A Review of the Research Literature on 24-Hour Shifts for Firefighters

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Introduction

On January 24, 2012, more than 100 firefighters in Washington, DC walked out of their Fire Chief's "State of the Department" address over the Chief's desire to move his department away from the traditional 24-hour on, 72-hour off shift schedule to a 12-hour shift model (D.C. Firefighters Protest Chief's Proposed Shift Change, January 25, 2012). The main arguments raised by the Chief were that moving to a 12-hour shift would save 36 million dollars annually and would reduce the number of mistakes made by firefighters, which increases during the second half of a 24-hour shift. Those opposed to the Chief's proposal argued that moving away from the 24-hour shift schedule would significantly reduce morale, reduce the efficiency of the department, force some members to quit, create a de facto residency requirement, and ultimately reduce public safety (D.C. Firefighters Protest Chief's Proposed Shift Change, January 25, 2012).

In many jurisdictions in the United States, the 24-hour shift schedule is the standard model (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2006). Originally, this schedule was implemented to address the needs of a 56-hour work week with a three platoon system. The notion was that the 24-hour shift schedule was the most efficient way to manage both the mandatory hours that firefighters needed to work and the call volume. While the 24-hour shift schedule is common in the United States, very few jurisdictions in Canada have adopted it. For example, in 2011, there were only 13 fire departments in Ontario that used 24-hour shift schedules (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2011). However, there is an increased call for fire department and emergency services to consider adopting the 24-hour shift schedule.

Before fundamentally changing how fire departments in Canada function, one would expect a rigorous analysis of all the issues associated with changing from a 10, 12, or 14-hour shift schedule to a 24-hour shift cycle. However, there are very few studies that have analysed the direct effects of 24-hour shifts on firefighters and fire departments from the United States, and there are no objective analyses on this issue in Canada (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2006). Instead, both sides of the argument commonly point to the literature on the effects of extended shifts from other kinds of 'similar' employment, such as medical interns, truck drivers, and aircraft pilots, and apply the findings to firefighters and emergency services.

In addition, there are a number of common arguments raised by those in favour and those opposed to 24-hour shifts for firefighters. For example, some assessments of fire departments in the United States that have moved from 24-hour shifts to 48-hours on and 96-hours off have indicated that the change has resulted in a decrease in sick leave and has not resulted in an increase in injuries or public satisfaction (Elliot and Kuehl, 2007). Others have argued that extended shift hours puts increased strain on family life, increases sleep deprivation to dangerous levels, increases the number of on-the-job injuries, and impairs the cognitive abilities of firefighters during the physically and mentally demanding tasks associated with responding to a call for service, especially for those who have been on duty for 16 hours or more (Elliot and Kuehl, 2007). Given the conflicting opinions expressed in the literature, this paper will outline these arguments and highlight the research in support or against the arguments used by those in favour or opposed to 24-hour shifts for firefighters. The purpose of this paper is not to recommend one shift schedule over another, but to provide an objective analysis of the evidence in support or against the more common arguments used to support one shift schedule over another.

The Development of Fire Services Shift Schedules

As with the police, originally, in Canada and the United States, volunteers staffed fire services. However, as the requirements of the profession became more sophisticated and the volume of calls increased, it became necessary to employ qualified, full-time, well-trained firefighters. According to the Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association (2011), in Canada, the adoption of the 10 to 14-hour shift schedule occurred without any scientific consideration of the effects of this schedule structure on the health and safety of firefights. Instead, this structure was adopted because it made it easier for the administration of the service and aligned firefighting work schedules with many other professions that worked 10 to 14 hour shifts. This scheduling model has continued to the present day where most fire departments in Canada with full-time paid firefighters use some variation of the 10 to 14-hour shift structure (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2011).

Conversely, in the United States, tradition worked to establish a 24-hour work schedule. Originating the South, Midwest, and the West, which were the first areas to establish full-time paid firefighters, the tradition was for firefighters to work six or seven days in a row (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2011). Over time, work schedules were reduced from 86 hours per week to the more common standard of 42 hours per week. However, while the average number of hours worked per week continued to decline over time, most jurisdictions in the United States maintained the 24-hours on, 24-hours off structure. This has resulted in approximately two-thirds of American fire departments with full-time firefights using some variation of a 24-hour work schedule. Given the wide variation in 24-hour shift schedules in the United States, and that more than one-quarter of American fire departments (28.7 per cent) use some form of a 10 to 14-hour shift schedule, it is very difficult to directly compare the efficacies, benefits, and risks of one type of shift schedule over another. Given this, as mentioned above, this report will focus on the arguments made and the empirical evidence in support of the claims made by proponents of these various shift types.

In reviewing the limited research literature, the arguments in favour or opposed to the 24-hour shift schedule for firefighters and emergency services can be grouped into two main themes; health and safety concerns, and operational concerns.

Health and Safety

Inherent in working for the fire service or emergency services is the requirement to work a shift schedule that includes nights. The challenge for administrators is to provide the necessary level of service to the community while recognizing that night work has consistently been recognized as a serious risk factor for workers' health as it interferes with our basic biological functions, social relations, and psychological/mental health (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2011; Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2006). While there is little agreement on the specific nature or severity of shift work on health, there is general agreement that shift work contributes to sleep disorders, gastrointestinal disorders, workplace injuries, psychological distress, cancer, cardiovascular disease, and pregnancy complications (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2011).

In order to better understand how shift work can contribute to physical and psychological problems, it is necessary to have a basic understanding of circadian rhythms. Humans are not nocturnal, but have evolved to be diurnal, or awake during daylight hours and asleep at night. In effect, humans have evolved to be active for approximately 16 hours and to sleep for 8 hours per day. Shift work interferes with this natural cycle and can lead or contribute to the myriad of health problems. Research has indicated that brain and body functions decline at nighttime and in the early morning hours, with sleepiness, fatigue, and performance problems peaking between 3am and 6am. Moreover, sleep in the day following a night shift is typically shorter, of poorer quality, and not as refreshing as sleep during normal night time hours. In other words, it is not only about how many hours one sleeps, but when one sleeps that contributes to being fully awake, refreshed, and able to perform at peak levels (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2011). As expected, fixed shifts, even if they are at night, have the least amount of interference to one's circadian rhythm, as long as employees maintain the same sleep/awake patterns during their days off (Elliot and Kuehl, 2007). This is because it takes 21 consecutive days for the circadian rhythm to fully adjust to night shifts. However, if an employee is constantly alternating between day and night shifts, one's circadian rhythm cannot adjust, which can lead to chronic sleep deprivation and fatigue.

In order to counteract the effects that shift work can have on the circadian rhythm, several researchers have suggested taking short naps (approximately 20 minutes) as they can help restore mental abilities, while two-hour naps can be extremely restorative and can assist in minimizing the problems associated with interfering with the circadian rhythm. However, as will be discussed below, it is not always possible to guarantee that those working extended work hours will find an opportunity to get longer periods of uninterrupted sleep while on shift, especially in jurisdictions with higher call volumes (Elliot and Kuehl, 2007). Other ways to avoid a change in circadian rhythms may be to reduce the number of consecutive night shifts to maintain as much as possible a day-oriented life cycle. For example, the Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association (2011) reported that one European shift pattern for air traffic controllers used 8-hour shifts broken up into 2 mornings, 2 late afternoons, 2 nights, and then 4 days off. The importance of maintaining the circadian rhythm is that it has a direct effect on one's sleep and general health.

Perhaps the most discussed issues associated with 12 or 24-hour shifts are the issues of sleep and fatigue. Lack of sleep and fatigue contribute to making routine tasks more difficult and dangerous Lockley et al., 2004; Landrigan et al., 2004; Barger et al., 2005; Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2006; Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2011; Elliot and Kuehl, 2007). According to the research literature, the range of normal sleep is between 6 to 10 hours per day (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2011). Importantly, while some people can function with less sleep, it is generally accepted that 4 to 5 hours of uninterrupted sleep is necessary for physical and mental health, and to maintain minimum performance levels. Current thinking about sleep indicates that sleep progresses through four distinct phases and that it takes approximately 90 to 110 minutes for the average person to move through all four phases. Again, it is estimated that during a "good night's sleep", the average person will move through all four stages of sleep 4 to 5 times (see Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2011:15 – 16 for a description of the various phases of sleep).

Given this, sleep problems commonly occur when these cycles are disturbed or if one does not sleep long enough to move through all of the phases of sleep. Moreover, there are different outcomes based on which sleep phase the person was in when they were awoken. For example, if someone is awoken while in one of the first two phases of sleep (typically within the first 20 to 45 minutes of sleep), the person is more likely to feel alert and refreshed; however, if the person was awoken from a deeper sleep, they are more likely to feel sluggish or confused for a period of time following sleep. This is of particular concern for professions, such as firefighters or first responders, as it might take up to 30 minutes for the brain to become alert, and up to 2 to 4 hours to reach peak efficiency, if one is awoken from a deep sleep (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2011). However, when on duty, firefighters do not typically have a lot of time between when they are awoken and when they must perform challenging physical or mental tasks with potentially life threatening or lifesaving consequences.

Not getting enough sleep results in sleep deprivation. Sleep deprivation can manifest itself in many ways, including making physical and mental mistakes, exercising poor judgment, trouble remembering things, an inability to focus or concentrate, and a reduction in response time. For firefighters, one of the leading causes of not getting enough sleep or experiencing sleep deprivation is working extended hours. All of the research reviewed for this report concluded that working longer hours (typically more than 16 consecutive hours without sleep) increases the risk for cognitive and physical performance declines. According to Elliot and Kuehl (2007), based on a review of other research, 19 hours without sleep has the same performance effect as having a blood alcohol level of 0.05%; after 24 hours without sleep, the performance effect is equivalent to having a blood alcohol level of 0.1%. In part, as a result of this research, the government created regulations limiting the number of consecutive hours that truck drivers can operate a motor vehicle.

Equally troubling, the loss of sleep has a cumulative effect known as a sleep debt. According to Elliot and Kuehl (2007), losing one hour of sleep per night for seven consecutive nights has the equivalent effect of staying up for 24 consecutive hours once a week. The conclusion reached was that the more hours an individual was awake, the greater the sleep debt, and the longer the person needed to sleep uninterrupted to recover. The estimate was that a person who worked a 24-hour shift with no sleep would require two days of regular sleep to adequately recover. Troubling, even if a person was able to sleep during their 24-hour shift, if this sleep was interrupted, the effect on the sleep debt was the same as if the person did not sleep at all over their shift. While firefighters who are on duty at night are allowed to sleep, sleep is not guaranteed as calls for service may interrupt sleep, and chronic sleep loss results in "an decreased ability to think clearly, handle complex mental tasks, for new memories, and solve problems" (Elliot and Kuehl, 2007: 7). Given this, as an argument in favour of the current shift schedule used by most fire departments in Canada, the Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association (2011) indicated that a 14-hour shift removed the need for firefighters to count on the availability of sleep while on shift to remain effective, and provided an opportunity for an uninterrupted sleep in the subsequent 10 hours that the firefighter was off duty. The argument was that the 10 to 14-hour shift schedule provided the best opportunity for firefighters to be alert and able to perform their duties effectively, while minimizing the sleep debt.

While the amount of fatigue that one feels is the result of the combination of the circadian rhythm in sleep, sleep deprivation, the sleep debt, and when one is awoken from a sleep, there are, for firefighters, several extremely dangerous consequences of fatigue, both physical and mental. As outlined by the

Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, the most common effects of fatigue are: "a lack of concentration; poor judgment; reduced vigilance; slower reaction times; reduced capacity for effective interpersonal communication; reduced hand-eye coordination; reduced visual perception; impaired recollection of timing and events; and irritability" (2011: 21). All of these effects can have serious negative consequences for firefighters and the public they serve. The view of the Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association (2011) is that, as society continued to move to a 24-hour day in which serves are provided at all hours of the day and night, the volume of calls for service during the night and early morning hours will increase, thus decreasing opportunities for firefighters to sleep while working long shifts. Continuing with this logic, the Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association believes that it will become increasing necessary for firefighters to get their sleep before and after their shifts as opportunities to sleep during a shift will decrease. If this hypothesis is true, as mentioned above, the Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association argues that the best scheduling structure to guarantee sleep is the 10 to 14 hour shift. Although it is true that under a 24-hour shift model firefighters come on duty after a normal night's sleep, the belief of the Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association is that, given circadian rhythms, the performance of these firefighters will begin to lag after 16 hours and the effects will persist for the remaining 8 hours of their shift. If the call volume is such that they cannot sleep after they have been on shift for 16 hours, their performance and abilities will begin to be negatively affected in ways that puts them and the public at an increased risk, and will create a sleep debt in these firefighters that will take several days to recover from, which they may not have (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2011).

Even if one concedes that, for the most part, most fire departments' call volume is such that there typically are opportunities for firefighters to sleep during an extended shift, those opposed to the 24-hour shift schedule argue that allowing for naps during an extended shift is not necessarily the solution to the fatigue problem. Here, researchers point to sleep inertia or the time it takes for the brain to becoming fully awake and functioning after sleep. As mentioned above, the amount of time it takes to become fully awake is dependent, in part, on which phase of sleep the individual was in when they woke. Still, regardless of sleep phase, it is not recommended that one make an important decision soon after waking up (Curran, 2006). However, firefighters and first responders may be required to make a series of important, life-determining decisions while still feeling the effects of sleep inertia. Moreover, because fire crews tend to sleep at the same time, it is possible that an entire fire station may be suffering from sleep deprivation and sleep inertia at the same time when responding to a call for service.

Because of the paucity of methodologically sound studies on the effects of extended work hours with firefighters, researchers have used studies focusing on other professions, in particular the medical profession, working from an assumption that since approximately half of all firefighter calls for service are medically-related, their medically-related performance might be similar to doctors and interns who work extended hours. Rather than summarizing all of the medical research, the general findings from a meta-analysis of the research on working 24-hour shifts was that doctors made substantially more serious medical errors, medication errors, diagnostic errors, and attention lapses during 24-hour shifts when compared to those working 16-hour shifts (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2006; Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2011). Similarly, interns working 24-hour shifts made substantially more medical

errors than when they worked shorter shifts (Landrigan et al., 2004), eliminating extended work shifts significantly increased sleep and decreased attentional failures during night work (Lockley et al., 2004), and Barger et al. (2005) concluded that extended work shifts posed safety hazards for interns, including motor vehicle crashes after shifts, near-miss incidents, and incidents involving involuntary sleeping. Elliot and Kuehl concluded that "firefighters were at risk for the decrements in mental and physical performance that have been well documented among others working long hours and during the night" (2007: 57); however, they also stated that the use of non-validated research instruments and suboptimal research designs in the overwhelming majority of these types of studies have led many researchers to generally conclude that the research findings in this area remain inconclusive.

Another outcome of fatigue is the risk injuries and accidents. There is a large body of research pointing to the correlation between an increase in injuries and accidents and the number of consecutive hours worked and working night shifts (National Institute for Occupational Safety and Health, 2004 cited in Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association). In effect, the research indicates that after 8 hours of work, the risk for personal injury substantially increases, and, for firefighters in the United States, rates of injuries more than double between midnight and 6am when compared to mid-afternoon (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2011). While there were a number of factors that contributed to the increased risk and rate of injury for those working night shift or extended shifts, the research consistently indicated that fatigue was a factor.

In addition to measurable performance indicators, fatigue, sleep deprivation, or sleep debt can also have a range of other negative physical and mental effects. For example, according to Saunders (2010), fatigue from shift work can contribute to higher levels of burnout, emotional exhaustion, job stress, headaches, and upset stomachs. According to the Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association's 2011 report on health and safety related to 24-hour shifts, there is a number of very serious health problems associated to working rotating shifts or night shifts. These health problems include gastrointestinal disorders, an increased risk for diabetes, cancer, including breast and prostate cancer, and cardiovascular disease. While the Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association (2011) cited a number of studies to support their claims, it should be noted that, for the most part, the evidence was either inconclusive (diabetes, cancer), dated (the research on breast cancer was from 1999), lacked generalizability (the research supporting prostate cancer was conducted exclusively on Japanese men), or speculative (gastrointestinal disorders). It would appear that the strongest evidence was related to the association between a higher risk for pregnancy complications and cardiovascular disease and working night or extended shifts (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2011). It must be pointed out that even here, Elliot and Kuehl (2007) contended that because of confounding variables drawing firm conclusions remained difficult. For example, it is difficult to know if the increased rate of heart attacks among firefighters was the result of working extended hours or night shifts or some combination of "intense physical exertion involving extreme heat and life-threatening situations" (Elliot and Kuehl, 2007: 45). The issue of shift work and heart attacks is extremely important because heart attacks remain the most common killer of firefights in the United States and was also identified as significant in Ontario's Presumptive Legislation for firefighters (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2011).

In sum, even with the general limitations identified within the literature, the health and safety research suggests that chronic sleep deprivation is related to a number of health risks, including heart attacks, that the physical and mental performance of firefighters likely suffers in much the same way as those employed in other jobs that typically involve night shifts or extended shift hours, and fatigue may contribute to a greater risk of injury among firefighters and may also contribute to an increased risk for motor vehicle crashes when driving following an extended shift (Elliot and Kuehl, 2007). In effect, it would appear that there is general agreement among researchers that sleep deprivation and fatigue can contribute to a range of health and safety problems for firefighters and their fire department. The challenge remains to determine whether the 24-hour shift contributes significantly more to sleep deprivation and fatigue than the schedules currently used by Canadian fire departments.

Again, while the research from other professions seems to support a degree of risk associated with night and extended shifts, there is little agreement among those within the firefighter community. For example, when the Kitchener Fire Department considered moving to a 24-hour shift schedule, a number of fire chiefs argued that the change would lead to an increase in firefighter mistakes and sleep deprivation. To this point, Kingston Fire Chief Harold Turk stated that, unless departments scheduled sleep periods during the shift, the 24-hour shift could be dangerous. In contrast, the union stated that working two 24-hour shifts per week maintained a firefighter's circadian rhythm and left them better rested than the 10 to 14 hour shift model (The Record, 2010). Clearly, more empirical research on the health and safety benefits and risks is required before the merits of one shift model over another is fully understood and endorsed.

Operational Issues

There are a number of reported operational benefits associated with a 24-hour or longer shift schedule. While Frazier (1999, cited in Gregg, 2009) concluded from his study of the Hutchinson, Kansas City Fire Department that the 24-hour shift schedule was the safest, most efficient, and most popular model, Gregg (2009) argued that this model would make it easier for administrators to more regularly meet with staff, scheduling would be simplified, morale would increase, the quality of services would be improved, and the amount of overtime could be reduced. Gregg (2009) contended that the most important benefit would be that the current level of service and the number of on-duty firefighters could be maintained with fewer people, thus saving the fire department money.

The most important function of a fire department is its ability to adequately respond to calls for service. While the volume of calls varies between jurisdictions and between day and night shifts, the Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association (2006) raised the concern that 24-hour shifts might lead to call response challenges not experienced when employing the more traditional 10 to 14-hour shift schedule. One concern was that firefighters in high call departments would not get sufficient rest while working a 24-hour shift (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2006). While, theoretically, there may be merit to this concern, there may also be practical solutions to this challenge for some departments. For example, the Toronto Fire Service provided all firefighters two hours of sleep during their shift. When the station was asleep, another station covered their calls (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2006). While this may not be possible for all fire departments, and it was

unclear the effect that this solution had on response times, it is possible that fire stations can find creative ways to ensure that firefighters can sleep during a shift without jeopardizing public safety.

Another concern was that there would not be sufficient time between 24-hour shifts for firefighters to adequately recover from their shift, and that there may be fewer firefighters available for call-in emergencies. Major incidents require a large number of firefighters for an extended period of time. Commonly, major incidents require workers to be relieved and rotated. However, 24-hour shifts may reduce the number of people available for callbacks as a result of policies requiring 48 hours off following a 24-hour shift, which can result in some firefighters working for longer than 24 consecutive hours (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2006; Vancouver Fire and Rescue Services). The challenge of having sufficient numbers of firefighters available for callbacks is also a concern given the trend of firefighters to not live in the jurisdiction in which they work when their department uses a 24-hour shift schedule(Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2006; The Record, 2010).

Training is another concern raised by those opposed to 24-hour shift schedules. In the Ontario experience, it would appear that many of the fire services reported challenges ensuring that all members received the necessary training, with the exception of Toronto (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2006). Toronto claimed to have avoided this problem by developing a "daily work schedule for every day of the year" (Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association, 2006: 17). It is unclear from the report how difficult or practical this approach would be for all departments considering a 24-hour shift schedule.

In British Columbia, the concerns associated to training and the 24-hour shift schedule were that many existing training programs are designed for a two or four day duration, and changing the program structure to accommodate the 24-hour shift schedule might require training models not supported by the research on how adult learners best learn (Vancouver Fire and Rescue Services). For example, as a result of days off, it might be necessary to break training session up over a much longer period of time. Learning with large time gaps between sessions is not optimum for best results. Vancouver Fire and Rescue Services were also concerned that the 24-hour shift model would likely eliminate the ability of firefighters to attend external training or education for personal or career development. Overall, there appears to be very little empirical research on the challenges of maintaining adequate training schedules with a 24-hour shift model. Many of the concerns reviewed for this report were theoretical, anecdotal, or based on the assumption that a 24-hour shift model would only increase current difficulties and challenges in ensuring that all firefighters receive the training required. While there may be merit in the concerns raised by fire service leaders in British Columbia, empirical research or theoretical model testing should be undertaken before a final decision in taken on the effect of a 24-hour shift schedule on training.

As a result of changing to a 24-hour shift schedule, the number of hours worked per week by firefighters was not changed in Ontario. This has led some in British Columbia to suggest that overtime would increase as a result of moving to this shift model. According to the Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association (2006) and the Fire Chief (The Record, 2010), Kingston reported a substantial increase in overtime expenditures. Vancouver Fire and Rescue Services are also concerned that a change to a 24-hour shift schedule would result in greater overtime. Kitchener, Ontario committed to a three-year test of the 24-hour shift model. They reported that, in the first year of using 24-hour shifts, overtime costs increased significantly. In fact, for about 40% of shifts, at least one firefighter had to be called in on overtime (The Record, 2012).

It is also important to consider more than just the financial costs associated with overtime. One of the concerns with overtime in the 24-hour shift schedule is the increased risk for health and safety problems with working overtime or having firefighters who have not had enough rest to fully recover from a previous shift coming back to the station to work overtime. Although there is very little empirical research on this issue, it would appear that overtime costs, at the very least, are not reduced with a change to 24-hour shifts. More likely, a fire service could expect overtime costs to increase. It is possible, however, that these costs can be offset by advantages associated with the 24-hour shifts, such as a reduction in absenteeism or sick days.

It would appear that there is no clear consensus in the literature on the effects of the 24-hour shift schedule on absenteeism. The Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association (2006) reported that a change to a 24-hour shift schedule may result in an increase in absenteeism as it would allow firefighters to string a significant period of time off by being absent for just one or two consecutive shifts. Recently, Kitchener reported that in the first year of their change to a 24-hour shift schedule, they did not experience the anticipated reduction in absenteeism (The Record, 2012). However, the President of the Kitchener Firefighters Association pointed to other jurisdictions, such as Barrie, as an example of a fire service that did see the shift change result in a reduction in both overtime and absenteeism (The Record, 2010). The same article did point out that Kingston, like Kitchener, did not see a reduction in absenteeism. It would appear that these jurisdictions also saw an increase in sick days with the change to 24-hour shifts. In one situation, the fire chief of Kingston had to threaten removing the 24-hour shift schedule to curb absenteeism. He reported that too many firefighters were still taking their allotted 18 sick days per year, and then being absent for many shifts, which resulted in a substantial increase in overtime costs (The Record, 2010).

While the Canadian experience with 24-hour shift schedules is rather limited, there may be lessons learned from the American experience that can assist with some of the operational concerns raised by fire service leaders. However, the research literature on 24-hour shifts does not provide much guidance for how to best deal with the issues of overtime, absenteeism, staffing levels, and training. It would appear from the limited Canadian information that changes to the 24-hour shift schedule may present training, education, and staffing challenges, continued absenteeism and overtime, and little to no cost saving. As with the section on health and safety, much more rigorous analysis of the pilot sites in Ontario and British Columbia must be undertaken before leaders commit to a change to the 24-hour shift model.

Conclusion

As stated by the Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association (2011), fire departments employing the 24-hour shift schedule have found it difficult to manage fatigue when there are high call volumes, an insufficient number of firefighters to manage rotating crews during a long incident, or when there is an insufficient number of firefighters on duty to guarantee that some members can sleep while on duty. This results in sleep debt and fatigue that affects a firefighter's overall level of performance. This can have a number of negative physical, mental, and performance outcomes, including a greater risk for certain physical and mental problems, on the job injuries, public safety concerns, and family challenges. While those working longer shifts can be encouraged to sleep while on duty, regular sleep cannot always be guaranteed. Given this, the Ontario Association of Fire Chiefs and Ontario Municipal Human Resources Association (2011) recommended that more research be undertaken

before departments implement the change from their current shift schedules to a 24-hour shift schedule. In particular, they recommend further research on the degree to which 24-hour shifts increase the risk to the health and safety of firefighters and the public, what can be done to reduce their potential concerns, and the possibility of other shift models to deal with anticipated operational challenges.

It should be noted that research from the United States with fire departments using the 24-hour shift schedule indicated that there were very few complaints from firefighters, the unions that represented them, or family members about working extended shifts (Elliot and Kuehl, 2007). In fact, as the anecdote at the beginning of this report suggested, many American firefighters are quite resistance to any change away from the 24-hour schedule. Still, research with EMS responders who switched from the 24-hour shift schedule to 12-hour shifts using a rotation of 3 days of 12 hours, 2 days off, 2 days of 12 hours, followed by 3 days off perceived that "they were more productive and felt better, with less family and social disruption from their work" (Elliot and Kuehl, 2007: 55).

The 24-hour shift system may provide firefighters with an opportunity to spend more consecutive time with family, hold part-time jobs, commute to work less, and live further away from their fire stations. The 24-hour shift schedule may also provide firefighters with more time to physically and mentally recover from shifts, and work or non-work related illnesses. However, this needs to be balanced with a concern for public safety, the short and long term effects of this scheduling model on the health and safety of firefighters, and the financial costs to jurisdictions. In Canada, there are not a lot of jurisdictions with extensive experience with this shift model, and there is a general paucity of research on the effects of this shift model with firefighters from the United States. Given this, much more evidence with Canadian firefighters is necessary to determine whether the 24-hour shift model is positive or detrimental to fire services and the public they serve. As a result, given the current state of Canadian fire services' knowledge and experience, it is difficult to endorse or support a change from the contemporary practice in British Columbia to a 24-hour shift model for firefighters.

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