

# **Crime Prevention in Practice: An Analysis of Pharmacy Robberies**

**by  
Elliott Mann**

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# Approval

**Name:** Elliott Mann  
**Degree:** Master of Arts (Criminology)  
**Title:** *“Crime Prevention in Practice: An Analysis of Pharmacy Robberies”*  
**Examining Committee:** **Chair:** Dr. Alexandra Lysova  
Assistant Professor

**Dr. Martin Andresen**  
Senior Supervisor  
Professor and Associate Director,  
Graduate Programs

**Dr. Bryan Kinney**  
Supervisor  
Associate Professor

**Dr. Neil DuBord**  
External Examiner  
Chief of Police  
Delta Police Department

**Date Defended/Approved:** August 17, 2017

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## **Abstract**

This paper investigates the incidents of pharmacy robberies in British Columbia, Canada between 2001 and 2016. Using rational choice theory and situational crime prevention, this paper examines the sudden decrease in pharmacy robberies in fall 2015 and proposes theory-based implementations that may further reduce counts of pharmacy robbery throughout the province. This study also measures the effect of recent bylaw implementation enacted in September 2015, and the effect this may have had on reducing pharmacy robbery counts throughout British Columbia. Employing negative binomial regression models, counts of monthly pharmacy robberies are analyzed in four locations: Vancouver, Lower Mainland, Interior, and Vancouver Island. Statistically significant results are found to support the preventative measures enacted by the pharmacy bylaw implementations.

**Keywords:** environmental criminology; crime prevention; situational crime prevention; pharmacy robbery

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## List of Acronyms

CPTED	Crime Prevention Through Environmental Design
PRIME	Police Records Information Management Environment
SCP	Situational Crime Prevention
RCT	Rational Choice Theory
COPS	Community Oriented Policing Services

# Chapter 1.

## Introduction

The study of crime often involves an examination of various factors intersecting in a given time and space. The study of crime through the lens of environmental criminology is benefitted by the examination of criminological theories that examine crime as the intersection of variables within time and space. In addition to the present study, which will examine the efficacy of pharmacy crime prevention bylaws, two criminological perspectives will be examined: situational crime prevention and rational choice theory. The former employs highly specific methods of crime prevention measures dependent upon the specific crime and location. Popularized by Clarke in the early 1980s, this perspective of crime prevention is well suited for the analysis of crime as an event within a particular area or space. In the examination of a crime such as commercial robbery, it is paramount that research is grounded upon theories or perspectives that aid the explanation of the phenomena in question. An examination of crime prevention techniques based on empirically tested and internationally recognized crime prevention theory is well-suited for the examination of a specific crime such as pharmacy robbery. Rational choice theory also lends itself to the examination of pharmacy robbery, as this type of crime requires a motivated offender and often a specific decision-making process (Clark & Cornish, 1985). Situational crime prevention and the rational choice theory will be used to provide context for the present study; rational choice theory examines crime through the lens of a rationally-minded offender, and situational crime prevention utilizes this theory in its application of space-specific crime prevention strategies and techniques.

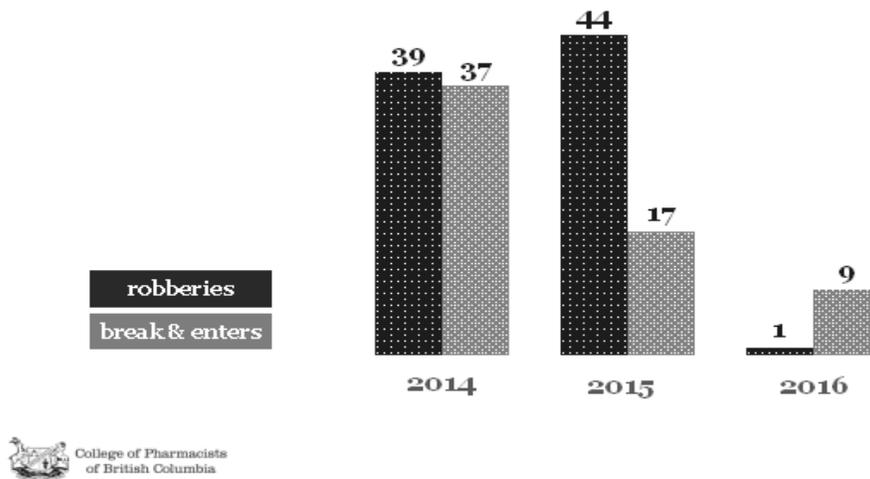
Rational choice theory within the study of criminology was made prevalent by Ronald Clarke and Derek Cornish in the mid 1980s (Clarke & Cornish, 1985). This theory is based on the rational decision-making process of potential offenders, and operates under the assumption that the rationality of potential offenders is not limitless, but rather is bounded based on limited information and subjective experience. Both rational choice theory and situational crime prevention together provide a basis upon which to examine the phenomenon of pharmacy robbery.

Pharmacy crime in North America has been reported to have increased over the past decade, with opportunistic criminals targeting pharmacies for specific narcotics (La Vigne & Wartell, 2015). However, within the province of British Columbia, Canada, there has been a significant and sudden drop in recorded pharmacy robberies between 2015 and 2016 (Figure 1.1). While robberies have increased in the United States but have decreased throughout Canada, there exists an opportunity for further application of criminological theory in the examination of pharmacy robberies. This study will explore the pharmacy robbery trend in British Columbia from 2006 to 2016 on a yearly and monthly scale. Various crime prevention techniques will be examined, in order to inform recommendations for further pharmacy crime prevention. Finally, predictions of future trends within the data will also be examined.

This study proposes two primary research questions that guide the framework of this study:

1. What has been the impact of pharmacy policy and bylaw enactments on counts of reported pharmacy robberies throughout British Columbia?
  - a. Has the increase in visible signage or the presence of time-locked safes had a significant impact on the drop of reported pharmacy robberies?
2. Were there any observable differences between the impact of the new pharmacy policy and bylaw enactment between the four locations in this study?

It will be hypothesized that the recent implementation of mandatory time-locked safes and improved signage across all pharmacies under the jurisdiction of the College of Pharmacists of British Columbia has had a statistically significant impact on the reported drop of pharmacy robberies in Vancouver. It will also be hypothesized that the increase in visible, public signage indicating the presence of new time-lock safes has had a significant impact on the drop of pharmacy robberies in the Lower Mainland, Interior, and Vancouver Island.



**Figure 1.1 Pharmacy robberies and break & enters between 2014 and 2016.**  
 Source: College of Pharmacists of British Columbia. Reproduced with permission.

## 1.1. Pharmacy Policy Changes

In September 2015, the College of Pharmacists of British Columbia enacted new changes to pharmacy policy that entrenched certain crime prevention features within pharmacies across British Columbia (Community Pharmacy Security Information, 2015). These purposive changes were intended to enhance pharmacy security, protect patients, protect pharmacy employees, and to prevent the diversion of drugs. The two primary changes to this policy included the use of time locked safes and standardized signage within and throughout pharmacies (Community Pharmacy Security Information, 2015).

Supported by situational theories of crime prevention, these changes to pharmacy security policy were implemented with an aim to reduce pharmacy robberies and to improve safety and security. Following the implementation of these policy changes, a drastic and sudden reduction in recorded pharmacy robbery counts were observed throughout British Columbia, and most notably within the city of Vancouver (Figure 3.1). While these changes may appear to have been simply a result of an improvement to pharmacy security and signage, the preventative and deterrent effect of these implementations retain great significance and importance when examined through the lens of crime prevention theory. For example, improved signage is one of the key

techniques of situational crime prevention theory, which advocates site-specific techniques for reducing crime precipitators and opportunity for crime to occur. An observed decrease in pharmacy robberies as a result of the implementation of new pharmacy policy and bylaw amendments has great implications for the efficacy of crime prevention theory in practice. In essence, this study will not only explore the relationship between pharmacy bylaw efficacy in reducing recorded pharmacy robberies, but will also aim to further entrench the effectiveness of a crime prevention theory that has proven successful through empirical research (Guerette & Bowers, 2009; Weisburd et al., 2006).

## **Chapter 2.**

### **Literature Review**

#### **2.1. Crime Prevention Theory**

Any study within criminology may be traced to the fundamental theories upon which it is based. The study of crime prevention is no exception, as this area of study within criminology is grounded on several “dispositional” and “situational” theories (Clarke, 1983). Dispositional theories focus on the individual, rather than the event of the crime itself. These theories examine the biological, psychological, or sociological characteristics of individuals (Clarke, 1980). “Situational” theories, however, provide an examination of the environmental factors that are external to the individual. Such theories place a larger emphasis on the setting of the crime, rather than the offender committing the crime (Clarke, 1997).

Most criminological theories are best suited to study particular forms of crime. Certain dispositional theories are best suited to study the motivations of offenders, as these theories focus on the psychological, biological, and sociological antecedents of criminal behaviour (Clarke, 1980). Situational theories are particularly suited for the study of crime prevention measures for commercial businesses, as situational crime prevention measures may be applied with a broad scope on the macro level, while utilizing crime-specific measures on a micro scale (Exum, Kuhns, Koch, & Johnson, 2010).

Several theories of criminology will be discussed in this paper that serve to exemplify the effect of the impact seen from the implementation of the DrugSafeBC pharmacy security program in 2015 (Community Pharmacy Security Information, 2015). Supplementary to the analysis in this study, this review of the literature and theory will provide an explanation for the observed drop in pharmacy robberies through a criminogenic lens. This effect may be observed through two situational theories: situational crime prevention and the rational choice perspective (Clarke, 1980; Clarke, 1997; Clarke & Cornish, 1985; Felson, 1986).

## 2.2. Situational Crime Prevention

Ronald Clarke posited a situational perspective of crime prevention in 1980 that has since evolved into a multifaceted approach forming the basis for much of the crime prevention literature and research today. While not formally a theory of criminology, this perspective titled Situational Crime Prevention (SCP) draws largely from the theory of crime prevention through environmental design (CPTED), and is one that is broadly applicable to a variety of situations (Clark, 1997; 2008). While situational crime prevention originated in the UK, it has been influenced by other policy research within the study of environmental criminology in the United States, namely “defensible space” (Newman, 1972), and “crime prevention through environmental design” (Jeffrey, 1971), both of which had preceded the idea of situational crime prevention (Clarke, 1997, p. 7). Today, situational perspectives on the study of crime form the basis for many crime prevention policies both on a micro and macro level. SCP is one that utilizes scientific methods in order to achieve a very specific goal: crime prevention. This approach seeks to reduce societal harm and improve overall quality of life by modifying the designs of environments and systems (Farrell, 2010). Clarke defines the theory in the following manner:

[Situational crime prevention contains] opportunity-reducing measures that are (1) directed at highly specific forms of crime (2) that involve the management, design, or manipulation of the immediate environment in as systematic and permanent a way as possible (3) so as to increase the effort and risks of crime and reduce the rewards as perceived by a wide range of offenders (Clarke, 1983; 1997).

The formation of this crime prevention perspective arrived in a period where most criminological theories focused on the examination of sociological or psychological factors as the causes of criminal events (Clarke, 1983). Little focus was given to the situational factors that may precede the commission of a crime, and as such, this approach has since filled a large theoretical gap within criminological literature.

Situational crime prevention advocates a more crime-specific approach that includes a greater emphasis on situational factors that are held to be more susceptible to manipulation in a way that may reduce the occurrence of crime (Hayward, 2007, p. 235). This approach is much less a criminological theory than a perspective of crime prevention that aims to alter the situational antecedents of crime so as to make crime

less likely to happen (Clarke, 2008, p 178). Clarke (1980) argues that crime prevention must be based on a thorough understanding of the causes of crime (p. 136). In his seminal paper titled "'Situational' Crime Prevention: Theory and Practice", Clarke addresses the mistrust directed at the use of physical measures to reduce crime, and the favouritism among academics and researchers toward a "dispositional" approach (1980, p. 136). This paper was a response to the alleged lack of concern of criminological theories for the situational determinants or "root causes" of crime (Clarke, 1980). Clarke argues for an alternative emphasis on the choices and decisions made by offenders, which leads to a more realistic approach in the study of criminality.

In the paper titled "Situational Crime Prevention: Its Theoretical Basis and Practical Scope", Clarke further substantiates his situational crime prevention perspective (1983, p. 225). He contends that this approach (a) is best directed at specific forms of crime; (b) involves the design, management, or manipulation of the environment; and (c) reduces the opportunity for crime and increases its risks to a large range of potential offenders (Clarke, 1983, p. 225; Clarke, 1997, p. 4). Clarke proposes that an accurate theory of criminal events would be comprised of two components: a description of the nature and distribution of criminal opportunities, and an account of how offenders' decisions are affected by personal history, upbringing, and the circumstances and situation in which they are found (1983, p. 231).

The theoretically based perspective of situational crime prevention has paved the way practical application in the study of environmental criminology and crime prevention through safe urban design (Hayward, 2007, p. 236). Situational crime prevention is by definition an approach that is tailored to specific crimes, the environment, and the reduction of opportunity for the commission of crime (Lersch & Hart, 2011, p. 176). As will be discussed in greater detail later, the manipulation of situational factors of crime is reflected by the attention given to the built environment in urban planning and design such that crime can be reduced and prevented.

### **2.2.1. Situational Crime Prevention Techniques**

Clarke (1997) introduces sixteen opportunity-reducing techniques for situational crime prevention in *Situational Crime Prevention: Successful Case Studies 2nd Ed* (Figure 2.1). Drawing in part from prior influential literature on crime prevention through

environmental design (CPTED), rational choice theory, and routine activity theory, Clarke (1997) provides a list of strategies used to manipulate the built environment in order to reduce the opportunity for crime to occur. While not all of the techniques are organized in mutually exclusive categories, this list of techniques was the first attempt to strike a balance between maintaining the definitional clarity of situational crime prevention, while avoiding overextending the reach of the theory and thus complicating the definition (Clarke, 1997). These techniques are organized into four broad categories that include increasing perceived effort, increasing perceived risks, reducing anticipated rewards, and removing excuses (Clarke, 1997, p. 18).

<b>Increasing Perceived Effort</b>	<b>Increasing Perceived Risks</b>	<b>Reducing Anticipated Rewards</b>	<b>Removing Excuses</b>
<b>1. Target hardening</b> Slug rejecter device Steering locks Bandit screens	<b>5. Entry/exit screening</b> Automatic ticket gates Baggage screening Merchandise tags	<b>9. Target removal</b> Removable car radio Women's refuges Phonecard	<b>13. Rule setting</b> Customs declaration Harassment codes Hotel registration
<b>2. Access control</b> Parking lot barriers Fencing yards Entry phones	<b>6. Formal surveillance</b> Red light cameras Burglar alarms Security guards	<b>10. Identifying property</b> Property marking Vehicle licensing Cattle branding	<b>14. Simulating conscience</b> Roadside speedometers "Shoplifting is stealing" "Idiots drink and drive"
<b>3. Deflecting offenders</b> Bus stop placement Tavern location Street closures	<b>7. Surveillance by employees</b> Pay phone location Park attendants CCTV systems	<b>11. Reducing temptation</b> Gender-neutral listings Off-street parking Rapid repair	<b>15. Controlling disinhibitors</b> Drinking-age laws Ignition interlock V-chip
<b>4. Controlling facilitators</b> Credit card photo Gun controls Caller-ID	<b>8. Natural Surveillance</b> Defensible space Street lighting Cab driver I.D.	<b>12. Denying benefits</b> Ink merchandise tags PIN for car radios Graffiti cleaning	<b>16. Facilitating compliance</b> Easy library checkout Public lavatories Trash bins

**Figure 2.1 Sixteen opportunity-reducing techniques.**

Source: Adapted from (Clarke, 1997, p. 18).

Richard Wortley (2001) proposed sixteen complementary techniques for reducing the precipitators of crime in response to Clarke's (1997) initial list of sixteen situational

techniques. Wortley stressed the importance of drawing a distinction between precipitators and opportunities, as focusing heavily on opportunity reduction strategies may only lead to the displacement of criminals to more conducive targets (Wortley, 2001). While opportunity implies that only certain situational factors will allow individuals to carry out a certain course of action, precipitators include the conditions that precipitate the behaviour. Precipitators may be defined as the circumstances and conditions upon which the decision to commit a crime is contingent. In the paper, A classification of techniques for controlling situational precipitators of crime, Wortley (2001) enumerates four categories of techniques aimed at reducing precipitators of crime, with four specific strategies in each category. These four techniques for controlling precipitators of crime include controlling prompts, controlling pressures, reducing permissibility, and reducing provocations (Wortley, 2001, p. 6). One of the stark differences between Wortley's proposed sixteen techniques for reducing situational precipitators of crime is the addition of the social policy considerations. While Clarke's sixteen opportunity-reducing techniques focused largely on modifying the built environment to reduce opportunity, Wortley's techniques for controlling precipitators addresses real-world precipitators that may precede the commission of crime (Figure 2.1).

<b>Controlling Prompts</b>	<b>Controlling Pressures</b>	<b>Reducing Permissibility</b>	<b>Reducing Provocations</b>
Controlling triggers: <ul style="list-style-type: none"> <li>• Gun control</li> <li>• Pornography restrictions</li> <li>• Environmental self-management</li> </ul>	Reducing inappropriate conformity: <ul style="list-style-type: none"> <li>• Dispersing gang members</li> <li>• Screening children’s associates</li> <li>• Bolstering independence</li> </ul>	Rule setting: <ul style="list-style-type: none"> <li>• Harassment codes</li> <li>• Staff inductions</li> <li>• “Shoplifting is stealing” signs</li> </ul>	Reducing frustration: <ul style="list-style-type: none"> <li>• Inmate control of comfort setting</li> <li>• Improved wet playtimes</li> <li>• Efficient road design</li> </ul>
Providing reminders: <ul style="list-style-type: none"> <li>• Warning signs</li> <li>• Symbolic territorial markers</li> <li>• Litter bins</li> </ul>	Reducing inappropriate obedience: <ul style="list-style-type: none"> <li>• Support for whistle-blowers</li> <li>• Participatory management</li> <li>• Semi-independent units</li> </ul>	Clarifying responsibility: <ul style="list-style-type: none"> <li>• Server intervention</li> <li>• Assigning discrete tasks</li> <li>• Encouraging sense of ownership</li> </ul>	Reducing crowding: <ul style="list-style-type: none"> <li>• Limiting nightclub patron density</li> <li>• Regulating nightclub patron flow</li> <li>• Use of colour, windows, light etc.</li> </ul>
Reducing inappropriate imitation: <ul style="list-style-type: none"> <li>• Rapid repair of vandalism</li> <li>• Controls on television content</li> <li>• Supervisors as exemplars</li> </ul>	Encouraging compliance: <ul style="list-style-type: none"> <li>• Persuasive signs</li> <li>• Fairness of request</li> <li>• Participation in rule-making</li> </ul>	Clarifying consequences: <ul style="list-style-type: none"> <li>• Copyright messages</li> <li>• Public posting</li> <li>• Vandalism information brochures</li> </ul>	Respecting territory: <ul style="list-style-type: none"> <li>• Identifiable territories for residents</li> <li>• Privacy rooms for residents</li> <li>• Avoiding intrusion into inmates’ cells</li> </ul>
Setting positive expectations: <ul style="list-style-type: none"> <li>• Pub gentrification</li> <li>• Domestic prison furniture</li> <li>• Fixing “broken windows”</li> </ul>	Reducing anonymity: <ul style="list-style-type: none"> <li>• Restricting uniform use (perpetrators)</li> <li>• School dress codes</li> <li>• Low-profile crowd management</li> </ul>	Personalising victims: <ul style="list-style-type: none"> <li>• Victim cooperation</li> <li>• Humanising conditions for prisoners</li> <li>• Concern with employee welfare</li> </ul>	Controlling environmental irritants: <ul style="list-style-type: none"> <li>• Smoke-free nightclubs</li> <li>• Air conditioning</li> <li>• Noise control</li> </ul>

**Figure 2.2 Techniques for controlling precipitators of crime**

Source: Adapted from (Wortley, 2001, p. 31).

In response to Wortley’s (2001) introduction of sixteen complementary ways in which precipitators of crime may be controlled, Cornish and Clarke (2003) released a critique of his approach, and acknowledge common ground between the two approaches of situationally reducing crime. “Opportunities, Precipitators and Criminal Decisions: A Reply to Wortley’s Critique of Situational Crime Prevention” (2003) addresses both the similarities between Clarke’s aforementioned sixteen techniques, and Wortley’s proposed techniques for controlling precipitators. Cornish and Clarke (2003) proposed a pragmatic merging of the two perspectives, as there existed much overlap between the

two list of techniques. In amending the current list of techniques, Cornish and Clarke merge “reducing permissibility” under a new category labelled “remove excuses”, and include many of Wortley’s (2001) strategies for controlling prompts, pressures, and reducing provocations in a new category titled “reduce provocations” (Figure 3.0) (Cornish & Clarke, 2003, pp. 88-89).

In their publication *Crime Analysis for Problem Solvers in 60 Small Steps*, Clarke and Eck (2005) enumerate twenty-five techniques for situational crime prevention (Figure 2.0). These methods have been often cited in more recent research on situational crime prevention, as these techniques have drawn on aggregate results from decades of criminological research (Clarke, 2005, p. 46; Clarke, 2008, p. 184). Combining Wortley’s (2001) techniques for controlling precipitators, this list of twenty-five techniques encompass the entirety of situational crime prevention. These twenty-five steps are the current standard for situational crime prevention, as it has undergone much evolution and revision in the decades since its formulation (Figure 2.2). Using these twenty-five steps, situational crime prevention has been implemented and used as a tool for crime prevention by addressing space-based strategies to reduce precipitators and opportunities for the commission of crime (Eck, Madensen, Payne, Wilcox, Fisher & Scherer, 2009). While situational crime prevention may be applied for many types of crime, Clarke & Eck (2005) postulate that rapid and sustained crime reduction can only come as result of addressing situational causes of crime that brings an immediate solution to the problem at hand (p. 89).

<b><i>Twenty-Five Techniques of Situational Crime Prevention</i></b>	
<b>Increase the Effort</b>	<ol style="list-style-type: none"> <li>1. Target harden</li> <li>2. Control access to facilities</li> <li>3. Screen exits</li> <li>4. Deflect offenders</li> <li>5. Control tools/weapons</li> </ol>
<b>Increase the Risks</b>	<ol style="list-style-type: none"> <li>6. Extend guardianship</li> <li>7. Assist natural surveillance</li> <li>8. Reduce anonymity</li> <li>9. Use place managers</li> <li>10. Strengthen formal surveillance</li> </ol>
<b>Reduce the Rewards</b>	<ol style="list-style-type: none"> <li>11. Conceal targets</li> <li>12. Remove targets</li> <li>13. Identify property</li> <li>14. Disrupt markets</li> <li>15. Deny benefits</li> </ol>
<b>Reduce Provocations</b>	<ol style="list-style-type: none"> <li>16. Reduce frustrations and stress</li> <li>17. Avoid disputes</li> <li>18. Reduce arousal and temptation</li> <li>19. Neutralize peer pressure</li> <li>20. Discourage imitation</li> </ol>
<b>Remove Excuses</b>	<ol style="list-style-type: none"> <li>21. Set rules</li> <li>22. Post instructions</li> <li>23. Alert conscience</li> <li>24. Assist compliance</li> <li>25. Control drugs and alcohol</li> </ol>

**Figure 2.3 Twenty-five Techniques of Situational Crime Prevention**

Source: Adapted from (Clarke & Eck, 2005, p. 88).

Not only may this theory used to explain why crime occurs, it is also used as a practical tool for the implementation of crime prevention strategies in a variety of settings. Eck et al. (2009) conducted a study on the implementation of SCP on place-based crime prevention and found that place-based crime policies were most effective in locations with high-crime, rather than those with average levels of crime and disorder (p. 117). Eck et al. concluded from their findings that place-based crime prevention strategies should be adjustable based on the context of the place, and the strategies that

account for economic and political contexts are most effective (Eck et al., 2009, p. 119). Given the dynamic nature of many environments where SCP may be applied, Eck et al. (2009) emphasizes the importance of a situational crime prevention strategy that accounts for varying circumstances and environments.

As this perspective is still very much in its infancy, more research is needed on the effectiveness of SCP as a long-term crime reduction strategy. However, much literature exists tangentially related to SCP, within the realm of crime prevention through environmental design (CPTED), which has been adopted worldwide by law enforcement agencies, policy makers, city planners, and stakeholders on both a micro and macro level scale (Cozens & Love, 2015; Amandus, Hunter, James, & Hendricks, 1995; Casteel & Peek-Asa, 2000; Jongejan & Woldendorp, 2013; Lee, 2010). CPTED influenced much of the early development of SCP, and the two perspectives share many similarities as both criminological theories and practical tools for crime prevention (Clarke, 1997). Situational crime prevention is a crime prevention approach that may be applied to all types of crime, given the dynamic nature of its application. As previously mentioned, situational crime prevention is a perspective that is based on elements from rational choice theory, and is based on the premise of rationally motivated offenders (Clarke, 1983; 1997). The inclusion of rational choice theory within the framework of SCP strengthens this approach both etiologically and within the practical scope of its application. As will be discussed in further detail, rational choice lends itself to SCP to create a framework whereby its crime reduction strategies are grounded within a much larger and popularized theory with a larger body of empirical support.

### **2.3. Rational Choice Theory**

Many criminological theories rely on the basis that crime is not random, and that crimes are committed primarily through conscious and rational decision. This train of thought forms the basis of the rational choice theory, which is a widely popularized theory within criminology (Clarke & Cornish, 1985; Felson, 1986). While this theory is popular in many other disciplines such as psychology, sociology, economics, or political science, there has been hesitation within criminology to accept this theory as a general theory of crime (Loughran, Paternoster, Chalfin, & Wilson, 2016). The rational choice perspective has roots in utilitarian moral philosophy, political science and legal theory, and economics (De Haan & Vos, 2003, p. 31). While commonly referred to as the

“rational choice theory”, it is more of a “rational choice perspective” than simply a criminological theory because of its widespread application spanning several disciplines. This theory, which is used to examine the decision-making process of offenders, also underpins the situational crime prevention approach, which is based on the assumption of rational offenders (Pease, 2001).

Economist and sociologist Herbert A. Simon quantified a concept of rational choice in “A Behavioral Model of Rational Choice”, through several mathematical models that illustrate an “economic man” as the idealistic “rational human being” (Simon, 1955, p. 114). This “economic man” is one who is assumed to have relative knowledge of the relevant aspects of his environment, a well-organized system of preferences, an ability to calculate alternative courses of action that are available to him, and which of these courses will allow him to reach the highest goal of his preferred outcomes (Simon, 1955, p. 99). Simon states that the purpose of the construction of these mathematical models was to, “provide some materials for the construction of a theory of the behaviour of a human individual or of groups of individuals who are making decisions in an organizational context” (Simon, 1955, p. 114).

While elements of rationality are essential components of theories in the social sciences, economics brings a specific element to the concept of rationality: the rationality of the utility maximizer (Simon, 1978). Becker (1968) built on the works of Simon and other economic theorists on the rational choice perspective by drawing from the principle of expected utility, whereby individuals analyze the cost of crime compared to the potential rewards (p. 176). Becker states that some individuals become criminals not because their basic motivations differ from that of other persons, but rather because their perceived benefits and costs differ (Becker, 1968, p. 176). With this rational choice model of analyzing criminal behaviour, Becker contends that the classical theories are no much less suited than a rational choice perspective. In his own words Becker states, “a useful theory of criminal behaviour can dispense with special theories of anomie, psychological inadequacies, or inheritance of special traits and simply extend the economist’s usual analysis of choice” (Becker, 1968, p. 170). Using this framework, Becker formulated an equation that models an offenders expected utility as a function of both the costs and rewards of crime (Loughran, p. 88

This cost-benefit analysis is also the foundation for the rational choice models popularized by Clarke and Cornish (1985) in their paper titled “Modeling Offenders’ Decisions: A Framework for Research and Policy” (p. 149). In this essay, Cornish and Clarke criticize current theoretical models of criminal behaviour and postulate that these models tend to ignore the offender’s decision-making and the conscious thought processes (Clarke & Cornish, 1985, p. 147). In their summary of contemporary economic theories, they state current economic models of criminal decision are useful in the analysis of financially motivated crimes, yet lacking in theoretical application for individual criminal analysis. They summarize contemporary economic models as follows (Clarke & Cornish, 1985):

1. Contemporary economic models of criminal decision making “demystify and routinize criminal activity”.
2. These economic models extend their analysis beyond financially motivated crimes. Attempts have been made to find room for non-financial gains as a part of the expected utility principle.
3. Economic models imply that criminals are deterrable and suggest a range of factors beyond traditional deterrence theory’s “severity of punishment” that may be manipulated for the interests of crime control (p. 156).

Cornish and Clarke note the efficacy of economic theory contributions to criminological theorizing and the evaluation of policy, however they argue that a variety of economic models generate little empirically based micro-level analysis of individual criminal behaviour (Clarke & Cornish, 1985, p. 147).

Their contribution to the rational choice theory is based on the assumption of a rational offender who carefully weighs the risks and potential rewards of criminal behaviour (Clarke & Cornish, 1985; Cornish & Clarke, 1986). These decisions are based on the offender’s expected effort and reward compared with the likelihood of punishment and other costs of the crime (Johnson & Payne, 1986). The rational choice approach makes the assumptions of human action that considers, a) the bounded rationality of human action; b) its interactional, transactional, and adaptive nature; c) the need to study offenders’ perceptions, decision-making activities, and choices; d) the need for a crime-specific approach noting the nature of different person-situation criminal events; e) the need for separate accounts of the reflected differences in variables, decision sequences, and time scales (Cornish, 1993, p. 364).

### **2.3.1. Limited Rationality**

Cornish and Clarke (1985) note the important fact that individuals do not always make the most “rational” decision based on the circumstances and the information available (p. 160). This limited decision-making based on information processing constraints is a concept known as “bounded rationality”, which has many practical implications in a real-world analysis of criminal behaviour (Simon, 1972, p. 162).

Herbert A. Simon’s (1955) theory of predictable rationality faces the issue of reliability in a real world setting, as the model of a theoretical “economic man” does not necessarily possess attributes that are an accurate representation of characteristics of individual humans. The problem of this untestable “economic man” vanishes when he is substituted for an organism with “limited knowledge and ability” (Simon, 1955, p. 114). As Simon (1955) writes, “the organism’s simplifications of the real world for purposes of choice introduce discrepancies between the simplified model and the reality; and these discrepancies, in turn, serve to explain many of the phenomena of organizational behaviour” (p. 114). Bounded rationality addresses the ways in which human rationality are limited by cognitive ability, access to information, and a predisposition to process information in a certain manner (Clarke & Cornish, 1985, p. 161). Proponents of this concept argue that even when an individual has complete information, the complexity of a situation may be such that maximizing is not feasible, and an individual may choose an option that may be considered “good enough” (Goldthorpe, 1998, p. 171). As individuals may greatly differ in their ability to process information, and cognitively process information, the concept of bounded rationality assists in the analysis of individuals in a real world setting. Within this limited notion of rationality, it is assumed that crime committed as a means to obtain basic needs through the making of certain decisions and choices that may be limited by time or the availability of relevant information (Clarke, 1997b).

### **2.4. Theory Integration**

Early iterations of situational crime prevention have been accused of being atheoretical in nature, until elements of rational choice theory were adopted by situational crime prevention (Marongiu & Newman, 1997, p. 117). Today, situational crime prevention contains inherent elements of rational choice theory, which provide the

guiding framework for this dynamic approach (Pease, 2001). There exists much overlap between RCT and SCP, and both may be used to explain crime as an event involving the intersection of multiple variables within time and space. In the examination of place-specific crimes, such as the robbery of pharmacies in the present study, the integration of multiple, overlapping theories is essential to providing a clearer understanding of the topic at hand. While situational crime prevention examines case-specific implementations for the reduction and prevention of future crime, rational choice theory examines the offender and the context of the bounded rationality that preceded the commission of an offence.

Both situational crime prevention and rational choice theory involve the presumption of a rational decision-maker, and as such, both theories are strengthened by the notion that situations may be changed or controlled in order to reduce opportunity or remove precipitators, and prevent crime from occurring. This may be accomplished through the manipulation of situational factors, which will in turn manipulate the decision-making process of potential offenders. Notwithstanding the notion of bounded rationality, rational decision-makers are by virtue predictable, and the removal or addition of particular stimuli within the environment may preclude the commission of a crime.

The practical application of criminological theory within a real-world setting often involves the integration of multiple theories, as the commission of crime often involves the intersection of a myriad of factors and variables specific to the offence. The offence of robbery involves a motivated offender, operating under a subjective mode of rationality that may be explained by the limited rationality model within rational choice theory. The study of pharmacy robberies benefits from the inclusion of theories and perspectives that provide place-specific techniques for crime prevention. Situational crime prevention contains a practical approach to crime prevention, drawing upon previous crime prevention literature from CPTED and routine activities theory, to provide informed and specific techniques for reducing crime within the built environment.

## **2.5. Pharmacy Robberies**

Robbery is a criminal offence that is of particular interest to criminological research as it is classified as a violent offence and is considered an offence against a

person. As such, it is an offence that has a direct correlative effect on public safety and fear of crime. Section 343 of the *Criminal Code of Canada* defines robbery as follows:

Every one commits robbery who

Steals, and for the purpose of extorting whatever is stolen or to prevent or overcome resistance to the stealing, uses violence or threats of violence to a person or property;

Steals from any person and, at the time he steals or immediately before or immediately thereafter, wounds, beats, strikes or uses any personal violence to that person;

Assaults any person with intent to steal from him; or

Steals from any person while armed with an offensive weapon or imitation thereof. (*Criminal Code*, 1985)

The robbery of pharmacies poses a considerable risk not only to pharmacy employees and patients, but to the general public as well. Drugs stolen from the robbery of pharmacies are often sold on the street, and this diversion of drugs is a health and safety risk to the general public. Pharmacy robberies may have further unseen consequences, as the illicit sale of drugs and other substances from pharmacy robberies may lead to chronic substance disorders, further crime, and even overdoses (La Vigne & Wartell, 2015, p. 7).

While robbery incidents have been declining steadily in Canada since the 1990s until 2015, an alternate trend has been observed in the United States (Statistics Canada, 2016; La Vigne & Wartell, 2015). Within the United States, the DEA reported an increase in the total number of robberies of pharmacies of 82 percent from 2006 to 2011 (La Vigne & Wartell, 2015). In Australia, the Australia Institute of Criminology published a report in 2003 that provided statistics on the rising rate of pharmacy crime between 1993 and 2000 (Taylor, 2003). This report states that pharmacies experienced an increase of 65% in recorded robberies between 1993 and 2000, with the majority of robberies being armed robbery (Taylor, 2003, pp. 2-3). While the accessibility of pharmacy crime statistics is limited, the online web tool “RxPATROL” contains a database of reported crime within pharmacies in the United States, including incidents of burglary and robbery (Smith, Graham, Haddox, & Steffey, 2007). In a descriptive, nonexperimental study published in the *Journal of the American Pharmacists Association*, it was found that

between 2005 and 2006, robbery represented 16.6 percent of all reported incidents and burglary represented 11.2 percent (Smith, Graham, Haddock, & Steffey, 2007, p. 601).

### **2.5.1. B.C. Robberies at a Glance**

While the rate of robberies in Canada has shown an overall downward trend since 1992, these changes are not an accurate reflection of robbery rates within and between provinces (Statistics Canada, 2016). Notwithstanding the Yukon and Northwest Territories, all of the other provinces have seen a decrease in overall crime rates between 2005 and 2015 (Statistics Canada, 2016). Between 2005 and 2015, British Columbia saw a 33% decrease in the overall crime rate. However, there was a 6% increase in violent crime rates in British Columbia between 2014 and 2015 (Statistics Canada, 2016, p. 36). Following the decreasing trend overall crime rates since the early 2000s, there has been a 39% decrease in robbery rates nationwide between 2005 and 2015. Despite this overall downward trend, there was a 5% increase in robbery rates across Canada between 2014 and 2015.

The 2015 robbery crime rate in British Columbia was 78 per 100,000 people, which was a 7% increase from the police-reported crime rate in 2014 (Statistics Canada, 2016, p. 44). This is ranked as the fifth highest increase in provincial robbery rates between 2014 and 2015 across Canada. The provinces with the largest changes in robbery rates between 2014 and 2015 included the Northwest Territories with a 30% increase, followed by Alberta with a 23% increase (Statistics Canada, 2016, p. 44). In a comparison of census metropolitan areas between 2014 and 2015, Vancouver, B.C. reported a 4% increase in robbery rates, Abbotsford-Mission reported a 29% increase, while Victoria and Kelowna reported a 1% and 12% decrease in robbery rates respectively (Statistics Canada, 2016, p. 48).

Prior to the launch of the DrugSafeBC campaign by the College of Pharmacists of British Columbia, it was reported that in the first six months of 2014, there were more pharmacy robberies in the province of British Columbia than all of 2013 (DrugSafeBC, 2015). This is indicative of a clear risk to pharmacy professionals, patients, and the general public. Herein lies the impetus for this present study, prompted by the need for crime prevention measures to be implemented within pharmacies across British

Columbia in order to maintain physical security and safety of clients and pharmacy personnel

## **Chapter 3.**

### **Data and Methods**

#### **3.1. Generalized Linear Models**

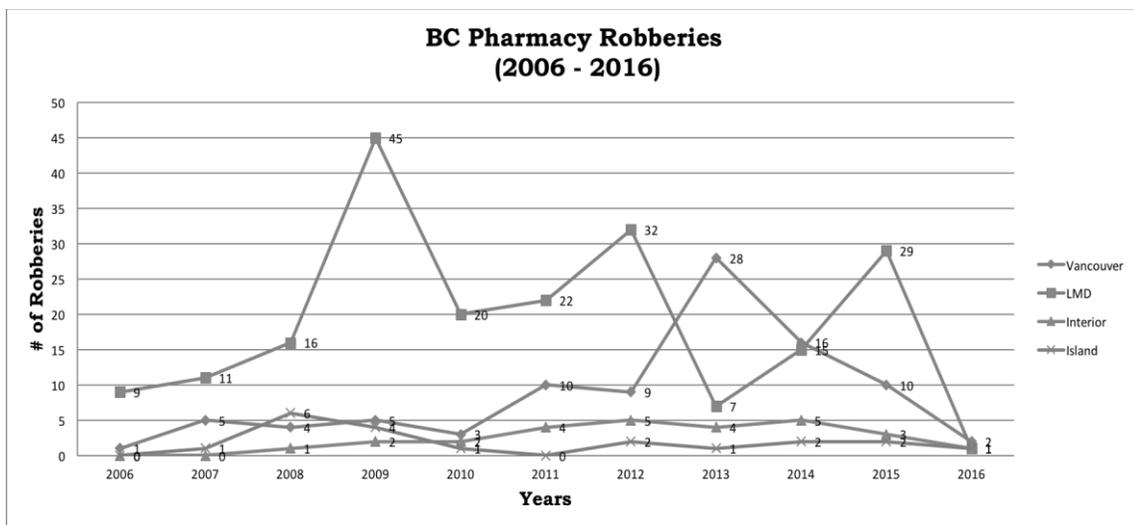
Generalized linear models are often the staple models used for the analysis of data within the social sciences. Of these models, Poisson regression models is most commonly used. Generalized linear regression models may also be used in the analysis of count data exhibiting over-dispersion. Over-dispersion may be caused by an excess number of zero counts in the data (Zeileis, Kleiber, & Jackman, 2008). While over-dispersion is self evident with an excess of zero count values in the data, it may also be determined by calculating the mean and variance. The study of crime data often employs the use of certain generalized linear models well-suited for over-dispersed data. A variance greater than the mean indicates the presence of over-dispersion in the data. The Poisson regression model, which has long been the staple model for the analysis of count data, is restricted by the assumption of the mean being equivalent to the variance (Cameron & Trivedi, 1990). This assumption may be avoided by the use of quasi-Poisson regression models, whereby an estimated dispersion parameter is used (Zeileis, Kleiber, & Jackman, 2008). Another formal method of analyzing count data is through the utilization of negative binomial regression models. Implicit in the negative binomial regression formula is the ability to account for excess zero values in the data and the inherent over-dispersion caused by this effect.

##### **3.1.1. Negative Binomial Regression Models**

Among the regression models used in the social sciences, negative binomial regression is well-suited for data that are in count format and contain an excess of zero values. As the data used in this study is overdispersed and contains an excess of zero values, the negative binomial model was chosen as the primary model for analysis. This negative binomial model accounts for overdispersion through the assumption that there may be unexplained variability among results of the same predicted value (Coxe, West, & Aiken, 2009, p. 132).

### 3.2. Pharmacy Robbery Data

The data in this study uses Police Records Information Management Environment (PRIME) count data of pharmacy robbery counts for the city of Vancouver, and the Lower Mainland, Interior, and Vancouver Island locations. The data for the city of Vancouver was provided by the Vancouver Police Department, containing counts of robberies by month from 2001 to 2016. The data for the locations of Vancouver Island, Interior, and the Interior (excluding Vancouver) were recorded between 2006 and 2016. Tables 3.1 and 3.2 provide descriptive statistics for the dependent and independent variables used in this study. Figure 3.1 provides a graph of pharmacy robberies by year in each of the four locations, since 2006.

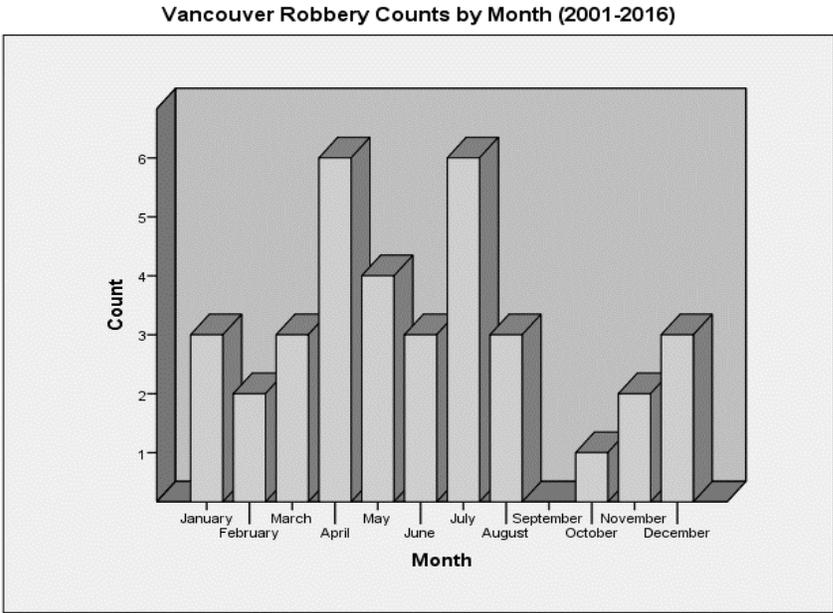


**Figure 3.1 BC Pharmacy Robbery counts by year**  
 Source: College of Pharmacists of British Columbia, 2016.

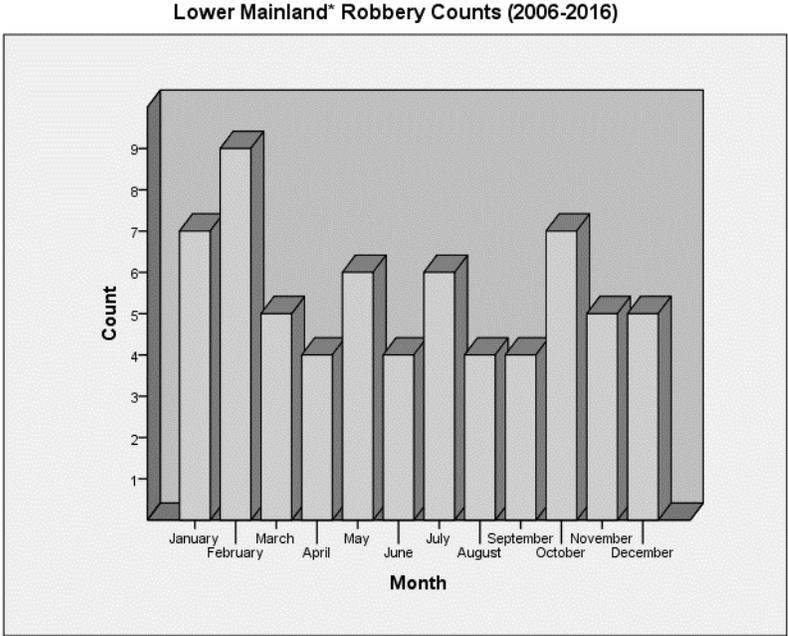
The variables of interest within this dataset are the robbery count variables by month, for the four locations throughout British Columbia. These four location variables containing monthly counts of pharmacy robberies are treated as the dependent variables for the models of analysis used in this study. These dependent variables are continuous in nature, and the descriptive statistics for these variables are shown in Table 3.2. The primary independent or predictor variable created for this study is the *bylaw* variable, which is coded as the presence or absence of the pharmacy bylaw which came into

effect in September of 2015. This categorical variable contains the values of 0, 1, or 0.5, measuring before and after the new pharmacy bylaw came into effect. The *bylawtrend* variable is coded as a trend beginning after the enactment of the pharmacy bylaw in September 2015. This variable is similar to the *bylaw* variable, and is coded as a value of '0' prior to the enactment of the bylaw, '0.5' for the month of September, 2015, and begins sequential value numbering (1, 2, 3 and so on) following the implementation of the bylaw (Reid & Andresen, 2014). Other independent variables used in this study to control for the effect of the *bylaw* variable include *days*, *year*, *month*, and *month squared*. The *days* variable indicates the number of days in each month associated with the *month* variable. The variable *year* varies between datasets; it is coded as a number between 2001 and 2016 for the Vancouver data, and an ordinal value between 2006 and 2016 for the dataset excluding Vancouver robbery counts, due to the inherent data limitations. The *month squared* variable is simply the squared value of the *month* variable, which is used to better fit the negative binomial regression model in this study. The *trend* variable contains a count from 1 to N, indicating the time-ordered nature of the count data in each respective dataset. Within the data originating in 2001, the maximum value of the *trend* variable is 192. In the dataset excluding Vancouver robberies, the maximum value of this variable is 132, as shown in Table 3.2. Similar to the *month squared* variable, the variable *trend squared* contains the squared value of the *trend* variable in order to control for the effects seen on the dependent variables in the negative binomial regression models.

Figures 3.2 through 3.5 present a graphical view of the monthly robbery counts by frequency within the years captured in the data. For the city of Vancouver, shown in Figure 3.2, this interval is between 2001 and 2016, and for the locations of lower mainland, interior, and Vancouver Island, this interval is 2006 to 2016. As shown in Figure 3.3, the monthly counts in the lower mainland region excluding Vancouver contain a larger maximum count of pharmacy robberies than in any of the other locations. The interior and Vancouver Island locations contain much fewer data points than the lower mainland or Vancouver locations, and these graphs are shown in Figures 3.4 and 3.5.

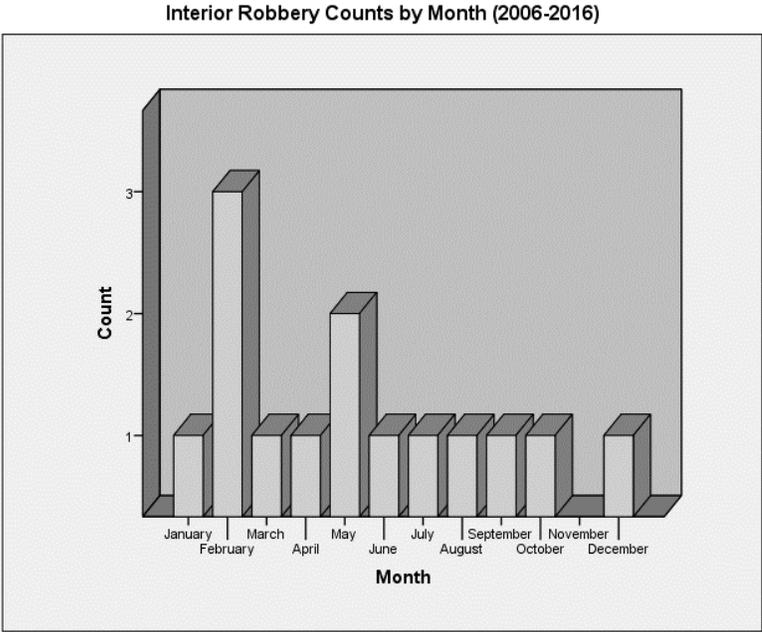


**Figure 3.2 Vancouver monthly pharmacy robbery counts by frequency**

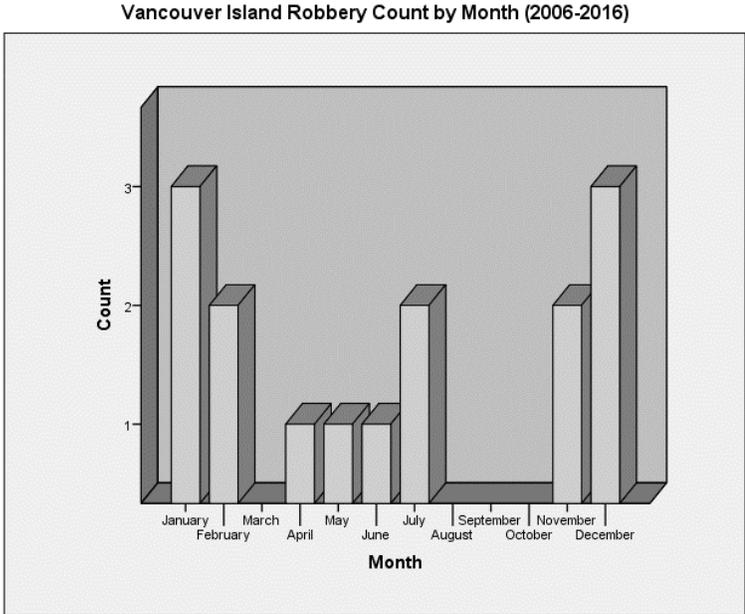


\* Excluding Vancouver

**Figure 3.3 Lower mainland monthly pharmacy robbery counts by frequency**



**Figure 3.4 Interior monthly pharmacy robbery counts by frequency**



**Figure 3.5 Vancouver island monthly pharmacy robbery counts by frequency**

**Table 3.1 Univariate statistics for study variables excluding Vancouver\***

Variable	Min	Max	$\mu$	SD	Variance
<b>Dependent Variables</b>					
Vancouver Island	.00	3.00	.15	.52	.27
Interior	.00	3.00	.20	.47	.23
Lower Mainland	.00	9.00	1.57	1.88	3.51
<b>Independent Variables</b>					
Bylaw	.00	1.00	.12	.32	.10
Bylaw trend	.00	15.00	.91	2.94	8.63
Year	2006.00	2016.00	2011.00	3.17	10.08
Month	1.00	12.00	6.50	3.47	12.01
Month squared	1.00	144.00	54.17	46.28	2141.36
Days	28.00	31.00	30.44	.81	.66
Trend	1.00	132.00	66.50	38.25	1463.00
Trend squared	1.00	17424	5874.17	5251.48	27578037.67

\* N = 132

**Table 3.2 Univariate statistics for study variables in Vancouver\***

Variable	Min	Max	$\mu$	SD	Variance
<b>Dependent Variable</b>					
Vancouver	.00	6.00	.48	1.01	1.02
<b>Independent Variables</b>					
Bylaw	.00	1.00	.08	.27	.073
Bylaw trend	.00	15.00	.63	2.47	6.10
Year	2001	2016	2008.50	4.622	21.36
Month	1.00	12.00	6.50	3.46	11.98
Month squared	1.00	144.00	54.17	46.22	2136.27
Days	28.00	31.00	30.44	.82	.67
Trend	1.00	192.00	96.50	55.57	3088.00
Trend squared	1.00	36864.00	12384.17	11073.08	122613157.30

\* N = 192

## Chapter 4.

### Results and Findings

#### 4.1. Bivariate Correlations

Bivariate correlations were run on the data in order to observe any effects of collinearity within the data. Pearson correlation was used to determine the strength of the predictor variables, and to test the presence of any variables with perfect collinearity. In the dataset for the three locations excluding the city of Vancouver, a statistically significant and strong relationship was observed between the *bylaw* and *bylaw trend* variables. Furthermore, the *year* variable had a statistically significant relationship with the *bylaw*, *bylaw trend*, *trend*, and *trend squared* variables. These initial bivariate correlations suggest that these variables may be strong predictor variables when used in the negative binomial regression models. The values and respective significance of the correlation coefficients are shown in Table 4.1. Similar correlative strength in the relationships between independent variables was observed in the dataset for the Vancouver location in Table 4.2.

In the initial bivariate correlations, the variables *bylaw* and *bylaw trend* are statistically significant and positively correlated with the *year* variable, which aligns with both the policy changes observed during the time-frame of this study and the distribution of the data itself. Among the locations excluding Vancouver, *bylaw* and *bylaw trend* have a Pearson's coefficient of .861. Similarly, the *trend* variable has a statistically significant and positively correlated relationship with the *bylaw* and *bylaw trend* variables in all locations, indicating its potential predictive power in the models. Finally, the *trend squared* variable possesses similar predictive power as the *trend* variable. *Bylaw* and *bylaw trend* are statistically significant and positively correlated with the *trend squared* variable, with Pearson's coefficients of .683 and .617 respectively, indicating a relatively strong relationship between these variables in the dataset excluding Vancouver (Table 4.1).

The same variables in the Vancouver location dataset are statistically significant and positively correlated in the dataset for the Vancouver location. *Bylaw* and *bylaw trend* are statistically significant and positively correlated with the *year* variable, with

Pearsons coefficients of .472 and .412 respectively. *Bylaw* and *bylaw trend* are also found to be statistically significant and positively correlated with the *trend* and *trend squared* variables, significant at the 0.01 level (Table 4.2). Following the bivariate correlations of the independent variables, several negative binomial regression models were run on the data. While the initial regression models (Table 4.3) only produced limited statistically significant results in the model, variables were removed by order of least significance, and the final results for these negative binomial models are shown in Table 4.4.

**Table 4.1 Bivariate Correlation for independent variables excluding Vancouver<sup>t</sup>**

Variables	X1	X2	X3	X4	X5	X6	X7	X8
Bylaw	1	.861*	.556**	0.101	0.111	0.035	.563**	.683**
Bylaw trend		1	.488**	0.130	0.130	0.042	.498**	.617**
Year			1	0	0	0.009	.996**	.995**
Month				1	0.973**	0.247**	0.091	0.088
Month squared					1	0.222*	0.088	0.086
Days						1	0.031	0.031
Trend							1	0.969**
Trend squared								1

<sup>t</sup>N = 132 \*p < 0.05, \*\* p < 0.01

**Table 4.2 Bivariate correlations for independent variables including Vancouver<sup>t</sup>**

Variables	X1	X2	X3	X4	X5	X6	X7	X8
Bylaw	1	.866**	.472**	0.082	0.090	0.029	0.476**	0.589**
Bylaw trend		1	.412**	0.106	0.106	0.034	0.417**	0.524**
Year			1	0	0	0.008	0.998**	0.967**
Month				1	0.973**	0.248**	0.062	0.060
Month squared					1	0.223**	0.061	0.059
Days						1	0.024	0.023
Trend							1	969**
Trend squared								1

<sup>t</sup>N = 192 \*p < 0.05, \*\* p < 0.01

## 4.2. Regression Models and Results

Negative binomial regression models were run on the data including all variables in both the Vancouver dataset, and the dataset excluding the Vancouver location. All of the independent variables were included in the initial regression models in order to determine the relative statistical significance of each variable and their ability to predict changes in the expected log count of pharmacy robberies. The intercept coefficients, standard errors, and z-values were included in the regression outputs for the completeness and presentation of the data results in its entirety.

An interesting and unforeseen relationship was observed in the initial regression model, whereby the *trend* variable was automatically eliminated from the regression results due to its similarity in effect to the *year* variable. In subsequent iterations of the regression model, the *year* variable was removed from testing the model and the *trend* variable was not rendered invalid, while subsequently proving to be statistically significant. For the purposes of this study, the results shown in Table 4.3 include the regression models where the *year* variable was included, and the *trend* variable had no effect on the regression results. In the initial regression analysis, only the *year* variable remained significant ( $p < 0.05$ ) for the Vancouver, Lower Mainland, and Interior locations. This result does little to explain the hypotheses presented in this study, though its effect presents an interesting relationship with the controlled variables in the initial regression results.

For a one unit change in *year* in the Vancouver location, the difference in the log of the expected count of pharmacy robberies is expected to increase by 0.46, while controlling for all other independent variables. These results, while included for completeness, do not support the logical presentation of the data itself. Based on the overarching trend observed within the data itself, there was expected to be a decrease in the log of the expected count of pharmacy robberies, while controlling for all other independent variables. A possible explanation for this phenomenon observed in the data is the increase in frequency of robberies in recent years, compared to the early 2000s, as shown in the graph of average robbery counts by year (Figure 3.1). Within the city of Vancouver, few pharmacy robberies were reported between 2001 and 2006, and these reported robberies increased in frequency until 2015. The *bylaw* variable reports a

coefficient of -1.91 for Vancouver, though this figure is not statistically significant while controlling for all other independent variables.

In the Lower Mainland region, the coefficient for *year* is 0.36 ( $p < 0.05$ ). With a one unit change in *year*, the difference in the log of the expected count of pharmacy robberies is expected to increase by 0.36, controlling for all other independent variables. This was a surprising result in the initial regression analyses, as there is an observed overall decrease in average yearly pharmacy robberies in the Lower Mainland between 2006 and 2016. A similar relationship was observed with the *year* variable in the Interior region in the initial regression analysis. For a one unit change in *year* in the Interior, the difference in the log of the expected count of pharmacy robberies is expected to increase by 1.3 ( $p < 0.05$ ), while controlling for all other independent variables. No independent variables were found to be statistically significant in the initial results for the Vancouver Island location. An effect was expected for the *bylaw* and *bylaw trend* variables in the initial regression model results, and much of the initial regression results were surprising. However, through the iterative process of removing variables of least significance, the *bylaw* variable retained statistical significance in later iterations of the regression models.

The aim of this study was to determine if there was a statistically significant relationship between the implementation of the bylaw in September 2015, and the recorded drop in pharmacy robberies observed since September 2015. In the final iterations of the negative binomial regression models, a statistically significant relationship was observed between the *bylaw* variable and pharmacy robbery counts in Vancouver, the Lower Mainland, and the Interior locations. In Vancouver, the coefficient for the *bylaw* variable is -2.70 and is significant ( $p < 0.001$ ). For a one unit change in the *bylaw* variable, the difference in the log of the expected count of pharmacy robberies in Vancouver is expected to decrease by 2.70, while controlling for the *month* and *trend* variables in this model. In the Lower Mainland location, the statistically significant ( $p < 0.001$ ) *bylaw* coefficient is -2.21, indicating that for one unit change in the *bylaw* variable, the difference in the log of the expected pharmacy robbery count in the Lower Mainland is expected to decrease by 2.21 while controlling for *month* and *trend*. The *bylaw* variable for the Interior location has a statistically significant ( $p < 0.05$ ) coefficient of -2.36 indicating that for one unit change in the *bylaw* variable, the difference in the log of the expected pharmacy robbery counts in the Interior is expected to decrease by 2.36,

while controlling for the *month* and *trend* variables. The *bylaw* regression coefficient for the Vancouver Island location is -0.93, while the negative value of this coefficient is consistent with the research and data design, it is not statistically significant within the model.

In response to the proposed research hypotheses, the first hypothesis is accepted, based on the results from the final negative binomial regression model, whereby a statistically significant relationship was observed between the bylaw variable and log of the expected robbery count in Vancouver. The second research hypothesis is partially accepted, as there was a statistically significant relationship found between the bylaw implementation and the log of the expected robbery counts in the lower mainland and interior regions. While the relationship observed between the bylaw variable and the log of expected robbery counts for the Vancouver island contained a negative value, it was not found to be statistically significant.

**Table 4.3 Negative binomial regression models with all study variables**

Variables	Vancouver			Lower Mainland			Interior			Vancouver Island		
	Estimate	SE	Z-value	Estimate	SE	Z-value	Estimate	SE	Z-value	Estimate	SE	Z-value
Intercept	-926.70*	467.00	-1.99	-726.00*	315.00	-2.31	-2617.00	1150.00	-2.27	-685.00	100.00	-0.69
Bylaw	-1.91	1.24	-1.54	0.22	1.04	0.21	-0.05	1.92	-0.03	-0.34	2.34	-0.14
Bylaw trend	-0.08	0.15	-0.54	-0.38	0.24	-1.60	-0.20	0.36	-0.56	-0.01	0.25	-0.04
Year	0.46*	0.23	1.97	0.36*	0.16	2.32	1.30*	0.57	2.27	0.34	0.50	0.69
Month	-0.05	0.16	-0.28	-0.01	0.13	-0.08	-0.22	0.24	-0.94	-0.51	0.38	-1.34
Month squared	0.00	0.01	0.17	0.00	0.01	0.33	0.02	0.02	1.16	0.04	0.03	1.47
Days	0.26	0.18	1.49	-0.07	0.12	-0.60	-0.09	0.20	-0.46	-0.10	0.36	-0.27
Trend squared	0.00	0.00	-0.67	0.00	0.00	-1.99	0.00	0.00	-1.93	0.00	0.00	-0.62
Trend	-	-	-	-	-	-	-	-	-	-	-	-

<sup>†</sup>Note: Trend and Trend squared eliminated in the initial models \*p<0.05 \*\*p<0.1

**Table 4.4 Negative binomial regression models with select study variables**

Variables	Vancouver			Lower Mainland			Interior			Vancouver Island		
	Estimate	SE	Z-value	Estimate	SE	Z-value	Estimate	SE	Z-value	Estimate	SE	Z-value
Intercept	-3.39*	0.54	-6.25	0.25	0.29	0.88	-2.50*	0.65	-3.84	-1.90***	0.88	-2.16
Bylaw	-2.70*	0.67	-4.01	-2.21*	0.59	-3.75	-2.36***	1.09	-2.18	-0.93	1.41	-0.67
Month	-0.04	0.04	-1.07	0.00	0.00	1.45	-0.08	0.06	-1.30	0.01	0.09	0.14
Trend	0.03*	0.00	7.06	0.01	0.03	0.17	0.02**	0.01	3.12	0.00	0.01	-0.01

\* p<0.001 \*\*p<0.005 \*\*\*p<0.05

### 4.3. Study and Data Limitations

While the data used in this study is well-suited for the analysis of monthly trends of pharmacy robberies over a 10 and 15-year period, there are several limitations within the research design of this study and that data that should be noted. By nature, this study is an exploratory analysis of the policy efficacy implemented in September 2015. One of the primary limitations in this study is the lack of a universal control group, which may have included data of the overall robbery rates in each of the four locations for this study. The inclusion of total robbery counts within the time frame of this study would allow for a comparison to be made between the pharmacy robberies studied in this project and the overall criminogenic climate pertaining to robberies throughout the province. More factors are ultimately necessary to determine the exact causes of the observed drop in pharmacy robberies between 2015 and 2017. However, as evidenced by the results in this study, there is a statistically significant relationship between the *bylaw* variable and recorded pharmacy robbery counts in all locations except for Vancouver Island, while controlling for the *month* and *trend* variables.

One of the prominent limitations of this study is the excess of zero values in the count data for all four locations. While a statistically significant effect was seen for the impact of pharmacy bylaw on a decrease in pharmacy robberies, the robbery of pharmacies is a relatively infrequent crime, compared to crimes that are more commonly reported, such as property crime. As such, the data presented in this study is largely zero-inflated, and the observation of significant correlative effects is limited based on the limited counts in the data. The presence of multicollinearity at the bivariate level also proved to be a limitation within this data. While the lack of statistical significance in the regression models with many of the independent variables was unforeseen by the research design of this study, this is a limitation concerning the scope and applicability of the results, due to the few control variables present in the final iterations of the model. While the regression results conclude a statistically significant relationship between the implementation of the new pharmacy bylaw, the control variables in the final iteration of the regression model are limited to month and trend.

The scope of a research project may sometimes be limited in such that it fails to examine extraneous relationships that may impact the study. One such limitation noted in this study is the possibility of a substitution of drugs being stolen from pharmacies with

another widely used substance available outside of pharmacies. While the data in this study does not contain information on what was stolen in the reported robberies, the province of British Columbia has seen a spike in fentanyl use and overdose deaths from 2015 to 2017 (Vancouver Police Department, 2017, p. 10), and this may have a particular effect on the counts of pharmacy robberies within this time frame. While outside the scope of this study given the format of the data, this is an important limitation and consideration for research on this topic, when examining extraneous variables that may have an impact on the findings.

Another possible limitation for this study is the presence of prolific offenders or career criminals, which may have a specific and targeted impact on counts of pharmacy robberies throughout British Columbia. Similar to the aforementioned consideration, this possible limitation rests outside of the scope of this study, as the data is limited simply to monthly robbery counts. Future research on the study of pharmacy robberies would greatly benefit from an analysis of the details provided for each robbery incident, including offender profiles, the description of stolen goods, time of day, and whether a weapon was used in the commission of the offence.

## **Chapter 5.**

### **Discussion and Conclusion**

#### **5.1. Pharmacy Robbery Crime Prevention**

Within the criminological literature there exists a large gap in crime prevention research pertaining to pharmacies, and more specifically – the robbery of pharmacies. Past studies have examined crime prevention strategies for convenience stores (Amandus, Hunter, James, & Hendricks, 1995; Exum, Kuhns, Koch, & Johnson, 2010) and liquor stores (Casteel, Peek-Asa, Howard, & Kraus, 2004), though a gap exists within the academic literature specific to empirical studies on the efficacy pharmacy crime prevention strategies. The secondary aim of this study is to fill a gap in the academic literature specific to pharmacy crime prevention.

Rational choice theory suggests that rationally motivated individuals will implement a subjective cost-benefit analysis when deciding to commit a crime such as a robbery or burglary (Feeney, 1986; Clarke, 1997). Though pharmacies experience crime much like any other commercial establishment, little research has been conducted on the proximal and distal characteristics specifically related to pharmacy crimes. While pharmacies may be similar to other commercial businesses, they also have differing and arguably unique business practices given the sale of prescription drugs. Over the past decades, many pharmacies throughout North America have introduced modern security features that reduce the suitability of pharmacies as ideal targets for robbery or burglary (La Vigne & Wartell, 2015) Some features include CCTV, time-locked safes, physical barriers, and reinforced locks on doors and windows (La Vigne & Wartell, 2015).

##### **5.1.1. Crime Prevention Measures**

Situational crime prevention and rational choice theory help to explain the phenomenon of robbery, particularly as it pertains to commercial businesses such as pharmacies. As there exists a lack of empirical research on crime prevention measures specific to pharmacies, literature on crime prevention methods used in comparable commercial businesses may be used to determine “what works” within the context of

these environments. Previous studies have examined risk factors of convenience stores, and the degree by which they are at risk for robberies, based on principles of situational crime prevention (Amandus, Hunter, James, & Hendricks, 1995; Hendricks, Landsittel, Amandus, Malcan, & Bell, 1999). Situational crime prevention strategies have been utilized within liquor stores, fast-food restaurants, and convenience stores resulting in lower crime rates (Exum, Kuhns, Koch, & Johnson, 2010; Casteel, Peek-Asa, Howard, & Kraus, 2004). Many of these same implementations that have proven successful in their implementation within commercial businesses may also prove beneficial in reducing the frequency of robbery within pharmacies.

Casteel, Peek-Asa, Howard, and Kraus (2004) conducted a study on the effectiveness of CPTED in reducing criminal activity within liquor stores. An intervention program was developed based on CPTED concepts from a previous study by the Western Behavioral Sciences Institute, which had previously been successful in reducing robberies by nearly 20% during an 8-month period for 60 convenience stores in Southern California (Casteel et al., 2004, p. 451). Some of the implementations within the intervention program included target hardening features, improved cash handling policies, alarms, improved locks on doors, and improved lighting (Casteel et al., 2004). Furthermore, the intervention program was individualized for each liquor store in order to meet specific needs of each store. Using Poisson regression models, this study concluded that the largest statistically significant reductions in crime over the intervention period were for robbery and shoplifting with these crime rates reduced by 82.2% and 87.1% respectively (Casteel et al., 2004, p. 454).

In addition to SCP being successfully implemented within convenience stores in the United States, SCP has also been used as a crime prevention method for convenience stores and fast-food restaurants. Exum, Kuhns, Koch, and Johnson (2010) conducted a study on the efficacy of situational crime prevention within North Carolina in order to determine whether typical crime control strategies were as effective at reducing robbery within fast-food restaurants as they were within convenience stores (Exum et al., 2010). It was noted that fast-food restaurants and convenience stores are quite different in their design, operation, and business practices, and as such, the techniques that may prevent crime in one type of business may not be as effective in another. Using logistic regression, this study found that the most statistically significant predictor of future robbery in the multivariate model was whether or not the establishments were robbed in

the previous year (Exum et al., 2004, p. 286). Despite the lack of statistically significant results among the variables in this study, this was the first study conducted comparing robbery of fast-food restaurants to convenience stores. Based on three other statistically significant variables in this study, SCP recommendations were also given: the level of guardianship could be increased by adding an ATM to retain more patrons within convenience stores, a drop-safe sign should be displayed in convenience stores that contain drop-safes, and public transportation stops should be no closer than “200 yards” from each establishment (Exum et al., 2004, p. 288). Given the results of this study, Exum et al. conclude that fast-food restaurants and convenience stores should both plan for future safety measures based on past victimization or experiences with criminal activity.

The Center for Problem-Oriented Policing Services (COPS) published a report in 2015 providing an overview of pharmacy robberies in the United States, with specific crime prevention measures based on situational crime prevention techniques (La Vigne & Wartell, 2015). Congruent with situational crime prevention, COPS suggests four categories of measures that may be taken to reduce pharmacy robbery: increasing the risk of detection, increasing the effort to commit a robbery, and decreasing the susceptibility to robberies. The recommended steps taken to increase the risk of detection include (1) informing pharmacy employees about robbery trends, (2) providing prevention guidelines to pharmacy employees, (3) managing risk factors, (4) installing a panic alarm, (5) using video surveillance, (6) tracking the stolen drugs or offender, and (7) using deterring signage (La Vigne & Martell, 2015, p. 20-21). These techniques both modify the built environment as to reduce criminal opportunity, and allow for more informed employees who are aware of the risks relating to pharmacy robberies. Furthermore, the article enumerates measures to increase the effort required, which include employing security measures such as increased lighting, locking up narcotics, installing physical barriers, and insuring that front windows are clear (La Vigne & Wartell, 2015). While not all of these recommendations proposed by COPS have been evaluated for their implementation within pharmacies, several techniques have shown to be successful in reducing robberies within convenience stores (La Vigne & Wartell, 2015, p. 23). Finally, the report recommends two measures to be taken that will decrease the susceptibility to robberies, which include limiting the drugs available and limiting drug information available over the telephone (La Vigne & Wartell, 2015). All of the

techniques recommended by COPS fall within the scope of the twenty-five techniques proposed by Cornish and Clarke (2003), and are supported within the situational crime prevention literature.

## **5.2. Future Research and Direction**

The findings from this study provide support for the research questions presented in the introduction to this project. The policy and bylaw amendments made in 2015 have had an observable impact on counts of reported pharmacy robberies in three of the four locations in this study. The uniform implementation of visible signage and time-locked safes may have had an impact on the observed drop in pharmacy robberies. It may also be said that the DrugSafeBC program has been widely successful throughout the province of British Columbia, though the aforementioned limitations are important considerations for the scope and breadth of this research project.

This explanatory study has provided a foundation for future research on the efficacy of crime prevention strategies that may further serve to reduce incidents of commercial robbery. While many of the implementations enacted in pharmacies throughout British Columbia are designed specifically for the reduction of pharmacy robberies, similar implementations may be used to reduce other forms of commercial robbery. The use of physical barriers is a safety feature that is not limited to pharmacies, and is one that may be purposefully and aesthetically implemented within other commercial establishments insofar as its implementation may result in a less appealing target for potential offenders. Furthermore, the addition of clearly visible and purposeful signage throughout commercial establishments indicating the presence of CCTV, alarms, or other security features may serve to make such establishments less appealing for potential offenders.

Based on the data provided in this study, there may be an increase in pharmacy robberies between the months of April and July, exclusively within the city of Vancouver, and an examination of seasonality effects on this data is a possible direction for future research (Andresen, 2013). Further studies using this data may expand upon its longitudinal scope, utilizing future data points to establish a stronger significant relationship between the pharmacy bylaw enactment and a decrease in pharmacy robbery. While further research expanding the scope of this study may be beneficial in

order to utilize a greater number of control variables in the models of assessment, it is expected that the trend of reduced pharmacy robbery counts will continue, based on the theory-driven and research-based security implementations that have been enacted.

A study of this nature may also be applied to a macro-level examination of the efficacy of policy implementation. The present study was prompted by an observed drop of a very particular form of crime: pharmacy robberies. Using the results from the present study, this research may serve to provide empirical evidence to support the efficacy of new bylaw and policy implementations through improved crime-specific prevention measures. Using crime-specific data from other metropolitan centres across Canada, the framework of the present study may be used to support further policy analysis on the efficacy of crime prevention measures nation-wide. Count data analysis using negative binomial or Poisson regression models is particularly well-suited for the analysis of longitudinal trends using limited data points or zero-inflated data. Utilizing several methods of count-data analysis to examine longitudinal trends across large areas over a lengthy period of time, trends may be observed that would serve to inform policy changes and improve upon existing crime prevention initiatives. This study may serve as a stepping stone for future research examining the efficacy of policy implementation and bylaw enactment in other regions of Canada. The present study has not only shown the impact of policy and bylaw enactment in its function of improving upon crime-specific prevention measures, but also the ability to serve as an aid for future research within the area of crime prevention.

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