Poisoning Expertise and Outcomes in Malicious Contamination Incidents

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Abstract

Purpose: It is often assumed that poisoners and product tamperers are likely to share an interest in or knowledge of poisonous substances. The purpose of this research is to determine whether perpetrators with existing poison knowledge will choose different contaminating agents than non-experts, as well as whether there is a link between poison expertise and outcomes in malicious contamination cases. Based on their expertise, it is expected that those perpetrators with some form of existing poison knowledge would select more concerning and difficult to obtain agents, and that attacks committed by experts would result in more harm than attacks by non-experts.

Methodology: A content analysis was conducted on qualitative descriptions of malicious contamination events, with relevant behavioural variables identified as being present or absent for each individual case. Differences between experts and non-experts in agent choice and incident outcome were then explored using descriptive statistics, contingency tables and Mann-Whitney U tests.

Findings: Agent choice was found to differ between experts and non-experts, with different agents chosen depending on whether the event was a threat or a genuine contamination incident. However, attacks by poison experts were found to be no more deadly than attacks perpetrated by non-experts.

Value: This research provides the first known analysis comparing agent choice and outcomes in malicious contamination incidents as a factor of perpetrator knowledge. Investigative applications are discussed.

Keywords: poisoning, product tampering, malicious contamination, CBRN, threat, expertise

Introduction

Malicious contamination is a blanket term which can be used to describe any act of intentionally adulterating a consumer product, with either the intent to harm or the knowledge that an individual could be harmed as a result of the contamination. The consumer product selected could be found anywhere in the supply chain, from the point of manufacturing or distribution as in the case of many product tampering incidents, to being found in the home after purchase, as in the case of the typical poisoning incident. However, it is difficult to distinguish between product tampering and poisoning incidents in many cases, as the definitions of each in the literature are often vague and share considerable overlap (Wilson and Kilbane, 2017). There has been sparse research to date in the area of malicious contamination, although several studies have been conducted separately on homicidal poisoning (e.g. Adelson, 1987; Westveer *et al*., 2004; Shepherd and Ferslew, 2009; Zaitsu, 2010) and product tampering (e.g. Logan, 1993; Cremin, 2001). As these studies have either been theoretical in nature, focusing on the victims of such crimes, or looking primarily at demographic information, little is known about the perpetrators of such crimes or their offending behaviour. This study thus seeks to fill an important gap in the literature and provide a better understanding of who may commit an act of malicious contamination, and whether the outcomes in these incidents are shaped by specialist knowledge of poisonous substances.

Poison 'expertise'

Due to the fact that there have been few past studies examining the perpetrators of malicious contamination incidents, little is known about poisoners specifically. This is compounded by the fact that such incidents are often difficult to identify, and so it is likely that a number of these cases may remain unreported or unsolved (Westveer *et al*., 2004; Trestrail, 2007). Similarly, information about product tamperings may be kept out of the public eye by the authorities or victimised companies (Cremin, 2001), and with the literature sparse even less is known about this group of perpetrators. Recent data from the American Association of Poison Control Centers suggests that there were 7,695 cases of contamination or tampering and 7,448 cases of malicious poisoning in the United States during 2016 (Gummin *et al.*, 2017). While this is a considerable number of attacks, each incident (or 'exposure') represents a call having been made to a poison control center in which the caller expressed concern about exposure to a substance. As such incidents are based solely on the concern of the caller they do not necessarily represent verified attacks. In the case of an intentional malicious poisoning, one act of contamination could potentially lead to dozens or even hundreds of separate calls depending on the scope of the act. Finally, cases flagged as contamination incidents were composed of both malicious and unintentional tamperings, which represent two very different phenomena, and as a result the number of reported cases here is likely to be substantially larger than the number of malicious tamperings alone. Thus the scope of malicious contaminations incidents remains difficult to determine.

Although little is known about such cases, one characteristic that poisoners and product tamperers are theorised to share is some degree of prior interest in poisonous substances or existing poison knowledge. This has been noted by Dalziel (2009, p.18), who stated that those who engage in food defence incidents may have a “strong interest in poisons”, as well as Trestrail (2007) who indicated that poisoners may work in the medical field, or in a laboratory where there is easy access to chemicals. In addition to medical or laboratory work, a perpetrator could be classified as having existing poison knowledge through work in the fields of, for instance, pest control, farming or agriculture, where they may select agents that they have working experience with in order to harm another person or persons. However, it is not known whether an interest in poisons attracts certain individuals to these professions, or whether access to such agents predates poison interest (Trestrail, 2007). Alternatively, such poison ‘experts’ could also be individuals who have studied, either officially through an institution of higher education or privately in their own time, topics such as chemistry, biology or virology. Finally, poison expertise may also come in the form of specialised military training, either legitimately or as part of a clandestine organisation, in the handling and use of poisonous substances.

Previous estimates indicate that at least 20% of malicious contamination cases committed by a lone offender who was known to the authorities involved some sort of poison expertise, whether that be in the form of vocational, educational, personal, or military knowledge (Wilson and Kilbane, 2017). Additionally, such knowledge was found to be more prevalent among poisoners (24%) than product tamperers (12%; Wilson and Kilbane, 2017). However, in cases where groups were responsible for the contamination incident, where the identity of the perpetrator remained unknown, or where information related to expertise was simply not reported, it was not possible to identify whether the perpetrator had any existing poison knowledge. As a result it may be that this 20% is an underestimation when it comes to identifying perpetrators with existing poison knowledge.

Whether or not the perpetrator of a contamination incident has knowledge of poisonous substances is an important consideration, as Henretig (2001, p.719) has previously noted concern around “amateur” terrorists or scientists using their knowledge of bioweapons to cause casualties –

and possibly even fatalities – in the hundreds or thousands. Indeed, Trestrail (2007) notes that, in comparison to homicidal poisonings, no other type of homicide produces the number of victims per single offender, and so the presumed knowledge of poisons on behalf of one perpetrator has the possibility of harming a number of individuals. This presumed knowledge may be related to a number of specific factors which could increase the likelihood of causing substantial harm, including access to poisonous substances, awareness of handling and storage practices, as well as knowledge of the toxicity of the substances chosen. For instance, Trestrail notes that "one of the greatest aspects desired in a poison is for its effects to mimic a natural disease state, because the poisoning will be missed" (2007, p.33). The requirements for such an agent used in an attempted homicide is thus for it to work quickly, be deadly, and fail to arouse suspicion, and it is likely that some additional knowledge beyond that possessed by the average individual would be needed to identify and obtain such a poison. As poisonous substances vary wildly in their availability, toxicity, and reactivity, it is worth considering how these substances may be selected, as well as which agents have been previously identified as being particularly appealing to criminals.

Agents and outcomes

In considering poisoning and product tampering incidents together, there is a great deal of variety, both in the agents used, but also the amount of harm caused by such agents. Despite a previous emphasis on the importance of poison knowledge among perpetrators, past research has also found that many agents used in poisoning and product tampering incidents are readily available and quite easily accessible. These include, for poisonings, arsenic, cyanide and strychnine (Trestrail, 2007) or narcotics (Westveer *et al*., 2004), while a large number of deaths from product tamperings have involved cyanide (Logan, 1993), with household poisons such as pesticides most commonly used in food defence incidents (Dalziel, 2009). Additionally, the largest number of food defect related prosecutions in the UK is due to the use of foreign objects, which are most commonly items such as metal, insects, or glass (Graves *et al*., 1998), and require no specialist skill to use. While foreign objects are relatively low on the list of concerning agents, others such as pesticides and cyanide have the potential to cause a great deal of harm. Examples of the former include thallium (Peter and Viraraghavan, 2005) and tetramine (Croddy, 2004) which are both easily accessible in certain areas where they are used as rat poisons, and which have the potential to cause staggering levels of harm. For instance, in 2002 a man in China named Chen Zhengping used rat poison to contaminate the food of a rival snack bar owner, killing 42 and injuring another 300 (Croddy, 2004).

With this being said, the use of more specialised agents has typically been indicative of a perpetrator working with or having knowledge of such agents (Dalziel, 2009). Indeed, despite the ease of access and toxicity surrounding many household poisons, the threat of chemical or biological weapons used in contamination incidents remains a substantial concern. If used properly, chemical, biological and radionuclear (CBRN) agents, while incredibly threatening and having the potential to create widespread destruction, would likely require some specialist knowledge in order to obtain, handle, and use to maximum effectiveness. Agents such as botulinum toxin and anthrax can be considered those of highest concern as they are “easily disseminated, cause high mortality and morbidity, can produce social disruption, and need special action for public-health preparedness” (Sobel *et al.*, 2002, p.875). However, others argue that such agents may not require much skill to obtain or use, with Bailey (2001, p.2) stating that the process of separating ricin from castor beans is “simple”, with castor beans easy to obtain worldwide, and Török *et al.* (1997, p.394) adding that producing large amounts of bacteria is “inexpensive and involves simple equipment and skills”. Broussard (2001, p.324) states that “[b]iological warfare agents are easy to manufacture, generally don’t require sophisticated delivery systems, [and] have the ability to kill or injure large populations”, with the World Health Organization (WHO, 2008, p.18) adding that a university-level knowledge of relevant scientific subjects may be all that is needed to make the necessary quantities of certain agents. And according to Root-Bernstein, engaging in bioterrorism may simply require a “sophisticated understanding of the properties of various edible plants, medicinal herbs, toxins and venoms, and infectious and pharmaceutical agents” (1991, p.45), although the phrase ‘sohpisticated understanding’ implies some form of knowledge attainment. However, Dalziel (2009) emphasises, based on previous incidents, that intentional contamination of both the food supply chain and the water supply are likely to be quite difficult to accomplish. The ongoing debate over what is ‘easy’ or ‘requires knowledge’ in these scenarios thus makes it difficult to come to any conclusion about who may use such concerning agents.

Finally, it is also worth noting that, in cases of product tampering in particular, the goal may not always be to cause harm. Indeed, the notion that an ideal poison is one which may go undetected (Trestrail, 2007), is of no use to an extortionist or a terrorist who is attempting to gain attention for their cause through the use of a threat or hoax. In an attempt to gain such attention, threateners or hoaxers may even claim to have used particularly fear-inducing agents, regardless of whether they have access to or knowledge of such agents (Carus, 2002; Cornish, 2007; Author, forthcoming). Therefore, it is imparative not only to determine what agents are used by experts in comparison to non-experts, but also to consider the assumed goal of the act, whether that be to injure many or to simply generate public fear.

As discussed, previous emphasis has been placed on those who may have existing poison knowledge, as their access to and skill with certain deadly substances could result in more 'successful ' (i.e. deadly or wide in scope) attacks. For example, the poisoning of ten restaurant salad bars in a small Oregon town in 1984 by the Rajneesh religious cult illustrates the possible scale of a bioterrorism attack using the food supply where at least one perpetrator had existing poison knowledge. While there were no deaths as a result of this attack, 751 people were made ill by *Salmonella* Typhi after eating at the affected restaurants (Török *et al*., 1997; Khan *et al.*, 2001). Applied to terrorists wishing to harm or kill a large number of individuals, knowledge about and access to CBRN weapons could thus have catastrophic results for the general public. However, given the potential deadliness and widespread availability of simple household poisons, there may be little advantage for perpetrators with poison knowledge over those without such knowledge when it comes to achieving their ultimate goals. There is thus a necessity to determine whether in fact those deemed poison 'experts' may produce more deadly attacks than perpetrators without poison knowledge.

The current study

From what little is known of contamination incidents, several questions emerge surrounding perpetrator expertise, agent selection, and incident outcomes which require further attention. This research will seek to address these unknowns by first exploring which agents are chosen by experts in comparison to non-experts in both cases of actual contamination and threats alone, and then by examining whether attacks by experts are likely to result in more harm than non-expert attacks. These results will thus help to determine whether the division between experts and non-experts in malicious contamination cases is even an important – or relevant – distinction to make.

Method

The database used for the current analysis consisted of 438 cases of malicious contamination, collected from 64 countries from 1970 to 2016. Incidents included actual contaminations as well as threats, hoaxes and unactualised plots, with a complete case list compiled from both existing databases (Carus, 2002; Dalziel, 2009) and by searching newspaper repositories including LexisNexis, ProQuest and ProQuest Historical. Search terms such as 'product tampering', 'tamper', 'poisoning', 'poison' and 'contamination' were used to find relevant reports. Cases were then included in the database for this study if a consumer product was contaminated by either someone with the intent to harm, or knowledge that the contamination had the potential to cause harm. Identifying such intent was based on the case descriptions provided in the source material, but excluded cases of corporate negligence and accidental contamination. Harm here could cover physical harm in the case of actual contamination, but also psychological and financial harm in the case of hoaxes and threats. Each individual case was identified as a single incident committed by a perpetrator or group of perpetrators against one or more individuals. Campaigns involving multiple threats or attacks by the same perpetrator were also coded as a single case, provided these threats or attacks involved the same method and motive.

Once known cases of product tampering and poisoning were identified, qualitative case data was collected from archival sources, including academic books and journal articles, government reports (e.g. conviction press releases from the US FDA) and newspaper publications, with the latter being the largest source of data. Local, regional and national newspapers were searched using the same databases identified above, with US and UK newspapers being the most common sources used. Triangulation of the data through the incorporation of multiple sources for each case was used wherever possible. The database was then constructed, with the qualitative reports subject to a quantitative content analysis, in which pertinent behavioural variables were identified and coded as either absent or present for each case. Specific to the current analysis, these variables included any descriptions of training, employment or research that could indicate existing poison knowledge on behalf of the perpetrator, the specific agent which was either used, or which the perpetrator threatened to use, and the number of victims in each case.

One of the key pieces of information recorded in each case was whether the perpetrator was known to have any previous knowledge of or expertise with potential contaminating agents. A poison 'expert' was thus defined as any individual who had professional experience handling poisonous substances, such as those who had studied or were working in the fields of bacteriology, parasitology, microbiology, virology or chemistry, working in a medical position such as a pharmacist, doctor, nurse, hospital technician (or other medical training), or as a veterinarian, farmer, exterminator, or working for a drug company or chemical company. While it is noted that varying levels of knowledge likely exist both between and within the professions mentioned (e.g. that an exterminator and a microbiologist will likely have expert knowledge of different poisonous substances), a clear classification was necessary to identify those who were assumed to have some knowledge and handling experience with poisonous substances. If such information was not available about a perpetrator then the incident was coded as not involving any expertise.

While it is noted that determining offender characteristics (in this case poison knowledge) from newspaper sources can be problematic, this is thought to be appropriate for the current analysis for a number of reasons. Firstly, unobtrusive data are commonly used in forensic psychology, and in particular in determining offender characteristics (see Alison *et al.*, 2001; Canter and Alison, 2003). More specifically, news reports have been used to study acts similar to contamination (Carus, 2002; Dalziel, 2009) as well as complex social phenomena in political science (Woolley, 2000), including being used in the construction of the Global Terrorism Database, for example (LaFree and Dugan, 2007). While the validity of news sources has been called into question, Franzosi (1987) notes that factual information is less likely to be associated with inaccurate reporting than, for instance, the motive behind an attack. This could be applied to offender occupation, which is thought to be an important offender characteristic and the most common source of poison knowledge. It would thus be expected that offender occupation would be reported and reported accurately, provided the information was known. Finally, triangulation of the data was used as previously mentioned in order to capture all of the available information about each individual case, thus reducing the chance that important information about offender poison knowledge was overlooked.

The data were collected in two sessions and so two separate inter-rater reliability assessments were conducted. For the data from 1970-2011, 15% (n=58) of cases were double coded, revealing a significant kappa value (κ=.783; p<.001). The second period of data collection consisted of the years 2012-2016, of which 26% (n=14) of cases were double coded, again with a significant kappa value found (κ=.693; p<.001). According to Landis and Koch (1977) both of these values would fall in the 'substantial' range from .61 to .80, and as such the coding was deemed to be sufficiently consistent.

Results

Perpetrator expertise

As mentioned, previous studies have suggested that one common trait among those who engage in contamination incidents is the presence of some form of poison knowledge. For the current sample, when the identity of the perpetrator was known (n=315), 19.7% (n=62) of cases were reported to involve a perpetrator who could be classified as having some form of existing knowledge of contaminating agents. The majority of this reported knowledge came in the form of professional expertise (n=53; 85.5% of experts) such as being employed in one of the professional roles described above. A much smaller number (n=8; 12.9%) were identified as having conducted their own personal research, while a minority (n=2; 3.2%) received specialist military training in contaminating agents[1]. However, as stated above, previous authors have argued that specialised expert knowledge both may (e.g. Dalziel, 2009) and may not be (e.g. WHO, 2008) a prerequisite for obtaining and using certain deadly agents. Therefore, this distinction between expert and non-expert needs to be explored with particular attention paid to the agents chosen, as while perpetrators may not require any specific poison knowledge in order to carry out a successful contamination attack, they may be more likely to achieve the desired result if they have such knowledge and are able to carefully control the dose delivered to their victims.

Agents used

For malicious contamination cases generally, the agent selected for use can be broken down into four basic categories: chemical agents (e.g. pesticides, heavy metals), biological agents (e.g. bacteria, viruses), radiological agents (e.g. plutonium, polonium-210), and foreign bodies (e.g. bone, glass, needles). Chemical agents were by far the most common agent category selected in this sample (n=227), and this was true for both experts and non-experts alike (see Table 1). However, when considering biological agents, these were more likely to be used by experts, with a significant relationship found when using a two-way contingency table ($\chi^2=13.381$, $p<.001$). Two-way contingency tables were used here to test relationships between variables composed of dichotomous (present/absent) data. Additionally, radiological agents were found to have been used exclusively by experts, whereas foreign bodies were used exclusively by non-experts. Finally, in less than 15% of non-expert and 10% of expert cases the actual agent used was either unknown or unreported, which could have a relatively minor impact on some of the other agents categories discussed. While examining these agents in more specific detail could provide a better understanding of agent choice among experts and non-experts, it is first important to consider the distinction between cases of actual contamination and threats or hoaxes, as different desired outcomes may require the use of different agents (Dalziel, 2009; Tishler, 2013; Author, forthcoming), regardless of the perpetrator's knowledge.

[TABLE 1 ABOUT HERE]

[1] In one instance the perpetrator had both a professional qualification and received additional military training.

Threats vs. actual contamination

Irrespective of whether the perpetrator was identified as an expert or a non-expert, the likelihood of actual contamination was found to be comparable between these two groups; 72.6% (n=45) of expert cases and 79.8% (n=202) of non-expert cases were successful contamination incidents, with the remainder being threats, hoaxes, and unactualised plots. In cases where a product was actually contaminated (see Table 2), experts most frequently used arsenic, prescription drugs, thallium, or some form of bacteria. For non-experts, rat poison[2] was by far the most common substance used, followed by insecticide and herbicide more generally, as well as cyanide.

For threats and hoaxes the non-experts most frequently claimed to have used some form of bacteria, while experts most frequently claimed to have used ricin (see Table 3). It is worth mentioning here that there were only six instances where someone with poison knowledge was known to make an empty threat or hoax, although this made up a similar proportion of threats by non-experts as discussed previously.

[TABLES 2 AND 3 ABOUT HERE]

Outcomes

While the results above lend support to the initial belief that experts and non-experts tend to select different agents, each of the agents described have the potential to cause serious harm, if not death. Therefore, for the use of an agent to result in serious harm, other factors must be considered as well, such as the delivery mechanism and the ease of reaching the target individual or group. It is expected that perpetrator knowledge will make the above easier to accomplish.

In order to determine whether expert attacks were likely to be more deadly than those perpetrated by non-experts, these two groups were compared based on their outcomes in terms of victims involved. The percentage of cases involving no actual harm was found to be roughly equivalent for both experts and non-experts (see Table 4). In cases where there was at least some harm (i.e. excluding the ‘no harm’ cases), the mean number of deaths was found to be lower for non-experts than experts, although the reverse was true for all victims inclusive of injuries and deaths. However, neither the number of individuals killed nor the total number of victims were found to be significantly different between experts and non-experts (total victims U=2401.00,

[2] Rat poison was distinguished from other types of pesticide due to the sheer number of cases involving its specific use

p=.841; total deaths U=601.50, p=.738). Mann-Whitney U tests were conducted as a non-parametric way to examine the difference between the two independent groups of experts and non-experts in regards to the number of victims and fatalities.

[TABLE 4 ABOUT HERE]

Discussion

Of all known perpetrators in the current sample, nearly 20% were reported to have some existing knowledge of poisonous substances, which is expected to be higher than would be found in the general population (Dalziel, 2009) and is consistent with previous research (Wilson and Kilbane, 2017). However, the possibility remains that this is actually an underestimate, with more cases in reality involving a perpetrator with poison knowledge than have initially been identified. This could be in part due to the reliance on open source data, and primarily news reports. Although triangulation was used in an effort to avoid this issue, it is still possible that, in the case that perpetrator information pertaining to poison knowledge is not reported, a perpetrator may be mistakenly classified as having no existing poison expertise when in actuality the opposite is true. In addition, the presence of specialist knowledge may allow for greater specification and targeting, making it easier to commit a crime that is not only deadly, but which also goes unnoticed by the authorities. As Trestrail (2007) has noted, an ideal poison mimics a disease state, and as such some homicides may not even be identified as poisonings. Therefore it may be that experts are typically more 'successful' in attacks where homicide is the ultimate goal, with their crimes being misattributed to natural causes of death.

Additionally, it is worth noting that while it may be relatively easy to identify when individuals have some manner of professional poison knowledge, it is much more difficult to determine when someone has conducted their own personal research on poisonous substances. Rather than considering poison knowledge as being either present or absent, a more realistic portrayal of knowledge may be depicted as occurring on a continuum, from considerable poison knowledge on one end to limited or no knowledge on the other. Such a model could include both those who work in fields where poisonous substances are used on a daily basis as well as those who may have a basic educational background in chemistry or biology. In addition, the lines between expert and non-expert have become increasingly blurred with the ease of accessing poison information via the internet. For example, both the case of UK man Mohammed Ali, who procured ricin through the darkweb in 2015 (BBC News, 2015), as well as US man Mark Retterath, who plotted to kill another man with ricin extracted from castor beans (Pieper, 2016), were claimed to have been inspired by the US television show *Breaking Bad*. Neither of the men were reported to have any previous poison knowledge, and instead were able to procure the information needed from a simple internet search. While the ability to create ricin from castor beans may require some level of skill, even if as Bailey (2001) argues this is relatively 'simple', the fact that ricin is extremely deadly has now become common knowledge.

Despite the possibilities of underestimating the number of poison experts responsible for contamination crimes, the information gleaned from this sample indicates that the vast majority of offenders are not expected to be poison experts. This lends support to the argument that little specialist knowledge is required to engage in acts of malicious contamination, although it is not clear whether this also extends to the use of more serious agents, such as those which fall into the category of CBRN agents. As such, further study is needed to understand why these individuals may chose contamination as a way to achieve their criminal goals, and how they may go about obtaining the necessary poisonous agents.

The most commonly identified agents in this sample were found to be consistent with previous works (e.g. Logan, 1993; Westveer *et al*., 2004; Trestrail, 2007; Dalziel, 2009). In general, foreign bodies were used only by non-experts and radiological agents were used exclusively by poison experts, with biological agents more frequently used by experts as well. In cases involving genuine contamination, common household poisons like rodenticides, insecticides, pesticides and herbicides were much more likely to be used by non-experts. This fits with the assumed profile of someone without poison knowledge, who would be expected to use items which are easily accessible, potentially already available in the home, and which require no specialist skill to handle. While the proportion of genuine contamination cases involving cyanide appeared to be roughly equivalent among experts and non-experts, other common agents such as arsenic, thallium, and prescription drugs were used slightly more often by experts. While the use of prescription drugs could indicate that the perpetrator works in a medical field, and while arsenic has legitimate uses in manufacturing and farming (Ratnaike, 2003), it is also important to note that these are quite well known poisons, which are unlikely to require specialist knowhow to use. In the case of thallium, while it is still used by the general public in some developing countries as a form of rodenticide (Peter and Viraraghavan, 2005), it has also been used in a number of political attacks as well (e.g. Sharquie *et al*., 2011). It is thus important to note that some agents such as those described above may span the boundary between specialist and generalist use.

Perhaps due to its frequent use in popular culture over recent years, ricin was found to be used by both experts and non-experts, although this was more prevalent in threats than cases of actual use for both groups. Interestingly, while bacteria were found to be used slightly more among experts, such contaminates were still used in several attacks and threats by non-experts. In total, the proportion of cases involving these biological agents was higher for threats and hoaxes than actual cases of contamination, and this was true for both experts and non-experts. This seems to be consistent with past literature, which shows that biological and particularly concerning agents are more likely to be used during threats and hoaxes (Author, forthcoming), and that concerning agents may be particularly useful in eliciting fear (Sparks and Shepherd, 1994). In addition, in the case of hoaxes and threats it takes only knowledge of the poison's existence and usefulness in eliciting fear for a perpetrator to claim the use of such an agent. Therefore, and as has been mentioned previously, when considering how certain agents are selected it is important to go beyond perpetrator knowledge and consider the ultimate goal of the act. In other words, a threat issued as part of an extortion attempt is likely to require a different 'weapon' than an attempt to murder a spouse for the payout on a life insurance policy. This again emphasises the importance of considering threats and hoaxes separately from actual attacks, which has been highlighted by previously authors (e.g. Tishler, 2003), despite the sparse attention given to threats and hoaxes in the literature to date.

When considering outcomes in cases involving physical harm, attacks perpetrated by experts were found to be no more deadly, or harmful, than attacks by non-experts. However, it is not clear whether this is due to failure on the part of experts to select the ideal agent or to effectively manage the agent dose, or whether non-experts were able to cause a considerable amount of harm despite their lack of knowledge. It may also be that agents are typically selected not because they are most likely to achieve the desired outcome, but rather based on the ease of obtaining such an agent. This has previously been identified in the case of specialist agents, which are likely to be obtained by the perpetrator through their profession (Dalziel, 2009). Such agents may be chosen as they are encountered by the perpetrators in their daily lives, meaning they may have both knowledge of how to use the agent and easy access to it as well, despite the fact that a common household poison may be just, as if not more, effective.

While only a minority of the sample was found to possess existing poison knowledge, perpetrator expertise may still be a helpful starting point to consider during criminal investigations. This is especially true in cases where more specialised agents have been used which could be indicative of the perpetrator's place of work. For those without existing knowledge of, and more importantly access to poisonous substances, the need to acquire such agents is likely to leave a trail which would again prove useful during the investigation process. However, as the majority of the sample could not be identified as possessing poison knowledge, it would be useful for future research to attempt to identify other factors which may be related to different outcomes in contamination cases. These may include variables related to, for instance, the attack location, the product selected, and the access to the supply chain.

As with other studies on the topic of contamination crimes which have relied on archival sources (e.g. Dalziel, 2009), a bias in the data was found towards Western, English-speaking countries, which could have implications for the generalisability of the results. In addition, as many of these crimes often go unreported as previously noted, the data could also be missing important cases, making it potentially difficult to obtain a representative sample of this group of offenders. Incomplete data also makes it difficult to identify poison knowledge as discussed, but also what specific agents were used during the incident. This is elaborated by Dalziel (2009) who notes that news sources are often inconsistent in how they report this information, with some using general terms (e.g. ‘pesticide’) while others may use more specific terminology (e.g. ‘paraquat’). There is thus a necessity to ensure that both the data used, and the process of coding the data, are as reliable as possible.

Conclusion

One of the few beliefs surrounding perpetrators of malicious contamination incidents has been the assumption that they have some existing knowledge of poisonous substances. Although this has found to be true of roughly 20% of the known perpetrators in this sample, and while they may select different agents from those without such knowledge, these poison experts appear to be no more of a threat to the general public than those without poison expertise. When a contamination incident has occurred, it may be helpful for investigators to first focus their attention on those likely to have knowledge of or access to the specific agent used, however a potential suspect should not be ruled out due to a perceived lack of poison knowledge. While this research sheds some light on those who engage in poisoning and product tampering, further study is needed to gain a full picture of the perpetrator who engages in acts of malicious contamination.

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Table 1

Chi-square relationships showing each agent type for experts and non-experts; α=.01 (Bonferroni corrected)

Agent used	**Experts (n=62)**		**Non-experts (n=253)**		**Total uses**	χ^2	**Sig.**
	n	**%**	**n**	**%**	**n**		
Chemical	39	62.9	188	74.3	227	3.217	p=.073
Biological	19	30.6	30	11.9	49	13.381	p<.001
Radiological	2	3.2	0	0.0	2	8.213	p=.038*
Foreign body	0	0.0	11	4.3	11	2.793	p=.130*
Unknown poison	5	8.1	35	13.8	40	1.495	p=.221
Total	**65****		**264****		**329****		

Note. *At least one cell had an expected frequency of less than 5. Fisher's Exact p has been used. **Categories are not mutually exclusive, and so scores may not add up to 100%

Table 2

Most commonly used agents for both experts and non-experts during actual contaminations (n=247)

Specific agent	**Experts (n=44)**		**Non-experts (n=203)**	
	n	**%**	**n**	**%**
Rat poison	1	2.3	54	26.6
Cyanide	4	9.1	17	8.4
Insecticide / pesticide / herbicide	1	2.3	18	8.9
Arsenic	8	18.2	12	5.9
Thallium	6	13.6	9	4.4
Prescription drugs	7	15.9	15	7.4
Ricin	1	2.3	1	0.5
Bacteria	5	11.4	4	2.0

Note. Agent categories are not mutually exclusive.

Table 3

Most commonly used agents for both experts and non-experts during threats and hoaxes only (n=68)

Specific agent	**Experts (n=6)**		**Non-experts (n=62)**	
	n	**%**	**n**	**%**
Rat poison	0	0.0	1	1.6
Cyanide	1	16.7	2	3.2
Insecticide / pesticide / herbicide	0	0.0	2	3.2
Arsenic	0	0.0	2	3.2
Thallium	1	16.7	0	0.0
Prescription drugs	0	0.0	5	8.1
Ricin	3	50.0	4	6.5
Bacteria	1	16.7	6	9.7

Note. Agent categories are not mutually exclusive.

Table 4

Mean number of all victims and fatalities per case for experts and non-experts when the identity of the perpetrator was known, and for cases where there was at least some harm

	Mean number of total victims	**Mean number of deaths**	**Number of cases involving no harm**
Experts (n=62)	30.8	11.5	27 (43.5% of expert cases)
Non-experts (n=253)	41.2	9.2	113 (44.7% of non-expert cases)