach to the calculation of cost-effectiveness in the health sector [15]. This approach is based on a microeconomic analysis that

Table 4. The components of financial cost incurred by the Villa Maraini Foundation (VMF) Street Unit for 90 overdoses

Item	Value in euro
1. Labour cost	14,774.40
2. Medical supplies and technical resources cost	2,101.57
3. VMF's resources used cost	13,116.98

takes into account the impossibility for the private sector to guarantee efficient solutions without government intervention. The major difference with the welfarist approach is the maximization of aggregation utilities for a set of objectives defined outside a state of market equilibrium. Thus, the utility function is replaced by functions that measure the quality of health. The most frequently used methodology is based on Quality-Adjusted Life Years (QALY), which calculates the years of life saved when death is avoided, by using quality weighting [15].

Following this approach, Coffin and Sullivan [5, 4] analysed the cost-effectiveness of distributing naloxone to addicts at risk of overdose, and found that in terms of QALY it was superior to most health interventions currently supported by governments. This "first attempt to apply the tools of mathematical modelling to opioid overdose" marks a turning point for the evaluation of the cost-effectiveness of using naloxone for the treatment of an opioid overdose. Despite this achievement, the methodology used by Coffin and Sullivan must be criticized because of three important limitations: i) it employed 27 parameters based on other studies and a number of assumptions; ii) the procedure does not follow the rules of

Table 5. Comparison between financial cost of National Health System (NHS) and Villa Maraini Foundation (VMF) for 90 interventions.

Item	Number of overdoses	Financial cost of the NHS	Financial cost of VMF	Saving (Deficit)
Worst-case scenario (only DRG 454)	90	233,370	29,992.95	203,377.05
Best-case scenario (only DRG 455)	90	153,360	29,992.95	123,367.05

DRG = Diagnosis-Related Group

Randomized Clinical Trials; iii) individual (set) and environmental (setting) factors were ignored. Furthermore, the unique features of opioid addiction are not adequately reflected by Coffin and Sullivan's mathematical model based on a Markov chain [1, 23], which is dependent on the last observation and not on the historical series of observations, and on ergodicity (that is, on a behaviour that remains stable over time).

To overcome these limitations in the present study we have used a methodology derived from the concept of economic evaluation, "the comparative analysis of alternative courses of action in terms of both their costs and consequences" [12]. One possibility is to calculate the costs of a naloxone intervention (the opportunity cost) versus the gains (the benefit): this is based on a cost function coherent with the theory of marginal analysis [11, 20]. However, the public health authority and public opinion both need a measure of the allocation of health resources in terms of its ability to improve the quality of life at three levels: individual, social, and medical. The first level concerns the would-be patient; the second concerns the general health status of the community; the third level concerns the epidemiological status of the population. In the present case, the methodology that is most appropriate for the achievement of these goals is that of comparing the cost of the intervention implemented by the VMF Street Unit with the fee charged by the A&E department of a hospital.

5. Conclusions

Too many addicts still die because of an overdose taken on a street. In most cases these deaths could be prevented by the timely administration of naloxone. The Villa Maraini Foundation has played a pioneering role in arranging for former addicts to be trained in diagnosing overdoses and then giving treatment with injectable naloxone in difficult street contexts. The saving of these lives not only fulfils the institutional aims of an organization affiliated to the International Movement of Red Cross and Red Crescent, it also meets more concrete societal needs. Indeed, the data reported here clearly show the cost-effectiveness of the naloxone programmes run by the VMF Street Unit with respect to a comparable service provided by the Italian National Health Care System. It is important to emphasize the range of services provided by the VFM Street Units, including first aid to be given to dropouts and people with abuse problems, prevention, providing information, fully supporting the fight against drug smugglers and helping in the

struggle to win territorial control against all forms of crime. These services are not included in the financial cost sustained by the NHS expressed in DRG, as the calculation of these costs lies outside the scope of this paper.

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Conflict of interest

Authors declared no conflict of interest.

Ethics

Authors confirm that the submitted study was conducted according to the WMA Declaration of Helsinki - Ethical Principles for Medical Research Involving Human Subjects.

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