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Examining the Spatial Concentration of Mental Health Calls for Police Service in a Small City

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Abstract:

In recent years, police services have begun deploying more robust responses to calls for service involving persons with perceived mental illness (PwPMI), but at times do so in a limited capacity because of various challenges. Drawing from established evidence-based policing practices, a more efficient use of these responses may be to proactively deploy them instead, focusing their efforts on hot spots of PwPMI calls. Unfortunately, little is known about PwPMI call concentrations. Therefore, the current study seeks to contribute to the literature by not only examining the concentration of these calls within a small city, but also by introducing new methods and a new measure of concentration to the literature. Drawing on six years of calls for service data, the results reveal that a high proportion of PwPMI calls are concentrated in few spatial units – more so than in larger jurisdictions. Further analyses also reveal dispersion of these concentrations.

Keywords: Police; Mental Health; Spatial Concentration; Co-Response Team; PwPMI

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Introduction

In light of multiple social and systemic reasons, the police have increasingly come into contact with persons with perceived mental illness (PwPMI)¹ – a population that is more likely to be criminalized and have force used against them during interactions with police (Fisher et al., 2011; Livingston, 2016; Markowitz, 2011; Morabito et al., 2017). In an effort to prevent these issues, select police services have deployed specialized responses to PwPMI, but often do so on a limited scale due to funding limitations and other challenges, thus restricting their full potential (Iacobucci, 2014; Koziarski et al., 2020). However, to make efficient use of these responses, some have argued that these efforts should instead be proactively deployed, focusing on hot spots of PwPMI calls for police service (Coleman & Cotton, 2016; White & Weisburd, 2017;

Wood & Watson, 2017). In doing so, some PwPMI may be proactively directed toward mental health supports before reaching crisis, thus not only enhancing mental health care for that individual, but also preventing future police calls for service.

Such proactive efforts are not new to police practice. Hot spots policing and problem-oriented policing, for example, have long leveraged knowledge around where crime problems concentrate, subsequently deploying resources into these areas to target and successfully address said crime problems (Braga et al., 2019b, 2019a; Weisburd et al., 2019). Unfortunately, while these crime-focused proactive efforts are situated within a robust base of evidence on crime concentration (Lee et al., 2017), the spatial concentration of PwPMI calls has only recently received scholarly attention. As such, little is still known about the concentration of these calls in order to adequately inform similar proactive efforts for PwPMI.

In light of this, the current study seeks to contribute to the existing literature on PwPMI call concentration by not only drawing upon new methods and introducing a new measure of concentration, but also by examining the concentration of these calls within a new jurisdictional context that is smaller in land area than jurisdictions found in previous work, and has fewer spatial units – namely, street segments and dissemination areas. Examining PwPMI call concentration within this jurisdiction will reveal new knowledge about this phenomenon, which could result in vital practical implications for proactive police efforts into PwPMI call hot spots, in addition to setting the stage for subsequent spatial research on PwPMI calls in small cities.

Literature Review

Overview of Police-PwPMI Interactions

Calls for police service involving PwPMI are estimated to comprise up to 20% of services' call loads (Livingston, 2016), with some jurisdictions recording approximately a 10% annual increase in these calls (Vaughan & Andresen, 2018). While the deinstitutionalization of individuals living with mental illness and the subsequent lack of mental health supports is frequently cited as the reason for the rise in police-PwPMI interactions (Coleman & Cotton, 2016; Frederick et al., 2018), other factors, such as strict civil commitment criteria, homelessness, poverty, intolerance of social disorder, and lack of hospital beds – among other reasons – all contribute as well (Borum et al., 1997; Canada et al., 2010; Lamb & Weinberger, 1998; Markowitz, 2011; Schulenberg, 2016; Teplin, 1984). By consequence, the police have been tasked with the role of

‘street corner psychiatrist’ whereby they act as gatekeepers to both the criminal justice and mental health systems (Iacobucci, 2014; Teplin & Pruett, 1992).

Despite this role long being part of the policing profession (Bittner, 1967), and officers usually receiving some degree of mental health training (Coleman & Cotton, 2010; Cotton & Coleman, 2008), officers at times feel ill-prepared for interactions with PwPMI (Wells & Schafer, 2006). These interactions, however, can occur for any number of reasons beyond crisis, such as being casual/informal in nature, as victims of crime, by reporting crime, and as witnesses to a crime, among other reasons (Livingston et al., 2014). Although the nature in which PwPMI come into contact with police are certainly diverse, interactions with PwPMI have not only been found to take between 20 to 50 minutes longer than those not involving PwPMI (Charette et al., 2014; Schulenberg, 2016), but they also consume approximately 90% more resources (Charette et al., 2014; see also Vaughan & Andresen, 2018).

Further, police officers hold a significant amount of discretion when it comes to how they opt to conclude interactions with PwPMI. That is, they can choose to address an interaction through ‘official’ avenues, such as transport to hospital or arrest; or through ‘unofficial’ avenues, such as referral to a community-based mental health service or leaving them where/as they were (Bittner, 1967; Teplin & Pruett, 1992). While previous research suggests that interactions most often conclude with no action on behalf of the officer (Brink et al., 2011; Charette et al., 2011; Teplin & Pruett, 1992; Watson & Wood, 2017), numerous factors can affect officer decision-making. For instance, arrest or transport to hospital can consume a significant proportion of officer time (Charette et al., 2011), as such, some officers may opt for – or are encouraged by supervisors or co-workers to opt for – quick, informal conclusions to move onto the next call in the cue (Schulenberg, 2016). Moreover, in jurisdictions where there are few mental health resources, some officers may be forced to conclude that the individual’s best chance of receiving mental health care is through the criminal justice system, therefore arresting – or ‘mercy booking’ – them to provide them with this care (Lamb & Weinberger, 1998).

While arrests are a rare outcome for police-PwPMI interactions (Charette et al., 2011, 2014; Shore & Lavoie, 2018), criminalization of PwPMI is a significant issue. Research has shown that PwPMI have a higher probability of arrest than members of the general population (Boyce et al., 2015; Lamb & Weinberger, 1998; Teplin, 1984; Teplin & Pruett, 1992), even when the severity of an offence is equal (Charette et al., 2014). This holds true across various crime categories, especially disorder-related crime for

which PwPMI are 4 to 5 times more likely to be arrested (Fisher et al., 2011; Schulenberg, 2016).

Moreover, PwPMI are also more likely to experience police use of force. More specifically, previous research has not only found that use of force is indeed higher against PwPMI, but that those experiencing comorbidity – that is, both mental health and substance use issues – were found to be even more likely to experience police use of force (Morabito et al., 2017). Although police use of force is generally a rare occurrence, the higher likelihood of force against those experience comorbidity is certainly a cause for concern given that alcohol and/or drug use is present in approximately 25 to 50% of PwPMI interactions with police (Charette et al., 2011; Schulenberg, 2016; Shore & Lavoie, 2018).

Improving Police-PwPMI Interactions

Promisingly though, in recognizing the above issues and wanting to prevent them, police services in numerous jurisdictions have taken initiative in developing more robust responses to PwPMI. Efforts broadly referred to as a ‘co-response team’, for example, are commonly comprised of an officer and mental health practitioner who work together on shift and respond to PwPMI calls at the request of frontline officers, or an on-call mental health practitioner who also responds to calls on request (Iacobucci, 2014; Koziarski et al., 2020; Shapiro et al., 2015). Co-response teams are not only meant to filter PwPMI away from the criminal justice system (Munetz & Griffin, 2006), but they are also intended to improve interactions between PwPMI and police on a more general level (Shapiro et al., 2015).

Although evidence on co-response teams suggest that they are associated with decreases in use of force, involuntary apprehensions under mental health legislation, unnecessary hospital transfers, time spent at PwPMI calls, and costs associated with PwPMI calls, as well as increases in referrals to community-based resources, PwPMI satisfaction when interacting with the police, and PwPMI engagement with outpatient services (Blais et al., 2020; Fahim et al., 2016; Kirst et al., 2015; Kisely et al., 2010; Lamanna et al., 2018; Semple et al., 2020), some co-responses endure numerous challenges that hinder their ability to achieve these successes, such as lack of funding or understaffing (Koziarski et al., 2020). As a result, most mental health calls for service are still addressed by frontline officers, who are arguably less capable at addressing PwPMI calls than co-response teams (Iacobucci, 2014).

However, some scholars have recently begun conceptualizing what the ‘next wave’ of police responses to PwPMI should look like, including those of co-response teams (Coleman & Cotton, 2016; Wood & Beierschmitt, 2014; Wood & Watson, 2017). Currently, co-response teams operate within the ‘traditional’ model of policing: that is, reacting and responding to calls for service (White & Weisburd, 2017). Coleman and Cotton (2016), however, argue that co-response teams should – in addition to responding to crises – be proactively deployed, focusing on the root causes that may lead to PwPMI interactions with police. Wood and Watson (2017) see *place* as a critical area of opportunity for such proactive deployment, in that the geography of *where* these interactions concentrate could be used to inform targeted, proactive co-response team efforts. In this way, co-response teams can be situated in areas where they are needed the most, as opposed to reacting to calls within their assigned districts (Iacobucci, 2014)

Indeed, such proactive, place-based efforts are not new to the policing profession. For example, hot spots policing and problem-oriented policing both leverage knowledge around where crime problems concentrate, subsequently deploying resources into these areas to either deter criminal activity or to address problems at the source with significant success (Braga et al., 2019a, 2019b; Weisburd et al., 2019). Drawing from these crime-focused proactive efforts, White and Weisburd (2017) describe the first known attempt at proactive deployment of a co-response team in Baltimore, Maryland called the Co-responder Hot Spot Outreach Team (CHSOT). While this proactive co-response pilot project was deployed to aid those with mental health issues residing within violent crime hot spots (White & Weisburd, 2017), identical efforts that are instead focused on hot spots of PwPMI calls for service could result in numerous benefits, such as increased reach of co-response teams to PwPMI, prevention of mental health crises, and proactive diversion to mental health resources. These benefits, in turn, could not only put some PwPMI on a more fruitful path of mental health care, but they could also prevent future calls for police service.

Unfortunately, while place-based, crime-focused policing strategies are situated within mounds of empirical research which consistently shows that crime concentrates in a small number of places (Lee et al., 2017) – leading Weisburd (2015) to posit a Law of Crime Concentration – the spatial concentrations of PwPMI calls for service have only recently received scholarly attention and thus are not relatively well known to adequately inform attempts at proactive co-response team deployment.

Spatial Concentrations of Police-PwPMI Calls for Service

In using street segments as the unit of spatial analysis – that is, both sides of the street from intersection-to-intersection (Eck & Weisburd, 1995) – previous research on the concentration of PwPMI calls for service has found that 50% of calls occur on a very small percentage of segments: between 0.30 and 3% (Hodgkinson & Andresen, 2019; Vaughan et al., 2016, 2019; White & Goldberg, 2018). This same work as also found that, although PwPMI calls are highly concentrated, the calls are dispersed within that concentration. In other words, PwPMI calls for service tend to cluster in multiple hot spots that are spread out across the jurisdiction (Hodgkinson & Andresen, 2019; Vaughan et al., 2016; White & Goldberg, 2018). Further, PwPMI calls for service have also been found to be highly concentrated at larger spatial units (Vaughan et al., 2019).

While this early body of work has been instrumental in forming a preliminary understanding around the spatial concentration of PwPMI calls for service, additional research is certainly needed to further our understanding. This is especially pertinent given that most existing research draws on data from the same, or multiple adjacent, jurisdiction(s) in the Canadian province of British Columbia (Vaughan et al., 2016, 2018, 2019). Therefore, additional work is not only required to examine the concentration of PwPMI calls within new jurisdictional contexts, but especially in contexts that may generate new and unique patterns of spatial concentration, such small cities.

Research shows that smaller, less population-dense communities tend to have fewer mental health resources relative to larger cities, if any at all. More specifically, smaller communities tend to have fewer psychiatric beds and psychiatric facilities, understaffed hospitals, and a lack of specialized mental health staff (Canadian Institute for Health Information, 2019; Forchuck et al., 2010; Skubby et al., 2013; Yang et al., 2018). Beyond mental health, smaller communities also tend to have fewer resources for other services, such as social services, employment, and housing (Beimers & Gatlin, 2011; Belanger & Stone, 2008; Waegemakers Schiff et al., 2015), some of which are perceived as addressing foundational issues that certain PwPMI may need to resolve before being able to focus on their mental health (Kozierski et al., 2020)². Taken together, the scarcity of these resources not only exacerbates the issues discussed earlier and contributes to the police having a more predominant role in mental health within smaller communities (Durbin et al., 2010; Forchuck et al., 2010), but it also may affect the spatial patterns of PwPMI calls within these communities as well.

The work of Vaughan and colleagues (2016), for instance, suggests that there may be an association between places that may be frequented by PwPMI, such as social or mental health services, and the concentration of PwPMI calls (see also Hodgkinson & Andresen, 2019). However, since there are fewer of these resources in smaller communities, and thus fewer places around which PwPMI calls may concentrate, the concentration of these calls may be more pronounced in smaller cities. This concentration may also be further influenced through other small city characteristics, such as a smaller land area – which may be disproportionately residential – and/or fewer street segments. These factors effectively limit the extent to which resources and PwPMI calls for police service can be dispersed throughout a small city, thus likely contributing to a greater concentration of such calls in these contexts.

Given that PwPMI call concentration has yet to be examined within a small city, the purpose of the current, exploratory study is to develop an empirical and practical understanding around the spatial concentration of these calls within such a context: Barrie, Ontario, Canada. Doing so will not only reveal new evidence as it pertains to the concentration of PwPMI calls within small cities which can be used to inform proactive police practice, but this evidence can also be used to guide subsequent empirical or theoretical efforts that seek to understand the specific and/or unique factors that may contribute to PwPMI call concentration within smaller cities.

Data and Methods

Study Jurisdiction and Data

Barrie is a 99km² city – nearly one-third (32km²) of which is residential land use – that is situated approximately 100km north of the City of Toronto and sits on the western coast of Lake Simcoe in Central Ontario. As per the 2016 census, the population of Barrie is approximately 197,000 with a population density of 219 per km² (Statistics Canada, 2017). Data for this study were extracted from the computer-aided dispatch system (CAD) of the Barrie Police Service and include all calls made to the service for the six-year period of January 1, 2014 through December 31, 2019 ($N = 363,961$). Each incident in the data was accompanied by the date and time the respective call was made, the incident-type as reported by the caller, the incident-type as found by the officer(s), as well as CAD-generated XY-coordinates.

For the purpose of the current study, a subset of these data was created in which only calls for service were included if the ‘incident-type as found’ field was set to *Mental Health*. In other words, this subset contains all calls for service for the six-year period

in which the responding officer(s) perceived mental health as being the primary nature of the call³. In total, this subset includes 3,262 calls for service, thus comprising 0.89% of all calls made to the Barrie Police Service between 2014 and 2019. This finding is within the 0.50 to 3.48% range of previous work (Hodgkinson & Andresen, 2019; Vaughan et al., 2016, 2018; White & Goldberg, 2018).

Units of Spatial Analysis

The current study employs two units of spatial analysis. The first are street segments which consist of both sides the street from intersection-to-intersection (Eck & Weisburd, 1995). Street segments have become an immensely popular unit of analysis in spatial criminology not only because they are instructive for identifying high degrees of spatial concentration that would otherwise not be revealed through larger spatial units (Schnell et al., 2017), but also because of their practical utility in that problem segments can be identified with high precision thus informing police practitioners where additional resources may be needed down to the exact segment. With respect to the study jurisdiction, the City of Barrie has 2,975 street segments.

The second unit of spatial analysis are Statistics Canada dissemination areas which are a small census unit that contains between 400 and 700 residents (Statistics Canada, 2018). While the objectives of the current study could sufficiently be achieved through street segments alone, their small size make it difficult to generate visualizations where differences between spatial units are to be highlighted (such as those that will stem from the analyses below). Therefore, dissemination areas are employed because they are still a relatively small unit that can identify spatial concentrations with a high degree of precision, but are also large enough to generate meaningful visualizations (Hodgkinson & Andresen, 2019). An added benefit of employing dissemination areas along side street segments is that it will highlight how the concentration of PwPMI calls can vary based on the spatial unit. With respect to the study jurisdiction there are 243 dissemination areas within the City of Barrie as of the 2016 Census.

Relative to jurisdictions in previous research on the spatial concentration of PwPMI calls, Barrie is the smallest jurisdiction based on land area (Vaughan et al., 2016, 2019; White & Goldberg, 2018), has the fewest number of dissemination areas (Hodgkinson & Andresen, 2019; Vaughan et al., 2016, 2019; see Vaughan et al., 2018 for exception), and the fewest number of street segments (Hodgkinson & Andresen, 2019).

Kernel Density Estimation

Kernel Density Estimation (KDE) is used in order to generate an exploratory visualization of where PwPMI calls cluster within the study jurisdiction. KDE is a popular method of identifying areas of concentration by generating a smooth risk surface across points on a map (Chainey & Ratcliffe, 2005). The generated risk surface is commonly visualized through a heat map; however, the resulting visualizations can vary depending on two parameters: grid cell size and search radius (or bandwidth). The latter of the two is arguably most influential on the results because it determines the size of hot spots, whereby smaller search radii generate small hot spots and larger radii generate large hot spots (Chainey & Ratcliffe, 2005). For the current study, the grid cell size is set to 73m and the search radius is set to 421m. Nearest Neighbour Analysis was used to inform the selection of these parameters; however, varying the parameters did not impact the results.

Concentrations at Spatial Units

In line with Weisburd's (2015) Law of Crime Concentration, as well as previous research on the spatial concentration of PwPMI calls for service (e.g., Hodgkinson & Andresen, 2019; Vaughan et al., 2016), three measures of concentration will be calculated at both the street segment and dissemination area level: (1) the percentage of spatial units that have any PwPMI calls for service; (2) the percentage of spatial units that account for 50% of calls; and, (3) the percentage of spatial units with any calls that account for 50% of calls⁴.

In addition to calculating these measures, the degree of concentration for both spatial units will be additionally reported and summarized with Lorenz curves and Gini coefficients. Historically, the former has largely been used to visualize income inequality, whereas the latter summarizes the degree of inequality with a single number between 0 (perfect equality) and 1 (perfect inequality). Bernasco and Steenbeek (2017) argue that, to date, the literature on crime concentration has lacked a single, universal measure of 'concentration', therefore complicating efforts to compare the degree of concentration across areas, temporal periods, or crime types. They argue that Lorenz curves and Gini coefficients can fill this gap (Bernasco & Steenbeek, 2017). However, because methods in the PwPMI call concentration literature have been heavily influenced by those in the crime concentration literature, the lack of a single measure of concentration is also an issue. Therefore, although this is the first paper on PwPMI call concentration to present Lorenz curves and Gini coefficients, the aim is that by doing so, work that follows will also adopt these

measures to facilitate a more standardized method of comparing concentration across study jurisdictions. All Lorenz curves and Gini coefficients for the present study are generated through the *lorenzgini* package for the R statistical programming environment (Steenbeek & Bernasco, 2018).

Moran's *I*

Finally, in addition to generating an understanding around the degree of concentration of PwPMI calls for service in a small city, it is also pertinent to know whether these concentrations are clustered or dispersed across the study jurisdiction. To assess this, the current study employs Moran's *I* to test for spatial autocorrelation between units of analysis. Simply put, Moran's *I* tests whether or not street segments or dissemination areas with high or low counts of PwPMI calls for service are situated next to other street segments or dissemination areas with similarly high or low PwPMI call counts (Moran, 1950; Tobler, 1970). The degree of clustering is indicated through the Moran's Index which ranges from -1 to +1: the former indicates perfect dispersion, whereas the latter indicates perfect clustering. A value of 0 indicates that spatial units are dispersed across the jurisdiction at random, with no clustering or dispersion pattern⁵.

However, because Moran's *I* generates one statistic for the entire study area – also referred to as Global Moran's *I* – the current study also employs Local Moran's *I* (Anselin, 1995). Local Moran's *I* identifies which specific street segments or dissemination areas with high counts of PwPMI calls are next to other units with similarly high counts (High-High), as well as units with low counts that are next to other low-count units (Low-Low). These areas indicate clustering, whereas high units next to low units (High-Low) and low units next to high units (Low-High) are indications of dispersion. Both Global and Local Moran's *I* are executed with a first-order Queen's contiguity weights matrix and 999 permutations.

Results

Figure 1 displays the results of the KDE, which provides an exploratory visualization of where PwPMI calls for service cluster within Barrie. As is immediately evident in the figure, there are two PwPMI call hot spots.

[FIGURE 1 ABOUT HERE]

The first, larger hot spot is situated within the downtown core where there is a concentration of numerous social services and public health units. The second, smaller hot spot situated in the north-east corner of the city is at the local hospital.

[TABLE 1 ABOUT HERE]

Next, a series of calculations are performed to examine the degree of PwPMI call concentration at dissemination areas and street segments within Barrie. When considering all PwPMI calls, Table 1, column b, reveals that almost all dissemination areas (98%) had at least one PwPMI call; however, at street segments, this figure drops down to just 34%. In other words, 66% of street segments did not have a single PwPMI call for service between 2014 and 2019. Further, when considering the percent of units required to account for 50% of calls, column c indicates that there is a high degree of concentration at both units: only 13% of dissemination areas and 4% of street segments are required to account for 50% of PwPMI calls.

[FIGURE 2 ABOUT HERE]

[FIGURE 3 ABOUT HERE]

Lorenz curves are employed to further visualize the concentration at dissemination areas (Figure 2) and street segments (Figure 3), as well as to provide an additional measure of concentration via their respective Gini coefficients. The results confirm that not only are PwPMI calls for service highly concentrated, but the concentration is more pronounced at street segments. Recall that the Gini coefficient ranges from 0 (perfect equality) to 1 (perfect inequality). For dissemination areas, the Gini coefficient was found to be near the middle of the range: 0.57. As displayed in Figure 2, while there is an unequal distribution of PwPMI calls across dissemination areas, almost all dissemination areas have at least one PwPMI call. This is confirmed through the moderate coefficient, as well as the Lorenz curve nearly approaching 100% of calls at 100% of dissemination areas in the top-right corner. At street segments, on the other hand, the Gini coefficient was found to be much higher, indicating higher concentration: 0.84. In Figure 3, this extremely unequal distribution of PwPMI calls is indicative of the fact that the Lorenz curve reaches 100% of calls and plateaus at only 34% of street segments (see also Table 1, column b).

Thus far, it is clear that PwPMI calls are highly concentrated in Barrie, but are these concentrations clustered or dispersed across the city? Findings in Table 1, column d, suggests that it is the latter. More specifically, relative to column c where dissemination areas and street segments with zero PwPMI calls are *included* in the calculation, they are *excluded* for these same calculations in column d. While the percentage between these two columns is essentially the same for dissemination areas, there is an 8% increase for street segments. This indicates that although there is a

high degree of PwPMI call concentration at the street segment level, the calls are dispersed within that concentration. The presence of clustering or dispersion was further examined through Global Moran's I . At the dissemination area level, Moran's Index is 0.24 ($z = 7.01$, $p < 0.001$) and at street segments it is 0.08 ($z = 8.80$, $p < 0.001$). Although both indices are positive and statistically significant, thus indicating the presence of some dissemination areas and street segments clustering next to others with similar PwPMI call counts, the degree of clustering is quite low. In other words, PwPMI call concentrations across both dissemination areas and street segments are more so randomly dispersed, especially at street segments.

[FIGURE 4 ABOUT HERE]

At the local level, Figure 4 displays the results of Local Moran's I at dissemination areas. Recall that unlike Global Moran's I , Local Moran's I identifies the *specific* dissemination areas that contribute to clustering or dispersion at the global level. Immediately evident is that, similar to the KDE results, there is a cluster of dissemination areas in the downtown core of the city that are situated adjacent to dissemination areas with similarly high PwPMI call counts (i.e., High-High). Further, again in the north-east corner of the city, there is a cluster of High-High dissemination areas, as well as some Low-High outliers (i.e., low call count dissemination areas situated next to dissemination areas with high counts). Moreover, in the north-west and south-west of the city there are some Low-Low clusters (i.e., low call count dissemination situated next to dissemination areas with similarly low counts). Notably, however, there are no High-Low clusters (i.e., high call count dissemination areas situated next to dissemination areas with low counts), and, for the most part, many dissemination areas across the study jurisdiction exhibit non-statistically significant clustering or dispersion, thus driving the low Moran's Indices.

Discussion and Conclusion

The purpose of the current, exploratory study was to develop an empirical and practical understanding around the degree to which PwPMI calls for police service concentrate in a small city context. While this body of literature is certainly in its infancy, the current study builds on previous research by introducing a new measure of concentration, employing local spatial methods and – as mentioned – having an explicit focus on examining PwPMI call concentration within the context of a small city: Barrie, Ontario, Canada.

Exploratory KDE revealed two areas of call concentration within the city. One is in the downtown core where there is a concentration of various social services and public health units; the other is at the local hospital. While the current study did not explicitly explore the role of place, as explained earlier, previous research suggests that there may be an association between locations that may be frequented by PwPMI and the concentration of PwPMI calls for service (Hodgkinson & Andresen, 2019; Vaughan et al., 2016). However, to date, these associations have either been made through visualizing these locations over KDE results (Vaughan et al., 2016) or through the author's personal knowledge of the study jurisdiction (as is also the case here) (Hodgkinson & Andresen, 2019). Therefore, it is imperative that future research not only examine the association between place and concentrations of PwPMI calls for service – particularly within small city contexts – but to do so through more robust methods.

Further analyses at the dissemination area level revealed that nearly all dissemination areas had at least one PwPMI call for service, but that 50% of calls were concentrated in only 13% of dissemination areas, which is similar to that of previous work (Vaughan et al., 2019). Street segments, however, revealed an even higher degree of concentration. More specifically, it was found that 50% of PwPMI calls were concentrated on only 4% of street segments. When compared to that of dissemination areas, the finer degree of concentration found at street segments only further supports the use of this spatial unit to help guide place-based police practice with a high degree of precision.

Although 4% of segments accounting for 50% of calls is similar to that of previous work, it is also the least concentrated. As mentioned, earlier studies have found that 50% of PwPMI calls are attributed to between 0.30 and 3% of segments (Hodgkinson & Andresen, 2019; Vaughan et al., 2016, 2019; White & Goldberg, 2018). The small number of street segments in Barrie likely contributes to this finding. With only 2,975 street segments, there are already fewer segments on which calls can concentrate to begin with. Therefore, for each additional segment that is required to account for 50% of calls, calls will appear to be more dispersed in jurisdictions with fewer segments relative to jurisdictions which have a higher number of segments. Relatedly, others have also emphasized that caution must be used when interpreting concentration as *50% of events are attributed to X% of street segments*. This is because this measure includes *all* street segments in the jurisdiction as part of the calculation as opposed to only those where a call occurred, therefore making the concentration appear more significant than it truly is (Bernasco & Steenbeek, 2017). Excluding street segments

with no PwPMI calls for service instead revealed that 50% of calls are concentrated on 12% of segments. Relative to previous research providing this measure, Barrie has the highest degree of PwPMI call concentration with previous work ranging between 14 and 44% of segments with calls (Hodgkinson & Andresen, 2019; Vaughan et al., 2016, 2019)⁶. However, because not all research provides a measure that excludes spatial units without any calls (e.g., White & Goldberg, 2018), and because there is a lack of standardization when it comes to presenting results of PwPMI call concentration, future research must consider employing Lorenz curves and Gini coefficients in order to facilitate comparisons between jurisdictions through a standardized measure that can also take into consideration when there are many units with no calls (see Bernasco & Steenbeek, 2017).

Relatedly, measures that exclude units with no events also allude to the degree of call dispersion. The current study sought to examine this further through additional analyses. More specifically, at the street segment level, and similar to that of White and Goldberg (2018), Global Moran's *I* revealed some degree of street segment clustering next to other segments with similar counts of PwPMI calls, but that for the most part, segments appeared randomly dispersed throughout the jurisdiction. Dissemination areas revealed relatively the same results; however, their larger size also provided an opportunity to examine Moran's *I* at the local level. Doing so revealed numerous dissemination areas with high PwPMI call counts situated next to other dissemination areas with similar counts. Further, there were some low count areas identified next to high count areas, as well as some clustering of Low-Low areas. Knowledge not only with respect to where PwPMI calls concentrate, but also where they do not – that is, cold spots of PwPMI calls – can be especially instructive for police practice in that services can be informed on where *not* to situate their resources.

Ultimately, while the current study was conducted in a new, unique jurisdictional context, as well as introduced new methods and a new measure of concentration to the existing literature on PwPMI call concentration, the findings confirm those of previous work: PwPMI calls for police service concentrate in a disproportionality small number of areas. However, in the small city of Barrie, Ontario, Canada, it was revealed that PwPMI calls are less dispersed relative to larger jurisdictions in previous research. While additional work is certainly needed in this area, especially empirical and theoretical efforts that seek to understand what specific or unique factors may contribute to PwPMI call concentration within small (and large) cities, this small, but growing body of evidence is increasingly building support for co-response teams to be reconfigured into a proactive, hot spot policing-like practice (Coleman & Cotton, 2016;

White & Weisburd, 2017). As mentioned earlier, efforts such as hot spots policing and problem-oriented policing have long leveraged knowledge around the spatial concentration of crime to *successfully* deter criminal activity or to target issues at their source, both in a proactive manner. Along the same vein, co-response teams could leverage knowledge around PwPMI call concentration, target these areas through proactive outreach, and direct those who may appear to be struggling with their mental health toward mental health resources *before* a call for service is generated. In doing so, many individuals could be placed on a more fruitful path of mental health care, while also reducing PwPMI calls for police service. This is a unique and untapped area of empirical research and police practice that must be further explored.

Limitations

As with all empirical work, the present study is not without limitations. First, as others have also noted (e.g., Hodgkinson & Andresen, 2019; Shore & Lavoie, 2018; Vaughan et al., 2016), calls for police service are commonly classified based on what the *primary* nature of the call was. Consequently, this method of call classification masks other, secondary components of each call. Therefore, while the present study drew upon 3,262 calls for police service where *Mental Health* was selected as the primary nature, it is very plausible to assume that there may have been many additional calls for service involving PwPMI that were not accounted for because the primary nature was selected as something else by the responding officer(s).

A second, but related limitation is that the determination of whether a call for service is mental health-related is up to the perception of responding officer(s) (Bittner, 1967; Bohrman et al., 2018; Hodgkinson & Andresen, 2019; Schulenberg, 2016; Shore & Lavoie, 2018; Vaughan et al., 2016; White & Goldberg, 2018). While police officers commonly receive at least some degree of mental health training, they are not trained mental health practitioners who are qualified at forming mental health diagnoses. Signs of substance use, for example, are commonly misinterpreted by police officers as symptoms of mental illness (Bohrman et al., 2018). As a result, it is plausible to presume that some calls for service that were classified as *Mental Health* were in response to individuals who do not have a diagnosed or diagnosable mental illness.

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Figures and Tables

Figure 1. Kernel Density Surface of PwPMI Calls for Service

Table 1. Percent Spatial Units Accounting for 100% and 50% of PwPMI Calls for Service

Unit Type	(a) <i>N</i> Units	(b) Percent Units with Any Calls	(c) Percent Units Accounting for 50% of Calls	(d) Percent Units with Any Calls Accounting for 50% of Calls
Dissemination Areas	243	98.35	13.17	13.39
Street Segments	2,975	33.68	4.17	12.38

Figure 2. Lorenz Curve and Gini Coefficient for PwPMI Call Concentration in Dissemination Areas

Figure 3. Lorenz Curve and Gini Coefficient for PwPMI Call Concentration at Street Segments

Figure 4. Global and Local Moran's I for PwPMI Calls for Service, Dissemination Areas

Footnotes

1. The literature on mental health-related police interactions employs a variety of terms to refer to such interactions, with ‘persons with mental illness’ – often shortened to ‘PMI’ or ‘PwMI’ – being among the most frequently used terms (Frederick, O’Connor, & Koziarski, 2018). Within police data, however, mental health calls are often coded as such by responding officers due to a perception or belief – on behalf of the officer, bystanders, etc. – that mental health-related issues *may* be present, as opposed to a *certainty* that they are present. Therefore, as Frederick and colleagues (2018) note, among other issues, the broad use of ‘PMI’ (and related) terms may lead to validity-related issues in the literature, unless researchers are certain that the data are comprised of people living with a diagnosed mental illness or explicit steps are taken to sample individuals who have a diagnosis. Empirical efforts that, on the other hand, rely on officer-generated data should instead employ terms that reflect officers’ uncertainty of whether mental illness is present. Since this is the case for the present work, this study employs the term ‘persons with perceived mental illness’ (PwPMI) to reflect uncertainty. [↵](#)
2. While the work cited here largely discusses service disparities between urban and rural areas, the implications for small cities are nonetheless clear: they have fewer services and resources relative to large urban centres. [↵](#)
3. This is in contrast to some previous work on the spatial concentration of PwPMI calls in the Canadian context which drew upon incidents in which provincial mental health legislation was applied (e.g., Vaughan et al., 2016, 2018, 2019). The data drawn upon for the present study does not reveal how a PwPMI call concluded, either through application of mental health legislation or otherwise. [↵](#)
4. Approximately 50 (1.5%) of the 3,262 PwPMI calls were situated at street segment intersections. Upon closer examination of these calls it was noted that: (1) most intersections at which calls were located only had a single call; and (2) many segments which converged at these intersections had zero calls. Given that a majority of these points could be offset to any one of the converging segments to arrive at the same conclusion – that is, a street segment with one PwPMI call – it was, therefore, decided to manually offset these points to intersecting segments in a counterclockwise sequence following the four cardinal directions (North, West, South, East). [↵](#)

5. Given that the expected value of Moran's I is calculated as $-1/(N-1)$, the true value for random dispersion is slightly negative. [↵](#)
6. Hodgkinson and Andresen (2019) also include street intersections in their analyses, which likely contributed to 44% of their spatial units with events being required to account for 50% of PwPMI calls. [↵](#)