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ORIGINAL ARTICLE

Belgian Poison Centre impact on healthcare expenses of unintentional poisonings: a cost–benefit analysis

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Abstract

Objectives This study evaluates the impact of the Belgian Poison Centre (BPC) on national healthcare expenses for calls from the public for unintentional poisonings.

Methods The probability of either calling the BPC, consulting a general practitioner (GP) or consulting an emergency department (ED) was examined in a telephone survey (February–March 2016). Callers were asked what they would have done in case of unavailability of the BPC. The proportion and cost for ED-ambulatory care, ED 24-h observation or hospitalisation were calculated from individual invoices. A cost–benefit analysis was performed.

Results Unintentional cases (n = 485) from 1045 calls to the BPC were included. After having called the BPC, 92.1% did not seek further medical help, 4.2% consulted a GP and 3.7% went to an ED. In the absence of the BPC, 13.8% would not have sought any further help, 49.3% would have consulted a GP and 36.9% would have gone to the hospital. The cost–benefit ratio of the availability of the BPC as versus its absence was estimated at 5.70.

Conclusions Financial savings can be made if people first call the BPC for unintentional poisonings.

Keywords Poison control centre · Cost–benefit ratio · Unintentional poisonings · Decision tree · Healthcare expenses · Public health

Abbreviations

BPC	Belgian Poison Centre
ED	Emergency department
ED-amb	Emergency department ambulatory care
ED-24 h	Emergency department 24-h observation
FPS	Federal Public Service
GP	General practitioner
GUH	Ghent University Hospital
Hosp	Hospitalisation
PCC	Poison Control Centre

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Introduction

Cuts on public service

In difficult financial times, the public sector in general and poison control centres (PCCs) in particular is often a target for budget cuts or stagnation of the allocated resources. PCCs in the USA frequently underwent severe financial cuts with some centres even closing down (Giffin and Heard 2009; Thompson 2009; Woolf et al. 2001) and others reducing the type and availability of their services (The Lewin Group 2012).

Relevance of poison control centres

However, the relevance of PCCs has been demonstrated in many studies dealing with the financial impact of PCCs. A number of these studies investigated how many people with poisonings calling the PCC without need for further medical treatment would have used the emergency healthcare system in the absence of a PCC and what effect this would have had on the healthcare costs (Blizzard et al. 2008; Kearney et al. 1995; King and Palmisano 1991; LoVecchio et al. 2008; Miller and Lestina 1997; Phillips et al. 1998; Zaloshnja et al. 2003). Some studies focused on the *reduction in the length of stay* with assistance of a PCC (Friedman et al. 2014; Galvão et al. 2011). Other studies mentioned *a reduction in unnecessary visits to emergency departments (ED) and associated hospital charges*, and *improved patient management* (Friedman et al. 2014; Galvão et al. 2012; Spiller and Singleton 2011; Vassilev and Marcus 2007).

Economic evaluation consistently showing cost-saving results from PCC

In the USA, *cost–benefit ratios* ranged from 1.40 to 36.00 in the presence versus absence of a PCC in poisoning cases not needing further medical treatment after PCC consultation (Blizzard et al. 2008; Kearney et al. 1995; King and Palmisano 1991; LoVecchio et al. 2008; Phillips et al. 1998; Zaloshnja et al. 2003). The Lewin Group (2012) calculated a return on investment running up to 13.39US$/case with 41.3% due to avoided medical utilisation, 24.2% due to reduced length of hospital stay, 1.3% due to education and community outreach and 33.1% due to reduced work loss days.

In Europe, Anell and Persson (2001) (Sweden) calculated a cost–benefit ratio of 1.05, while Toverud et al. (2009) (Norway) concluded that the PCC did not save money (cost–benefit ratio 0.76) but provided safety.

Absence and need of a Belgian analysis of PCC

Probably because of the large variability between the structure and cost of healthcare systems in different countries, figures from PCCs are hardly interchangeable. Since studies in Europe are scarce and no cost–benefit data were available for Belgium, it seemed of interest to study the activities and financial impact of the BPC. Therefore, the aim of this study was *to examine the cost–benefit of the Belgian Poison Centre (BPC) in the presence versus the hypothetical absence of the BPC*.

Methods

Target population and subgroups

A prospective telephone survey was carried out between February 23 and March 18, 2016. All calls to the BPC for unintentional poisonings coming from the general public were included. Calls from general practitioners (GP) and hospitals were excluded. Calls were also excluded if patients did not give informed consent to be called back, if physicians handling the calls felt it was inappropriate to call them back (e.g. for psychological reasons) or if the patients could not be reached after three attempts.

Setting and location

The BPC is a public foundation, funded by the Federal Public Service Health (FPS Health) in the context of emergency medical assistance. Physicians of the BPC give 24/7 toll-free telephone advice to lay persons and healthcare professionals in Belgium (approximately 11,303,528 inhabitants) (Belgium 2017) in cases of (suspected) toxic exposures. Thirteen physicians handled 57,400 calls in 2017, of which 7685 were only requests for information. According to the risk assessment made by the physicians of the BPC, the advice given is either (1) to stay at home and/or advice on first aid, (2) to consult a GP or (3) to go to the hospital. Patients who were advised to go to the hospital were first assessed in the ED of the hospital.

During the survey period, seven 24-h periods (8 am until 8 am) were randomly selected taking care that each day of a week was represented once. The advice given by the physician was registered at this initial call, and patients were subsequently contacted during the days following the call, with a delay ranging between 2 and 8 days. During this follow-up contact, the person was asked (1) which action he/she had actually taken after having called the BPC and (2) what he/she would have done if the BPC would have been unavailable.

Study perspective

The hypothesis was that unavailability of the BPC would lead to substantial cost increases in case of calls from the public for unintentional poisonings as poisoning victims would unnecessarily use other, more expensive medical services.

Comparators

Two situations were compared in order to calculate the cost and benefit of both scenarios: (1) the flow of care of

accidentally poisoned patients after having called the BPC and (2) the estimated flow of care without availability of the BPC.

Time horizon

In order to ensure optimal comparability, data from 2017 were used to calculate the costs of the BPC, the GP and the hospital.

Choice of health outcomes

A cost–benefit analysis was performed as the measure of benefit (York Health Economics Consortium 2016).

Cost was defined as the payer's cost, i.e. the cost paid by the government and the patient. A call to the BPC is free of charges to the caller and is paid via the financial subvention of the BPC by the government. The cost charged by the GP and the hospital is partly paid by the government, through contributions from the mandatory health and disability insurance, and partly paid by a personal fee by the individual patient.

The benefit was determined by the cost of the chosen strategy as a measure of the use of service. We did not use natural units of effects like avoided harm and injuries.

Measurement of effectiveness

The results of the survey were used (1) to check—in the presence of the BPC—whether the advice given by the experts of the BPC was actually followed (stay at home, consult a GP, go to the hospital) and (2) to estimate—in the absence of the BPC—the proportion of patients who declared to have done nothing, to consult a GP or to go to the hospital.

A retrospective record review involving all poisoning-related episodes of patients admitted to the ED of Ghent University Hospital (GUH) in 2017 was used to estimate the proportion of patients with unintentional poisoning (accidental poisoning and substances of abuse) being referred by a GP to the hospital.

The same source was used to estimate the proportion of patients who (1) were ambulatory (ED-amb), (2) who had to stay in the ED for observation (ED-24 h) and (3) who were hospitalised (Hosp).

Estimating resources and costs

The cost/call to the BPC was calculated by taking 70% of the governmental subsidies divided by the total number of calls in 2017.

The cost of a GP's consultation was obtained from the National Health and Disability Insurance Service "Rijksdienst voor Ziekte- en Invaliditeitsverzekering" (RIZIV 2017) taking into account extra fees for out-of-hours consultations. The direct cost for ED-amb, ED-24 h and Hosp was abstracted from the invoices of the patients admitted with unintentional poisoning to the ED of GUH in 2017.

Currency, price date and conversion

Costs were expressed in EUR (€1 = US$1.17, December 2017).

Choice of the model

A decision tree was used as a tool to identify a model of decisions and their related financial outcomes (Stavros 2011). Cost presented is given as about weighted averages, depending on the probabilities and pay-offs of the followed pathways in the decision tree.

Assumptions

The assumption was made—based on the information of the survey—that callers followed the advice given by the BPC and that callers—in the absence of the BPC—would really do what they declared in the survey.

We also assumed that the probability of patients being referred by the GP to the ED was the same as in the poisoning data 2017 of GUH. Another assumption was that the proportion of ED-amb, ED-24 h and Hosp was the same all over the country as in GUH.

Analytical methods

A first sensitivity analysis was conducted assuming the hypothetical situation in which GPs would not send a single patient to the hospital and in which all ED-patients would receive only ambulatory treatment. A second sensitivity analysis made using the same assumptions but applying an even more conservative financial scenario, i.e. by using median cost values instead of average cost values.

The study protocol was approved by the Ethical Comittee of GUH on February 16, 2016. Data analysis was performed using Microsoft Excel 2013 and SPSS 25.0 (IBM®).

Results

Study parameters

During the study period, the BPC received 1045 calls of which 891 (85.3%) were for actual poisoning cases and 154

(14.7%) only requests for information (Fig. 1). Intentional and unintentional poisonings were involved in 98 (11.0%) and 790 (88.7%) cases, respectively. In the latter group, 618 calls came from the general public. Informed consent for participating in the telephone survey was obtained from 485 callers, of which 404 (83.3%) could subsequently be contacted.

According to the initial BPC advice given during the first call, 90.1% should not have sought further medical help, 5.4% had to consult a GP and 4.5% had to go to a hospital (Table 1). From the subsequent telephone survey, it appeared that after having called the BPC 92.1% did not seek any other medical help, 4.2% consulted a GP and 3.7% went to the hospital. When confronted with a hypothetical absence of the BPC 13.8% of the callers would not have sought any help, 49.3% would have contacted the GP and 36.9% would have gone to the hospital. From the figures of GUH, we estimated that 3.5% of ED-patients were referred by the GP and that 71.0% of these patients would have left the ED after consultation, 20.1% would have had to stay in the ED for a 24-h observation and 8.9% would have been admitted to the hospital, respectively.

Costs and outcomes

The BPC received a 2017 funding from the government of €2,044,930.00 per year, of which €1,431,451.00 was assigned to phone consulting. Considering 57,400 phone calls in 2017, the average cost per call was €24.94.

The average cost for consulting a GP was €36.11 of which €30.28 was reimbursed by the government and €5.83 was paid by the patient (cost sharing).

The average cost for the government in 2017 for GUH services, based on the analysis of 796 patients, was €198.94 (CI 95% €186.77–211.10) for ED-ambulatory consultation, €1120.60 (CI 95% €1060.06–1181.15) for ED 24-h observation and €5379.73 (CI 95% €3792.19–6967.27) for hospitalisation (total episode). GUH median cost was €166.19, €1068.19 and €2981.06, respectively.

Cost–benefit analysis

In the presence of the BPC, the estimated average weighted cost was €57.93 as compared with €330.48 without BPC (Fig. 2).

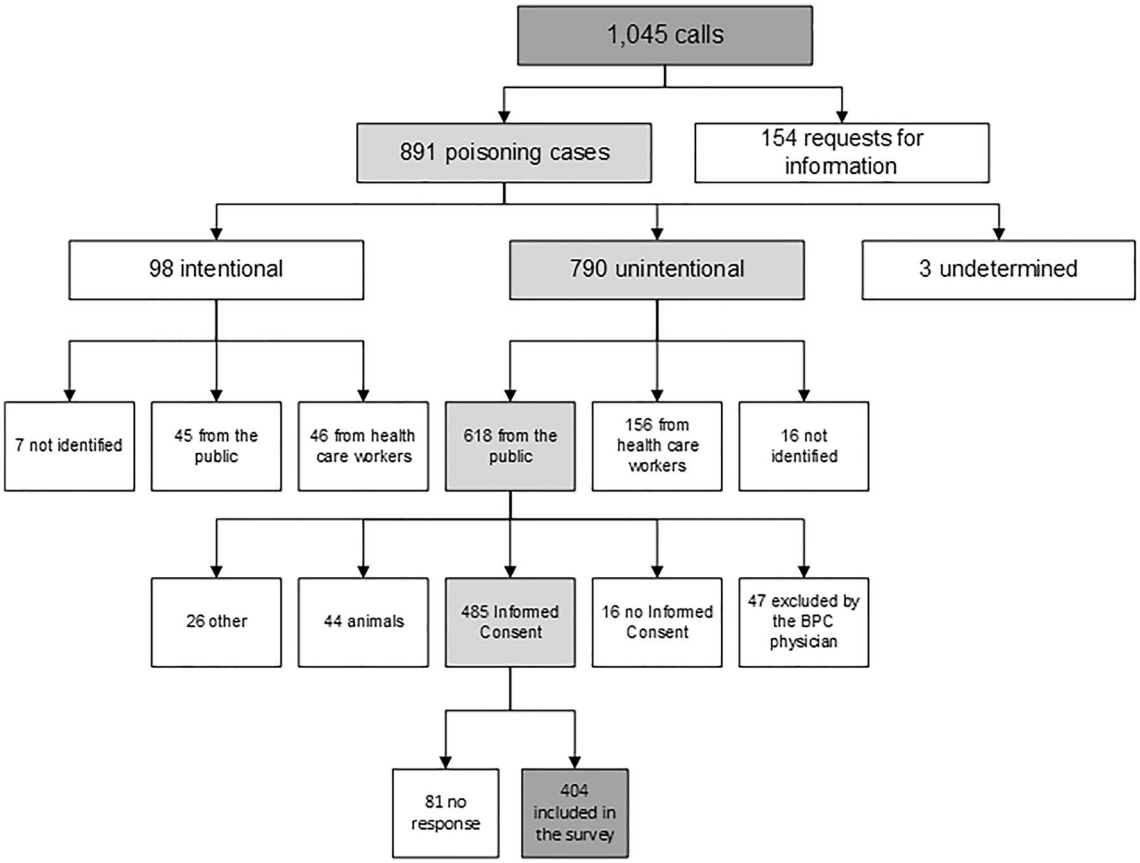

Fig. 1 Characteristics of calls to the Belgian Poison Centre and number of patients with unintentional poisoning included in the survey, Belgium, 2016

Table 1 Advice of the Belgian Poison Centre, patient's decision and further referral under circumstances of Belgian Poison Centres availability or hypothetical unavailability, Belgium, 23 Feb–18 March 2016

Medical help	Total *n* (%)	Estimated further referral[a]	%	*n* (%)
Patients decision in the presence of the Belgian Poison Centre				
No further medical help	372 (92.1)	Home	100.0	372 (92.1)
General practitioner	17 (4.2)	General practitioner	96.5	16 (4.1)
		Hospitalisation	3.5	1 (0.1)
Hospital	15 (3.7)	Emergency department ambulatory care	71.0	11 (2.6)
		Emergency department 24-h observation	20.1	3 (0.7)
		Hospitalisation	8.9	1 (0.3)
Total	404 (100.0)			404 (100.0)
Patients decision in the hypothetical absence of the Belgian Poison Centre				
No further medical help	56 (13.9)	Home	100.0	56 (13.9)
General practitioner	199 (49.3)	General practitioner	96.5	192 (47.5)
		Hospitalisation	3.5	7 (1.7)
Hospital	149 (36.9)	Emergency department ambulatory care	71.0	106 (26.2)
		Emergency department 24-h observation	20.1	30 (7.4)
		Hospitalisation	8.9	13 (3.3)
Total	404 (100.0)			404 (100.0)

[a]The proportions of further referrals are derived from the invoices of unintentional poisoned patients in Ghent University Hospital, Belgium, 2017

The cost–benefit ratio amounts to 5.70 (€330.48/€57.93). Taking into account an average of 35,107 calls per year from the general public for unintentional poisoning to the BPC in 2017, this corresponds with an estimated saving for the government of €9,568,338.55/year.

Characterising uncertainty

In the hypothetical and unlikely situation in which not a single patient would be sent to the hospital by the GPs and in which all patients who went to the hospital would only receive ambulatory treatment, a cost–benefit ratio of 2.55 (€88.29/€33.60) was found. In an even more conservative scenario using the same assumption as in the first analysis and using median values instead of average values, a cost–benefit ratio of 2.34 (€75.57/€32.30) was estimated.

Discussion

Summary and interpretation of findings

The aim of this study was to make an economic evaluation of two alternatives in case of unintentional poisonings, i.e. in the presence or absence of the BPC. Our data indicate an estimated positive cost–benefit ratio in the presence of the BPC of 5.70. Furthermore, we performed two sensitivity analyses. Even with these very conservative hypothetical situations which presumably underestimate the real cost savings, the estimated cost–benefit ratios were still positive (2.55 and 2.34, respectively).

The proportion of ED-amb, ED-24 h and Hosp were estimated based on the analysis of all patients with unintentional poisoning admitted to GUH in 2017.

Limitations

A first limitation is that, when considering the BPC ratio of 5.70, we should keep in mind that our ratio may lack accuracy as some assumptions have been made. It is difficult to extrapolate whether people, in real life confronted with poisoning in the absence of the BPC, would have taken the same decision as what they had answered in the survey.

Therefore, we performed two sensitivity analyses. The first hypothetically reduced to zero the number of patients sent by the GPs to the hospital and the number of ED-patients who had to go for an ED-24 h or Hosp. The second

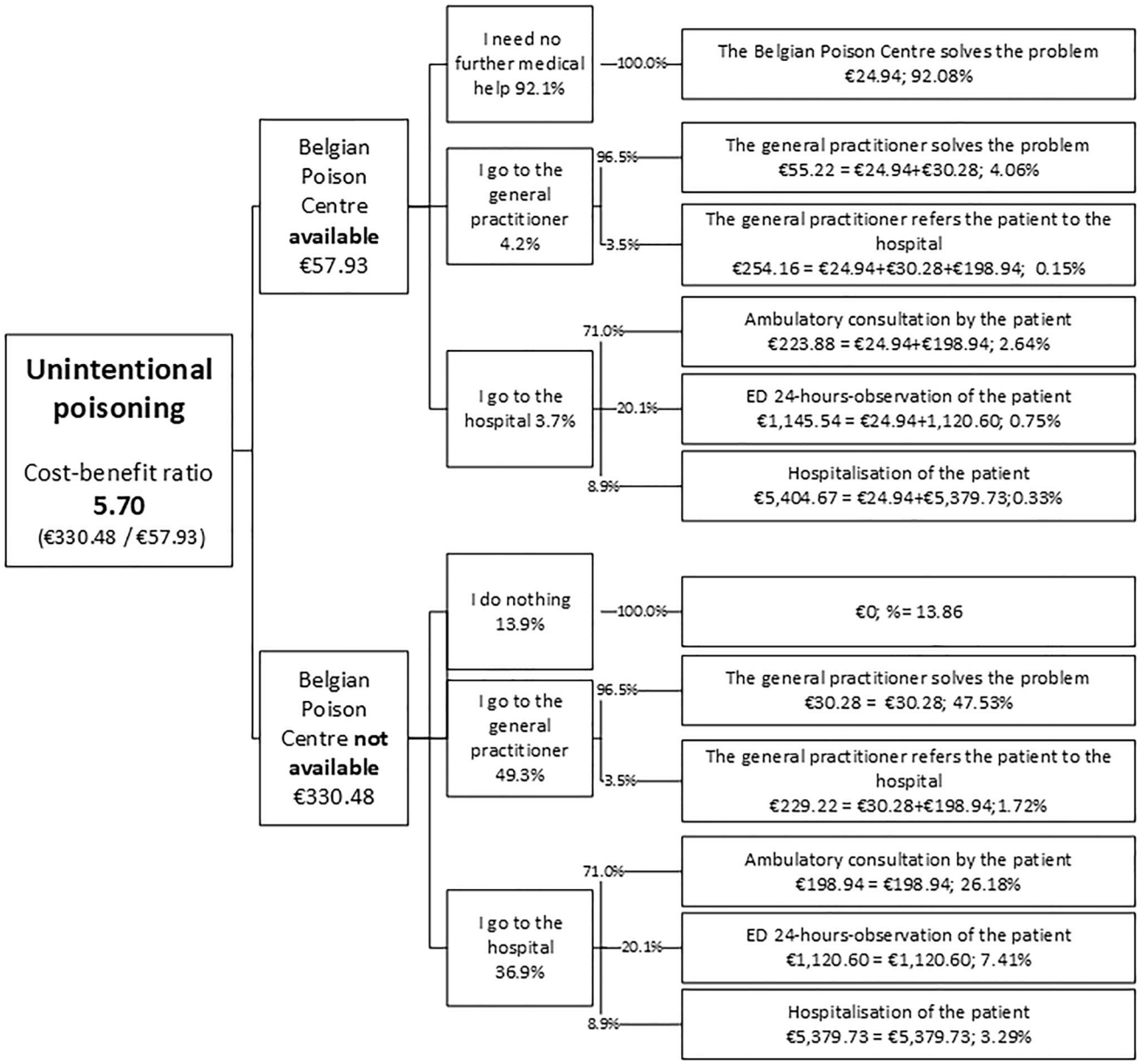

Fig. 2 Decision tree for unintentional poisonings in the presence or hypothetical unavailability of the Belgian Poison Centre for calls from the public, Belgium, 2016

sensitivity analysis applied an even more conservative financial scenario using median cost values instead of average cost values. Even with these very conservative hypothetical situations which presumably underestimate the real cost savings, the cost–benefit ratios were still positive (2.55 and 2.34, respectively).

A second limitation is that, although the response rate in our survey was high (83.3%, i.e. 404/485), we should keep in mind that the study period was limited to seven days and restricted to winter time.

A third limitation is that we had to estimate the proportion of ED-patients being referred by the GP using admission data for poisoning of GUH. This proportion has to be checked with a larger number of hospitals and with data from GPs to validate these assumptions.

A fourth limitation is that the type of poisoning of patients calling the BPC and those consulting the GP or the ED were not analysed. It is clear that further research is needed to have more detailed insight into the degree of similarity and differences between those patient groups and the related costs.

Research in context of current evidence

Many studies demonstrated that PCCs reduce healthcare expenses by avoiding inappropriate use of other medical services.

In our analysis, without BPC, 86.2% would have searched help from a healthcare professional (GP or hospital), which is in the same range as 79% of the study of Kearney et al. (1995) and 70% (37% Emergency Medical Services and 33% ED) in the study of LoVecchio et al. (2008). It is also noteworthy that in our study an estimated 13.8% of the patients would not have sought any help in the absence of the BPC. Blizzard et al. (2008) and Kearney et al. (1995) mention figures of 21% and 63%, respectively. Although not analysed in detail and restricted by the limited number of patients in our survey, this indicates an increased risk of undertreatment in cases of serious poisoning when a low-threshold consult of a PCC would not be available. It is clear that future research is needed to analyse the natural units of effects like harm or of dangerous poisonings that are left untreated, morbidity and mortality.

Cost–benefit ratios reported in the literature vary between 0.76 and 36 (The Lewin Group 2012; Blizzard et al. 2008; Kearney et al. 1995; King and Palmisano 1991; LoVecchio et al. 2008; Miller and Lestina 1997; Phillips et al. 1998; Zaloshnja et al. 2003). When interpreting these ratios, it should be kept in mind that there are important differences between these studies such as divergent types of economic evaluations, differences in the collection of data and heterogeneity of healthcare systems.

Some studies analysed the costs and benefits in the presence versus absence of a PCC only in cases of poisoning *not needing further medical treatment* (Blizzard et al. 2008; Kearney et al. 1995; King and Palmisano 1991; LoVecchio et al. 2008; Phillips et al. 1998; Zaloshnja et al. 2003). Our study, on the other hand, was not limited to unintentional poisonings not needing further medical treatment.

Three cost–benefit studies in the literature used, like in our study, *a telephone survey* (Blizzard et al. 2008; Kearney et al. 1995; LoVecchio), three other studies used only *data analysis* without survey (The Lewin Group 2012; Miller and Lestina 1997; Zaloshnja et al. 2003) and two set up an *experiment* by restricting public access to the PCC (King and Palmisano 1991; Phillips et al. 1998). Two of the three authors who conducted a telephone survey (Blizzard et al. 2008; Kearney et al. 1995) for poisoning cases without further medical treatment, calculated a cost–benefit ratio of, respectively, 7.67 and 5.3. Although methodologically not entirely comparable with our study, the cost–benefit ratio of 5.70 found by us for BPC is in the same range (as reported by these authors). In contrast, LoVecchio et al. (2008) found a much higher ratio of 36. This difference can probably be explained by the calculated cost for an ED-visit used in his study which is much higher (US$1152) than the average cost used in our study (€198.94).

In Norway in Europe, Anell and Persson (2001) and Toverud et al. (2009) presented a *cost–benefit ratio* of, respectively, 1.05 and 0.76, which is substantially lower than in our study. However, it should be noted that they included all calls to the PCC also including intentional poisonings, resulting in a higher proportion of patients sent to the hospital in the presence of the BPC.

It should be mentioned that the BPC contributes to avoiding the negative aspect of overcrowding in EDs resulting in less time left for high-quality care for the most severely ill patients. As in other countries in the world, Belgian EDs are under heavy public demand. A report of *the Belgian Healthcare Knowledge Centre* (KCE) (Van den Heede et al. 2016) states that the number of ED contacts increased from 3,006,321 to 3,195,897 between 2009 and 2012, especially because of the increase in ambulatory care visits. Our study estimated that without BPC, an estimated shift of workload from the BPC to the GP (49.3%) and the ED (36.9%) would occur, thus adding to the burden and associated risks of overcrowding in those medical services.

Concisely answer the objective

The aim of the telephone triage by the physicians of the BPC is to guide patients to the appropriate care, in a qualitative and cost-efficient way. In the absence of the BPC, it seems that victims of unintentional poisoning would inappropriately use other, more expensive medical services, such as physician's consultations and hospital use. This represents an estimated cost–benefit ratio of 5.70. In terms of avoided costs for the Belgian Government, this represents an estimated saving of €9,568,339 in 2017 for unintentional poisonings. All key parameters were validated by a telephone survey of 404 patients who called the BPC and by the cost analysis of the individual invoices of 796 patients with unintentional poisoning admitted with unintentional poisoning to a university hospital in 2017. Therefore, patients have to be sensibilised by policy makers to first call the Poison Centre in case of unintentional poisoning.

Compliance with ethical standards

Conflict of interest The authors report no declarations of interests.

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