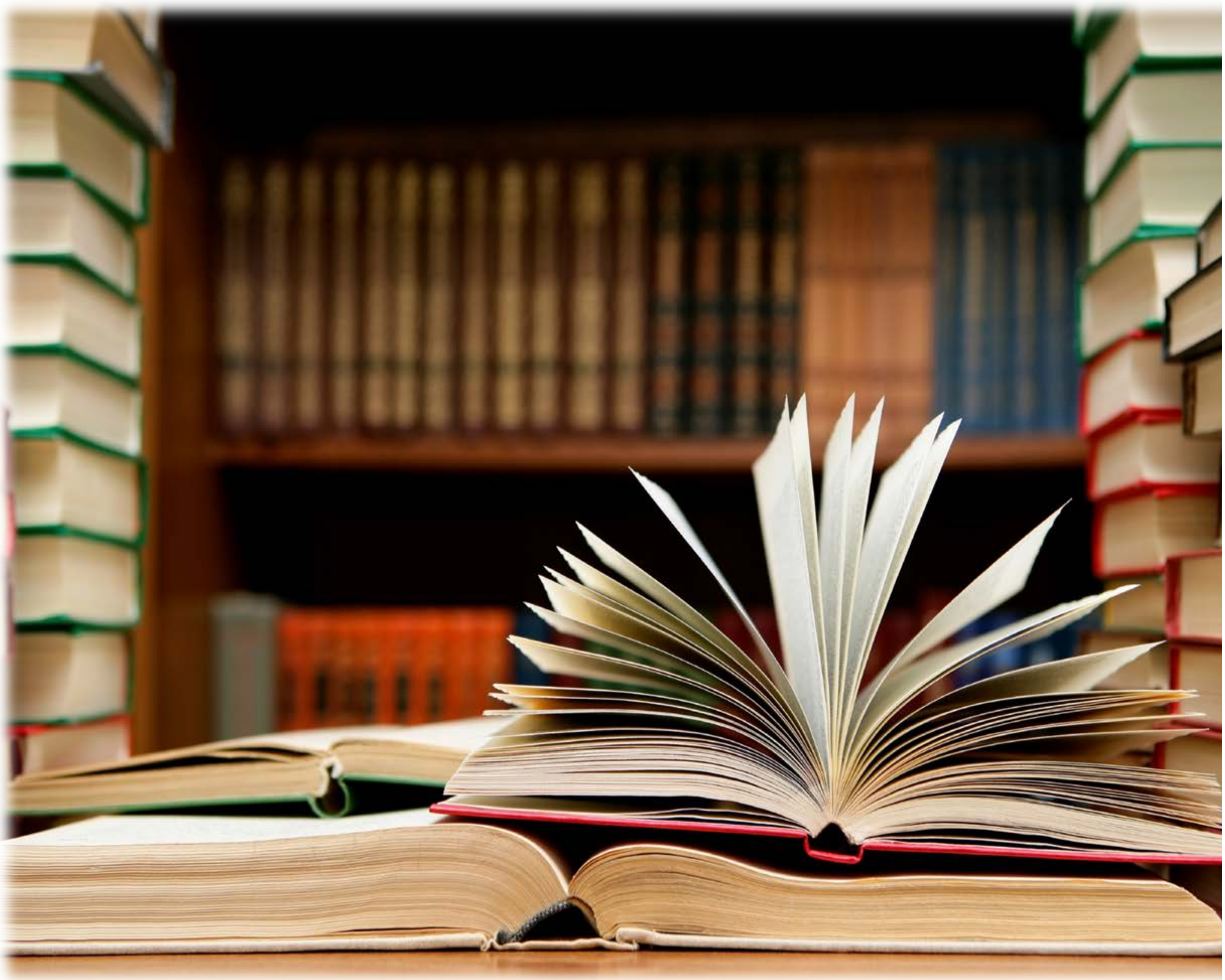
Examining "Regular" Fire-Safety Inspections

The Missing Relationship between Timing of Inspection and Fire Outcome



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Executive Summary

1. It is important to emphasize and explain, from the outset, that this paper is not intended to suggest that fire safety inspections should not be done. Instead, the purpose of this research is to demonstrate that elapsed time since last inspection does not seem to influence fire outcomes with respect to extent of fire and fire related casualty.

2. Under the BC Fire Services Act, municipal councils must provide a regular system of inspection. 'Regular' in this context is explained within a 1992 *Interpretive Guide* to determining frequency of inspections as not being designed to bind municipal councils to a specific inspections schedule, but instead is intended to act as a guideline within which the frequency of local inspections should be determined. This frequency should take into consideration local needs (e.g., ideal level of service and available resources) in addition to level of risk for fire.

3. This analysis was undertaken on the most recent 5-years of fire incident reports submitted to the BC Office of the Fire Commissioner for which the date of last inspection was captured (1999-2003): a total of 4,084 fires reported by 168 different reporting locations, 97% of which were located in municipal areas. These fires in municipal areas accounted for 87% of fire-related deaths and 96% of fire-related injuries.

4. It is unknown what the overall inspection frequency for all properties in this sample was, which makes it somewhat difficult to interpret whether time since last inspection had any impact on frequency of fire. However, it is clear that the majority of fires (74%), injuries (81%), and deaths (74%) occurred within 1 year of the most recent inspections. The frequency of all of these declined with duration between inspection and fire event, up until the inspection was over 36 months prior to the fire. There was no meaningful distinction between the duration since last inspection and the frequency of fires at residential and non-residential properties.

5. The timing of the most recent inspection did not influence the extent of fire spread. For those buildings that were inspected on a regular basis (at least once every 3 years), the timing of inspection (greater or less than every 12 months) had no significant effect on the extent of fire spread.

6. For the 335 injuries included in the dataset, the injury rate per 1,000 fires was significantly greater for residential properties compared to non-residential ones. When looking within these occupancy classes, there was no indication that the rate of injury increased as a consequence with the duration between most recent inspection and fire incident. In fact, the only indication was the counter-intuitive finding the injury rate per 1,000 fires declined for those fires that occurred more than 1 year after the most recent inspection.

7. The death rate per 1,000 fires was also significantly greater in residential properties relative to non-residential properties for the 23 fatalities included in the dataset. Within-occupancy class analysis revealed no difference in death rates as a function of time since the most recent inspection.

8. There is something qualitatively different about fires at inspectable properties that had not been inspected for over 3 years prior to the fire incident. However, this does not detract from the current argument about rethinking the inspections process that is driven by time, as a delay of over 3 years does not constitute 'regular', and is arguably indicative of a lax attitude towards inspections by the responsible organization in each case.

9. The potential to redesign the inspections process to acknowledge a broader set of risk factors, in addition to time, is discussed. This type of alternative approach would align more closely with the 1992 *Interpretive Guide* to inspections which listed a range of additional considerations when determining inspections frequency, including occupancy type, age, condition, maintenance, and degree of cooperation on behalf of the building's responsible person.

The Purpose of this Research

This report examines the relationship between duration since the most recent fire safety inspection and the outcomes of the fires, with respect to frequency, extent of fire spread, and fire-related casualty. Based on a sample of over 4,000 fires reported to the British Columbia (BC) Office of the Fire Commissioner (1999 to 2003), covering reporting areas across the whole province (168 areas), the analysis revealed the following main findings:

- The majority of fires and fire-related casualties occurred within 1 year of the most recent inspections, with the frequency of all of these generally declining as the duration between inspection and fire event increased.
- For buildings that were inspected at least once every 3 years the timing of inspection (greater or less than every 12 months) had no significant effect on the extent of fire spread.
- Although fire-related casualties were much more frequent in residential compared to non-residential properties, there was no influence of time since last inspection that indicated an increased rate of injury or death as a consequence of increased duration since last inspection.

As already stated in the Executive Summary, the purpose of this research is not to infer that fire safety inspections have no value. Instead, the aim is to demonstrate that elapsed time since last inspection does not appear to influence fire outcomes with respect to extent of fire and fire related casualty. These findings are discussed with respect to a range of other risk factors (both static and dynamic in nature) that time-driven inspections overlook. The authors believe that these additional variables provide relevant additional information that can be used to manage properties based on their unique risk levels.

Legislative Basis for the Current Regular Approach

There are two main pieces of legislation that influence fire safety inspections conducted by BC Fire Services. At a national level, the National Fire Code of Canada 2010, ensures a consistent standard is applied to fire prevention and safety across the country [1, designed to compliment the 2010 National Building Code of Canada]. On a provincial level, BC currently operates under the 2006 Building Code and Fire Code [2]. The national and provincial building codes are enforced during the construction, renovation, and demolition of structures, but once occupancy has occurred, these no longer apply. Post-occupancy, the fire codes are enforced at the municipal government level, meaning that it is incumbent on local fire services[1] to conduct fire-related building inspections.

Local fire services are responsible for inspecting properties for compliance with prescribed fire codes, and mandating maintenance should buildings be found to be in violation of those codes. To ensure compliance with these codes, fire safety inspections are undertaken and when infractions are found, inspectors issue an order that requires amendments to be made to bring the building into accordance with the prescribed codes. Inspectors are given the authority to inspect and enforce the fire code on behalf of the Fire Commissioner in *Sections 22* (Order to remedy conditions) and *23* (Order where owner absent) of the British Columbia Fire Services Act [2]. Should the owner/operator of a structure fail to comply with a written order there are a range of available legal sanctions that can be pursued. With respect to the timing of these inspections, there

[1] The BC Fire Code, Section 26(2) indicates that "the municipal council may authorize persons, in addition to the local assistant, to exercise within the municipality some or all of the powers" associated with this inspection and enforcement process.

are two locations within the BC Fire Services Act that stipulate the frequency at which these inspections should occur:

- Sections 26 – Municipal duty to inspect hotels and public buildings
  - 26(1) A municipal council must provide for a regular system of inspection of hotels and public buildings in the municipality.
  - 26(2) A municipal council may authorize persons, in addition to the local assistant, to exercise within the municipality some or all of the powers under Sections 21[2] to 23.
- Sections 36 – Inspections of buildings
  - 36(1) In this section:
    - **"building"** includes a hotel, public building, church, theatre, hall or other building used as a place of public resort;
    - **"officer"** means a local assistant and, in a municipality, the chief police officer and any other person authorized by the municipal council to exercise some or all of the local assistant's powers under this Part.
  - 36(3) A municipal council must provide for a regular system of inspection by an officer of buildings in the municipality.

As the *Interpretive Guide to the BC Fire Services Act* (Sections 26(1) and 38(3)), entitled "Criteria for Determining Frequency of Inspections" [3] stipulates, 'regular' within this context is not expected to bind municipal councils to a specific inspections schedule, and instead acts as a guideline within which the frequency of local inspections should be determined, taking into consideration local needs (e.g., ideal level of service and available resources), in addition to level of risk for fire. The objective here being that, "Through the development of their local 'regular system of inspections' any potential liability may be avoided and fire hazards identified and eliminated by a competent inspection process." The additional consideration made within the *Interpretive Guide* with respect to timing suggested that, "Some degree of equity should be present in the frequency of inspection of the same type of occupancy."

The *Interpretive Guide to the British Columbia Fire Services Act* [3] also acknowledges the varying "level of risk" between properties, and suggests that this should also influence the timing of inspections. The suggested approach to incorporating this into the inspections schedule would require the establishment of a comparative scale that takes into consideration the likelihood that certain fire hazards will be present to a greater degree. While the *Interpretive Guide* provides examples of structures that may be classified as low risk for fire (e.g., art galleries, opera houses, and hospitals), medium risk for fire (e.g., schools, psychiatric hospitals, and rest homes), and high risk for fire (e.g., restaurants, spray painting operations, and apartments), it is important to note that these are simply examples, and do not restrict a particular structure type to a pre-defined level of risk. As such, it is important for fire services in each community to create their own risk categories. Moreover, associating risk to different building structures is an essential exercise for fire services to engage in as it may have implications for the frequency and manner by which inspections are conducted. To this end, the *Interpretive Guide to the British Columbia Fire Services Act* classifies buildings into different risk categories with unique standards of inspection frequency. These classifications are based on a national standard, but can be amended locally based on community needs. Occupancies are divided into Groups:

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[2] Section 21 – Inspection of fire hazards

- Group A involves structures associated with performance arts, arenas, open air structures, or those not classified elsewhere, such as schools, nightclubs, and restaurants;
- Group B applies to care, treatment, and prison occupancies;
  - B1 is which concerned with detention facilities; and
  - B2 applies to care occupancies;
- Group C includes residential occupancies, such as hotels and apartments;
- Group D involves other business and personal services, such as office buildings;
- Group E applies to mercantile, such as retail stores; and
- Group F involves industrial structures, such as power plants, service stations, and distilleries.
  - F1 applies to high hazard industrial structures;
  - F2 applies to medium hazard industrial structures; and
  - F3 applies to those with a low hazard.

The final component of the *Interpretive Guide to the British Columbia Fire Services Act* [3] listed a set of *Other Considerations*, which emphasize the importance of factors beyond the building occupancy type. The types of factors that are discussed include the building age, the general condition of the building, the housekeeping and level of cooperation from the responsible person, and the staffing needs of the local inspections operation.

The History of Regular Inspections in BC

The non-binding interpretation of 'regular' combined with the variations in 'levels of risk' have interacted with the varying demand across municipalities in BC to produce a situation where there is no mandated consistent approach to the timing of inspections. Overall, the intention is that, "Inspections must be regular, fair, adequate, and the frequency justified by a responsible policy agreed to by the municipal council." The *Interpretive Guide* [3] initially proposed an example frequency system involving, "Two to three month intervals for high risk occupancies, four to six month intervals for the medium risk occupancies, and a twelve month interval for the low risk occupancies." This process was also intended to incorporate other elements that influence the fire risk posed by a property, such as age, condition, maintenance, and degree of cooperation of the owner/occupants [3]. In addition to this, responsible areas are required to develop a system that can be accomplished by the existing staff. In addition to the other parameters, the capacity of each department therefore also influences inspection frequency: an issue that becomes increasingly significant within rapidly growing municipalities. Combined, these factors probably account for a large degree of the variation that exists between municipalities with respect to frequency of fire safety inspections.

The Scope of the Dataset

Up to the end of 2003, fire incident reports that were submitted to the BC Office of the Fire Commissioner used to include a field that captured the date of last inspection at that property. This variable represented, "the period in which the building or structure was last inspected previous to the fire. 'Inspected' means by an Inspector in the employ of the fire department responsible for inspection in the jurisdiction in which the building is located." The purpose of this variable was cited as, "Helps to determine the effectiveness of various inspection regimens and frequencies" [4]. Given the direct relationship between the purpose of this fire incident report variable and the legislation governing risk and building inspections, it is unclear why the date of last inspection was no longer included in fire incident reports post-2003. This, however, is the case. As a result, the most recent 5-year period of data that is available to examine the relationship between the date of last inspection and fire outcomes is from 1999 to 2003: this forms the basis of the analysis presented within this research note.

In order to understand how representative this data set is of all BC fire incidents that occurred between 1999 and 2003, the frequencies of reporting locations, fires, deaths, and injuries are presented in Table 1. Overall, 168 reporting locations across the province submitted reports for fires that occurred in inspectable properties over this period of time. These were organized by broad reporting area (municipal, non-municipal with fire protection, non-municipal without fire protection, and First Nations band areas) and inspectable occupancy type (residential or non-residential).

TABLE 1: FREQUENCIES OF REPORTING LOCATIONS, FIRES, DEATHS, AND INJURIES BY BROAD REPORTING AREA AND INSPECTABLE OCCUPANCY TYPE

Broad Reporting Area	Inspectable Occupancy Type	# Reporting Locations*	# Fires	% Fires	# Deaths	# Injuries
Municipal Areas	Residential	82	1,827	44.7%	17	224
	Non-residential	105	2,127	52.1%	3	99
	Municipal Areas Total	*113*	*3,954*	*96.8%*	*20*	*323*
Non-Municipal, fire protection	Residential	23	27	0.7%	1	4
	Non-residential	22	62	1.5%	0	7
	Non-Municipal, fire protection Total	*39*	*89*	*2.2%*	*1*	*11*
Non-Municipal, no fire protection	Residential	12	26	0.6%	2	1
	Non-residential	10	14	0.3%	0	0
	Non-Municipal, no fire protection Total	*15*	*40*	*1.0%*	*2*	*1*
First Nations Band - grouped	Residential	0	0	0.0%	0	0
	Non-residential	1	1	0.0%	0	0
	First Nations Band - grouped Total	*1*	*1*	*0.0%*	*0*	*0*
Total		**168**	**4,084**	**100.0%**	**23**	**335**

* Counts for inspectable occupancy types within broad reporting areas do not sum to total within each reporting area

Of a total of 4,084 fire incidents reported by 168 different reporting areas across BC, 54.0% of the fires occurred in non-residential properties, and 96.8% occurred in municipal areas. In addition, fires in municipal areas resulted in 87.0% of the deaths and 96.4% of the injuries.

Timing of Most Recent Inspection in Relation to Fire Occurrence

Before examining the relationship between the timing of the most recent inspection and reported fire incidents, it is important to explain that it is not clear with what frequency properties were inspected within this dataset. This is very important, as the frequency of inspection for all buildings will influence the patterns observed with respect to the timing of fires in relation to inspections. For example, if all properties were inspected every 12 months, then 100% of fires would occur within 12 months of the most recent inspection.

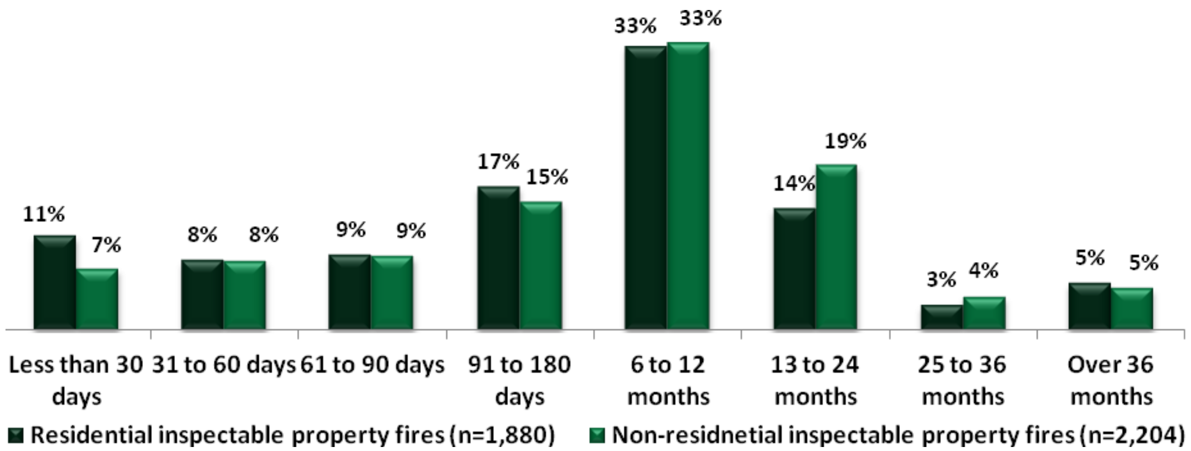
Table 2 demonstrates there is a general decline in the percentage of fires, injuries, and deaths that occurred more than one year after the most recent inspection. Overall, 74% of fires, 81% of injuries, and 74% of deaths occurred at inspectable properties occur within 1-year of their most recent inspection. Only for fires at properties that had not been inspected for over 3 years was there an increase in fires and injuries, relative to the preceding time interval since last inspection. This pattern must be interpreted with caution, however, as the 'Over 36 months' category incorporates fires at properties that had been inspected at some stage in the past, more than 36 months prior to the fire, and as such the sensitivity of this measure is unclear.

TABLE 2: FREQUENCIES OF REPORTING LOCATIONS, FIRES, DEATHS, AND INJURIES BY BROAD REPORTING AREA AND INSPECTABLE OCCUPANCY TYPE

Time since last inspection	% fires (n = 4,084)	% injuries (n = 335)	% deaths (n = 23)
Less than 6 months	41.0%	47.5%	34.8%
6 - 12 months	33.2%	33.1%	39.1%
13 - 24 months	17.2%	8.7%	21.7%
25 - 36 months	3.4%	2.1%	4.3%
Over 36 months	5.2%	8.7%	0.0%

In addition to this, there was a strong similarity between the patterns of fires with respect to time since the last inspection for residential[3] and non-residential buildings (r = 0.98, see Figure 1). Chi-squared analysis, which compared the frequencies for fires at residential and non-residential properties within each of these time periods, did indicate significant differences existed: X^2 (df = 7) = 25.85, $p < .001$. Post-hoc comparisons revealed significantly more fires less than 30 days post-inspection in residential properties (11.0% compared to 7.1%, Z = 3.59, $p < .001$, very small effect size (Phi coefficient), $\Phi = .06$), and significantly more fires in the second year (13-24 months post-inspection) in non-residential properties (19.2% compared to 14.1%, $Z = -3.56$, $p < .001$, very small effect size, $\Phi = .06$).[4] As explained above, because we do not know the relative frequency at which these different occupancy classes were being inspected, this effect may be as a consequence in the varying inspections frequency that have been developed as a consequence of occupancy type: residential properties more likely to be inspected at least annually, and non-residential properties increasingly likely to be inspected regularly, but less frequently.

FIGURE 1. LENGTH OF TIME BETWEEN LAST INSPECTION AND FIRE FOR RESIDENTIAL (N = 1,880 FIRES) AND NON-RESIDENTIAL (N = 2,204 FIRES) INSPECTABLE PROPERTIES, BC 1999-2003



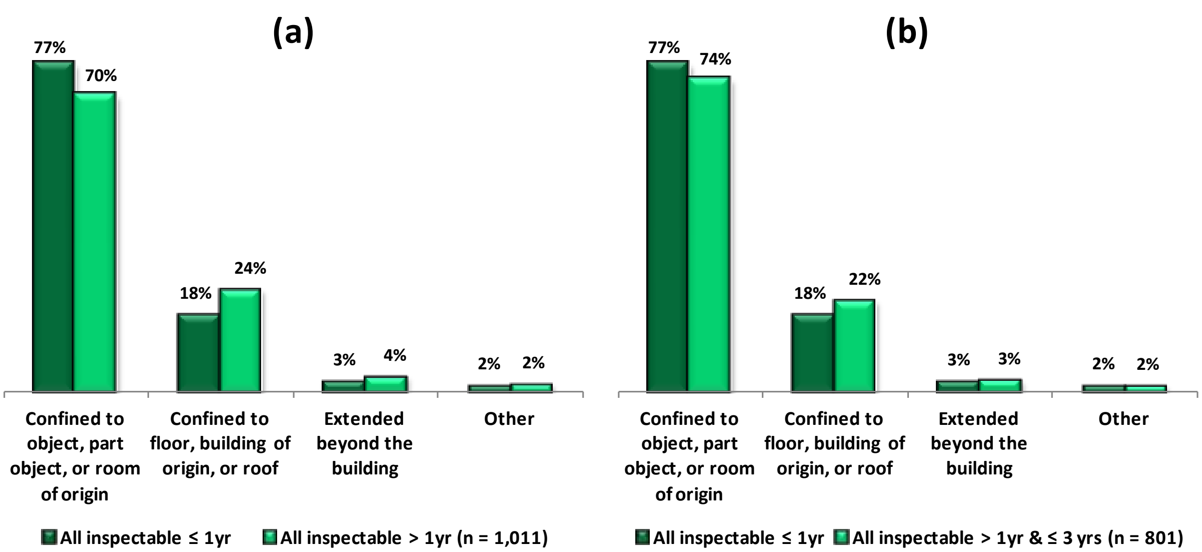
[3] Inspectable residential properties were identified by those records that were coded as residential properties (Property Classification, PR311 to PR399 for which the date of last inspection was not coded as either 'Unknown' or 'Not applicable'.

[4] The effect size measure was included here to give an indication of the size of this effect. As there is a very large sample size involved in this case, the power of this analysis is very large, resulting in highly significant, but small differences. In these cases, effect sizes add another dimension to the analysis output.

Timing of Most Recent Inspection in Relation to Extent of Fire Spread

Next, the relationship between the duration since the most recent fire safety inspection (≤ 1 year vs. > 1 year) and the extent of fire spread for residential and non-residential properties was examined. Figure 2 demonstrates this relationship in two ways: Figure 2(a) shows the total pattern across all inspectable properties, and Figure 2(b) shows the pattern for all inspectable properties where the most recent inspection was either ≤ 1 year compared to those that were > 1 year and ≤ 3 years. The reason for this distinction is explained, below.

FIGURE 2. LENGTH OF TIME BETWEEN LAST INSPECTION (≤ 1YR VS. > 1YR) AND EXTENT OF FIRE SPREAD AT INSPECTABLE PROPERTIES, BC 1999-2003, (A) INCLUDING AND (B) EXCLUDING CASES WHERE TIME SINCE LAST INSPECTION WAS GREATER THAN 3 YEARS



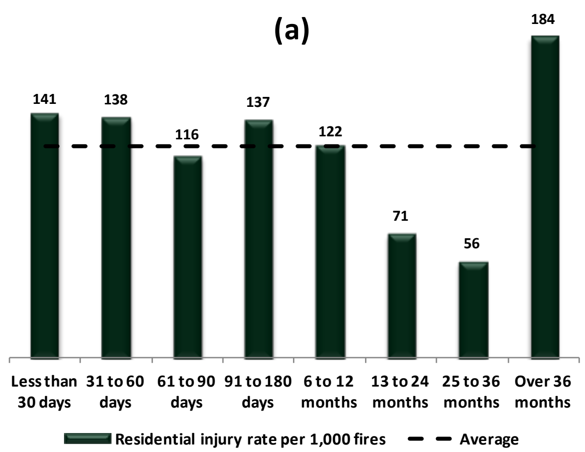
Initial examination of the pattern in Figure 2(a) produced a significant chi-square result with respect to extent of fire spread as a function of time since last inspection: X^2 (df = 3) = 18.69, p < .001, Φ = .07. The differences here indicated that there was a significant increase in the frequency at which fires extended beyond the room of origin, into the floor, building or roof for those properties that had not been inspected for over a year (24.3% compared to 18.3% for those inspected within 12 months of the fire). However, subsequent examination revealed this impact was being driven entirely by the 210 fires for which the date of last inspection was over 36 months prior to the fire. With these fires removed from the calculations (Figure 2(b)), the relative extent of fire spread for properties returned a non-significant result with subsequent chi-square analysis: X^2 (df = 3) = 4.17, p = .24 (and the percentage of fires in the > 1 year and ≤ 3 years decreased to 21.6%). What this demonstrates is that for those buildings that are being inspected on a regular basis (at least every 3 years), the timing of inspection (greater or less than every 12 months) has no significant effect on the extent of fire spread.

Timing of Most Recent Inspection in Relation to Fire-Related Casualty

Fire-Related Injuries

As demonstrated in Table 2, above, there does not appear to be an obvious link between increased risk of injury and death as the time since the last inspection increased, with the exception of an increase in the percentage of injuries that occurred over 36 months after the most recent inspection (relative to those that occurred in fires that were between 24 and 36 months after the most recent inspection). Additional analyses of these injury frequencies, as a rate per 1,000 fires, are displayed in Figure 3(a) for fires at inspectable residential properties and Figure 3(b) for fires at inspectable non-residential properties. As can be seen, the average rate of injury per 1,000 fires was significantly higher for residential properties (121.8 injuries per 1,000 fires) than for non-residential properties (48.1 injuries per 1,000 fires): $Z = 7.91$, $p < .001$. As a result, subsequent analysis of injury rates was undertaken separately for these two property classes. Across both panels of Figure 3 it is also clear that there was an increased injury rate per 1,000 fires for fires at properties that had not been inspected for at least 3 years.

FIGURE 3. RELATIVE RATES OF INJURIES PER 1,000 FIRES IN FIRES AT (A) RESIDENTIAL (N = 229 INJURIES) AND (B) NON-RESIDENTIAL (N = 106 INJURIES) INSPECTABLE PROPERTIES, BC 1999-2003



As with the analysis of the extent of fire spread, previously, the within-property type differences in injury rate were examined, comparing fires that occurred ≤ 1 year since inspection with (a) all fires over 1 year, and (b) fires that occurred > 1 year and ≤ 3 years since last inspection. The results of these comparisons are displayed in Table 3. This analysis again revealed the impact that the 210 fires (5.2%) which occurred over three years after the most recent inspection. When these fires were included (> 1 year (all) rows in the table), no significant difference was observed in the rate of injury per 1,000 fires as a function of time since last inspection. This despite the fact that the fires that occurred in more recently inspected properties did have larger rates for both residential (129.0 injuries per 1,000 fires) and non-residential (50.7 injuries per 1,000 fires) properties. However, when the cases where inspection was over 36 months prior to the fire were

TABLE 3: INJURY RATE PER 1,000 FIRES BY PROPERTY TYPE AND TIME SINCE LAST INSPECTION, INCLUDING AND EXCLUDING CASES WHERE TIME SINCE LAST INSPECTION WAS GREATER THAN 3 YRS

Property type	Time since last inspection	# fires	# injuries	Injury rate per 1,000 fires	*Z* compared to ≤ 1 yr	*p*-value
Residential	≤ 1 year	1,457	188	129.0		
	> 1 year (all)	423	41	96.9	-1.66	< .10
	> 1 year and ≤ 3 years	320	22	68.8	-2.79	< .01
Non-residential	≤ 1 year	1,616	82	50.7		
	> 1 year (all)	588	24	40.8	-0.94	< .35
	> 1 year and ≤ 3 years	481	14	29.1	-1.92	< .06

excluded, the injury rate per 1,000 fires in residential properties was actually significantly higher for the most recently inspected properties, and trending that way for non-residential properties (less than a 6% probability of observing rate differences of this size by chance alone).

Fire-Related Deaths

In all there were 23 fire-related deaths in the sample of fires between 1999 and 2003. The death rate in residential properties (10.6 per 1,000 fires) was significantly greater than the rate at non-residential properties (1.4 per 1,000 fires): $Z = 3.32$, $p < .001$). As can be seen from Table 4, when examining death rates by property types, there was no significant increase in the death rate for residential properties as a function of time, regardless of whether the fires that occurred over 3 years post- the most recent inspection were included. There were also no deaths in non-residential properties when the date since the last inspection exceeded 1 year. Overall, date since last inspection was non-predictive of death.

TABLE 4: INJURY RATE PER 1,000 FIRES BY PROPERTY TYPE AND TIME SINCE LAST INSPECTION, INCLUDING AND EXCLUDING CASES WHERE TIME SINCE LAST INSPECTION WAS GREATER THAN 3 YRS

Property type	Time since last inspection	# fires	# deaths	Death rate per 1,000 fires	*Z* compared to ≤ 1 yr	*p*-value
Residential	≤ 1 year	1,457	14	9.6		
	> 1 year (all)	423	6	14.2	0.80	< .43
	> 1 year and ≤ 3 years	320	6	18.8	1.37	< .18
Non-residential	≤ 1 year	1,616	3	1.9		
	> 1 year (all)	588	0	0.0	undefined*	
	> 1 year and ≤ 3 years	481	0	0.0	undefined*	

General Summary of Findings

Overall, therefore, this analysis demonstrated no relationship between increased duration since last inspection and the frequency, extent of fire spread, or fire-related casualties that is supportive of maintaining the current time-driven approach to conducting building inspections. Based on the whole of BC dataset, these findings directly concur with previous analysis undertaken in this area by McCormick [5], which focused on a smaller sub-set of data from Surrey, BC.

The findings from fires that occurred more than 36 months after the most recent inspection do not detract from these main conclusions. Although there is indication that these incidents experienced increased fire spread and fire-related injury, there are two main points to remember with respect to the purpose of this paper. First, it is important to restate that the sensitivity of this measure is unclear as this category has the potential to incorporate fires that occurred any time beyond the 36 month cut-off. Second, a delay of over 3 years does not constitute 'regular' system of inspection, as required under the BC Fire Services Act. Furthermore, it may be the case that such infrequent inspection history is indicative of a lax attitude towards inspections by the responsible organization in each case. There is definitely an argument for additional examination of this group in isolation, but these findings do not support the cause of continuing the inspection routine as it is currently executed.

If Not Just Regular, Then What?: Possible Additions and Alternatives

If time-alone is not the optimal method for determining inspection frequency, then it is important to consider what other factors may influence fire risk. If the move was to be made away from a solely 'regular' inspections process, then it would need to be clear where the move is being made to, and why. One potential alternative direction for inspections, that would acknowledge a broader set of risk factors, in addition to time, could align closely with the 1992 *Interpretive Guide* [3] to inspections. In addition to requiring 'regular' inspection, this guide listed a range of *Other Considerations* that should be included in the determination of inspections frequency; including occupancy type, age, condition, maintenance, and degree of cooperation on behalf of the building's responsible person.

As will be explained in the following paragraph, this type of approach would utilize a risk-assessment distinction that has been incorporated into areas such as forensic mental health, child protection, and offender recidivism management: the distinction between static and dynamic indicators of risk. In these contexts, static risk factors are those factors that have been demonstrated to relate risk potential. Translating this to a fire context, these risk factors would by the essentially non-changeable aspects of the property that influence fire likelihood, such as construction material, zoning density, geographic location in the city, etc. In contrast, dynamic risk factors are those factors that have a demonstrated association with risk, but are amenable to alteration. Within a fire context, these would refer to the types of risk factors that can alter over time and can be influenced by inspection and improved safety practices (the Three 'E's) [6]. Examples of this could include the level of diligence demonstrated by the responsible person (possibly captured in proxy by the prior compliance history at the property), recent compliance history, building use, etc.

With respect to the principles proposed in the *Interpretive Guide,* age is an example of a static risk factor, with the general assumption that risk for fire increases with building age. This issue is presented as even more prominent when the building was build pre-1975, given they will have fewer built-in safety features. Alternatively, the degree to which the person responsible for the building is committed to maintenance, safety, and compliance with the Fire Code, are all examples of dynamic risk factors. Depending on whom the responsible person is, these factors will vary over time. The *Interpretive Guide* even discusses relying on these dynamic factors by treating non-compliant building owner/managers as increased risks, suggesting, "it may be necessary to increase the frequency of inspection or visitations to that building" under those circumstances. This guide also suggests the possibility of reducing the frequency of inspection for properties that are always in compliance. Although these ideas are definitely sound, there is no current methodology or infrastructure in place that enables departments to achieve this goal. Meaningful variations in the risks posed by any structure are going to be identified by considering static and dynamic risk factors in parallel. All of these risk factors then need to be monitored in an ongoing, consistent manner, and the outcome of this assessment should drive the frequency of building inspections.

References

1. National Research Council Canada, *National Fire Code of Canada, 2010*, 2010, National Research Council of Canada. p. 343.
2. Ministry of Public Safety and Solicitor General, *2006 BC Fire Code*, 2006, Office of the Fire Commissioner, Ministry of Public Safety and Solicitor General, British Columbia.
3. Office of the Fire Commissioner, *Interpretive guide: criteria for determining frequency of inspections, Subject Fire Services Act - Sections 26(1) & 38(3)*, 1992, Ministry of Municipal Affairs, Recreation and Housing, Province of British Columbia.
4. Office of the Fire Commissioner, *Fire Reporting Manual*, 1993, Ministry of Municipal Affairs, Recreation and Housing, Province of British Columbia: Victoria, BC.
5. McCormick, A.V., *Residential Inspections and Fire Outcomes*, 2011, University of the Fraser Valley: Abbotsford. p. 5.
6. Baker, S.P., *Injury Control*, in *Preventive Medicine and Public Health*, R. M.J., K.F. Maxcy, and P.E. Sartwell, Editors. 1973, Appleton-Century-Crofts: New York.

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