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Towards holonomic emergency management networks: A nonparametric systems approach

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Abstract

In this 21st century of diverse regional, national and international threats, this study explores the leadership challenges unique to emergency management systems. These adaptive and complex systems respond to a range of critical emergency events, including mass emergencies, disasters and catastrophes. Effective emergency leadership with high-order capabilities is the lodestar of emergency management systems. This qualitative study explores the phenomenology of emergency leadership of emergency management systems through a holonic paradigm. The methodology deploys a grounded theory approach and thematic analysis. Through this key informant study, the perspectives of 103 emergency leaders of diverse professional backgrounds on systemic challenges are presented. The response rate was 83.5 percent from 81 organizations across Canada. Using the nonparametric statistical technique, the Kendall coefficient of concordance, what emerges from this study are ten ranked-ordered holonic properties of emergency leadership. These properties form the basis of a holonic paradigm that integrates and underscores the vital role of innovative technologies within the context of emergency management systems. A theory of holonic emergency leadership is also proposed. This study concludes with the potential implications of emergency leadership and this holonic framework for future healthcare research internationally.

1.0 Introduction

This is qualitative study explores the results and implications of a key informant study of transformational leadership challenges in emergency management systems in Canada. It uses a grounded theory methodological approach to identify the properties of emergency leadership from a holonic perspective. Thematic analysis of the study responses on emergency leadership were subject to the deployment of a nonparametric statistical technique- the Kendall coefficient of concordance. A rank order of ten holonic properties of emergency leadership emerged. These leadership properties point to an evolving bifurcation and emergence of two new leadership holons: one rooted in humanistic properties; the other in techno-support properties. Both promise to influence the future evolution of emergency management systems. A theory of holonic emergency leadership is posited as an outcome of the grounded theory approach. The research and theoretical implications for emergency leadership are suggested, as are potential implications for diverse healthcare systems internationally.

1.1 Emergency management as complex adaptive systems

Emergency management systems are complex adaptive systems that respond to external emergency events. [1-4] These events include mass emergencies, disasters and catastrophes and may be biochemical [5]; meteorological [6]; sociogenic [7-8]; technological [9]; or topological [10] in nature. The systemic mission is to lower mortality and morbidity rates, safeguard community integrity and deliver emergency services efficiently and effectively. Emergency management systems have both horizontal and vertical dimensions. The horizontal dimension is a continuum of care that includes: prehospital care, transportation, emergency unit care, critical care units, specialized tertiary care services, recovery and rehabilitation, and aftercare services. The vertical dimension includes emergency organizations, care institutions, municipal and regional authorities, national governments and international organizations. In normative times, emergency management systems tend to function as independent and loosely linked silos that focus primarily on internal care processes. In mass emergencies, disasters and catastrophes, closer horizontal and vertical systemic integration becomes compelling and essential.

1.2 Transformational emergency leadership

Emergency leadership is essential in managing the dynamics of care providers, resources, patients and technologies along the horizontal and vertical continuum in emergency management systems. The extant literature points to a range of theoretical leadership paradigms, such as: adaptive models [11], authentic models [12], integral models [13] and transformational models. [14-15] Effective transformational emergency leadership is crucial in all horizontal and vertical facets of emergency management systems. [16-17] As Rauner et al. (2013) pointed out effective emergency systems require the deployment of appropriate resources and supplies to support ongoing emergency operations. [18] Rodriquez and Sanchez (2015) stressed that emergency leaders must engage multi-disciplinary professionals across the socio-political spectrum and build cogent coalitions and relationships among diverse groups. [19] In effect, as Urby and McEntire (2015) [20] have underscored, leaders are transformational change agents that militate for systemic improvements throughout emergency management systems. The extant literature has given special attention to the importance of contextual aspects of emergency leadership [21-23] in promoting organizational resilience. [24-26] The literature also reports on the importance of continuous learning and the need for international emergency leadership education and training. [27-28] However, as Caro (2015) [29] noted qualitative research studies on emergency leadership have been sparse internationally. Moreover, there appears to be no literature that reports on transformational emergency leadership from a uniquely holonic perspective.

1.3 Holonic paradigms in emergency management systems

This study proposes a holonic perspective of emergency leadership in the context of complex adaptive emergency management systems. As Kostler (1967) [30] first suggested in his classic "The Ghosts in the Machine", holons are epistemological constructs and conceptual abstractions that represent complex adaptive systems in the real world. As adaptable, integrative and structured entities, they form holonic organizations with other holons to support systemic processes, as noted by Lei and Yang (2013) [13] in their study in the manufacturing sector. [31] Moreover, as Wilber (2000) underscored, as holons evolve, they constantly create new holons. Furthermore, as Edwards (2005) [32] suggests a holonomic framework with its inherent adaptability and transformative capacity provides relevant conceptual constructs. In this study, emergency leadership is viewed as an integrated holon that dynamically engages and interacts with its systemic horizontal and vertical components. Emergency leadership influences the evolution of emergency management systems, but is also changed by systemic evolution.

1.4 Study goals

This study deploys thematic analysis and a grounded theory approach within a holonic paradigm to give insight into the nature of emergency leadership. The central goals of this key informant study of emergency leadership in Canada are threefold: to identify the perceived key holonic properties of emergency leadership; to propose a theory of holonic emergency leadership; and to examine the implications of emergency leadership for the evolution of emergency management systems. These have implications for other diverse domains in healthcare internationally.

2.0 Methods

A phenomenological qualitative approach using a grounded theory approach with key informant analysis formed the methodological basis of this study. The salient points of this research design that follow include the research ethics and instruments, the sampling procedures, the study participants, the grounded theory approach, the research hypotheses, the non-parametrical statistical technique and the study limitations.

2.1 Research ethics and instruments

An institutional research ethics committee on human subjects reviewed and approved proposed research study goals and objectives, design and instruments. It fully endorsed the entire proposal, as meeting the confidentiality, privacy and ethical requirements. The research instrument consisted of a semi-structured questionnaire of six parts with 26 open-ended questions that focused on perceptions key informants of the challenges facing emergency leadership in Canada. Respondents could elect to complete the confidential research instrument tool online, or opt for a telephone interview, using the same identical questions of the online version. All respondents were given the option to respond either in English or French, both the official languages of Canada. On a consensual basis, respondents then accessed a secured and private database with a reputable and trusted online research firm. Qualified key

informants, who accessed the database, first read and then signed a confidential statement of consent in the official language of their choice. Only then were the key informants allowed to have full access to the online questionnaire.

2.2 Sampling procedures

A chain referral technique was the sampling procedure of choice in this study. Several professional bodies were approached and agreed to be points of entry. The participating bodies included: the Canadian Association of Fire Chiefs, the Canadian Association of Social Workers, the Canadian College of Health Leaders and the Canadian Information Processing Society. Each issued a general invitation to their membership to contact directly the researcher directly within six-week inclusion period, if they wished to participate. The recruitment of key informants was voluntary and confidential. The study only included key informants with ten or more years of experience in emergency management and who were willing to share their leadership perspectives. The sample saturation point occurred when the inclusion criteria yielded a representative sample of select key informants who responded within stated time deadline.

2.3 Study participants

Purposive sample size was determined by the six-week response time limit and the defined study objectives. Of the 103 questionnaires received within the study period, 17 were disregarded as they were not fully completed. In addition, seven key informants opted for a telephone interview. Given a total of 86 key informants from 76 organizations across Canada, the response rate was 83.5 percent. This included: 28 leaders in health care facilities and hospitals; 25 Government leaders in emergency management on either a municipal, regional, provincial or Federal (including defence) level; 14 leaders in fire and rescue officers and paramedics; 15 clinical leaders in emergency medicine, nursing and social work; and four leaders in private technology consulting firms. Of the total respondents, 89 percent were senior professionals with ten or more years of emergency management experience. These were organized in four professional groups are shown in Table 1.

Table 1: Summary of professional groups of key informants with significant emergency experience

GROUP		N
A	Leaders in health care facilities and hospitals	28
B	Government leaders in emergency management (municipal, regional, provincial, Federal (including defence)	25
C	Leaders in fire and rescue and paramedical services	14
D	Clinical leaders in emergency medicine and nursing and social work	15
	Total	82

2.4 Grounded theory approach

Grounded theory is a qualitative research approach whereby collected data is subjected to detailed systematic thematic analysis to generate new theory. [33, 34] In this key informant study, responses produced results that shed light on emergency leadership as a holonic construct. The open-ended questionnaire and interviews evoked detailed responses with relevant descriptions of experiences and perceptions of emergency leaders. The data responses were subject to iterative processes of coding, memoing and integration. [35] During coding, qualitative data was noted and categorized into themes that related to the core concept of emergency leadership. Repeating concepts were merged into substantive codes and formed the basis of new theory. Through memoing, thoughts and ideas were recorded, as they evolved and developed. In the integrative process, the holonic properties of emergency leadership were identified. New theory emerged and insight was gained into emergency management systems as complex and adaptive holonic organizations.

2.5 Research hypotheses

As the grounded theory approach proceeded, ten key holonic properties of emergency leadership emerged. Further analysis was deemed necessary to verify whether there was concordance among the participants of the four major professional groups. Given the smaller number of leaders in the private sector in this study, they were not included. The null hypothesis and the alternative hypothesis proposed were as follows:

H_o: There is no convincing evidence of agreement on emergency leadership properties among four professional groups.
H_1: There is convincing evidence of agreement on emergency leadership properties the four professional groups.

2.6 Nonparametric statistical techniques

Given the small sample size in this study, it was not possible to assume a normal distribution. Hence, nonparametric statistical techniques were deemed appropriate to test the hypotheses. In particular, the Kendall coefficient of concordance (W) was deployed to test for concordance on the ranked holonic leadership properties among the four professional groupings. Moreover, given that there were tied ranked scores, the following variation of the Kendall coefficient of concordance (W_t) was deployed. [36]

$$W_t = S / [.08333K^2(N^3-N) - K(\Sigma T_a)]$$
$$W_t = [(R_j-(\Sigma R_j/N))^2]/ [.08333K^2(N^3-N) - K(\Sigma T_a)]$$

Where:
K is the number of professional groups
N is the number of ranked criteria
S is the sum of the squares
R_j is the sum of the ranks for each criteria
ΣR_j is the sum of the ranks across the groups
$\Sigma R_j /N$ is the mean of the ranks
ΣT_a is the sum of tied scores $\Sigma T_j /12$

As suggested by Kendall and Smith (1939) [35], a calculated critical value (χ^2) was compared to the test statistic (T_s) to assess whether there was convincing evidence of agreement on holonic properties of emergency leadership among four professional groups.

The critical value formula is:

$$\chi^2 = k\,(N-1)\,W$$

The test statistic formula is:

$$T_s = 2(S)/K\,(N^2-1)$$

If the test statistic (T_s) was less than the critical value (χ^2), then there was no convincing evidence of agreement on leadership properties among the four professional groups. However, if the test statistic (T_s) was greater than the critical value (χ^2), then there was convincing evidence of agreement among the four professional groups on emergency leadership properties.

2.7 Study limitations

In the initial stages of the chain sampling technique, three additional invitations were also sent to other professional bodies. These included the Canadian Association of Chiefs of Police, the Paramedic Chiefs of Canada and the Canadian Nurses Association. None had responded by the required deadline of four weeks. However, the membership in the Canadian College of Health Leaders provided access to diverse public safety and emergency professionals across a vast spectrum of emergency leaders across Canada.

3.0 Study results

The key informant study results are presented below. They include the outcomes from the thematic analysis of the holonic leadership properties and the theoretical outcome that emerged from a grounded theory approach.

3.1 Rank-ordered thematic analysis

From this qualitative key informant study, a total of 82 key informants with significant emergency experience identified 68 leadership characteristics. These were rank-ordered across all four professional groups from which 20 leadership properties emerged and were identified. With further iterative rank ordering, ten key holonic properties of emergency leadership emerged. None of these properties are mutually exclusive, distinct and separate. Rather they interact with each other dynamically forming an integral holonic construct of emergency leadership. Table 2 summarizes the rankings of the professional groups on the perceived importance of the ten holonic properties of emergency leadership.

3.2 Nonparametric analysis results

The ten holonic properties were subject to rank-order analysis using the Kendall coefficient for concordance (W) for tied scores to test whether all four professional groups concurred independently of each other. The Kendall coefficient of concordance for tied scores (W_t) was .123. The critical value (χ^2) was then calculated to be 4.43. The test statistic (T_s) of 4.75 was greater than the critical value (χ^2) of 4.428. Thus, the proposed null hypothesis (H_0) was rejected in favour of the alternative hypothesis (H_1). In summary, there appeared to be evidence of concordance among the four professional groups on the ten holonic properties of emergency leadership.

3.3 Emergency leadership holonic properties

As in Table 2, the highest ranked attributes were those with lowest mean rank (Rj). These are each discussed below in the order of highest ranks.

Strategic communications. The key informants unanimously agreed that the ability of emergency leaders to communicate effectively was a crucial leadership skill. Clarity in all communications facilitated positive interactions and prevented conflicts and misunderstandings. Moreover, they identified systems interoperability as one of the pressing challenges to effective communications across technological networks. They acknowledged that non-compliance with common telecommunication standards have roots in larger sociopolitical and jurisdictional issues. Systems interoperability, according to the key informants, poses one of the most intractable challenges to effective emergency management systems.

Strategic collaboration. The key informants stressed that effective emergency leaders must build and solidify collaborative networks of diverse emergency organizations and professionals across emergency management systems. Moreover, they felt that effective collaboration enables information sharing and critical deployment of personnel, resources and supplies. They also expressed the view that strategic collaboration facilitates systems interoperability that underpin effective emergency responses.

Courage and equanimity. The key informants emphasized that leaders must demonstrate courage and equanimity, as they exercise their leadership duties and responsibilities in the "heat of the battle". They felt that such attributes inspire others to rise to the many challenges of emergency events. Moreover, they believed that spirited resolve and determination ultimately improves survivability, mitigates morbidity and reinforces organizational resilience in the face of emergencies.

Authenticity. Key informants underscored the importance of authentic leadership attributes, such as accessibility, adaptability, astuteness and emotional intelligence. All of these promote open communication, professional respect and mutual trust, upon which effective collaborative networks are built. Highly-developed social competencies were deemed very important, as were accountability, discipline, personal integrity and professional ethics. Key informants also felt that authenticity, credibility and trustworthiness were also critical in working with all levels of governing authorities.

Experiential knowledge. Key informants underscored the importance of cogent knowledge and frontline experience with proven expertise in emergency management systems. Operational and strategic management expertise, sound knowledge of emergency resource logistics and cogent experience in

emergency personnel deployment and management were vital. Some key informants noted the growing need for knowledge in emergency informatics and systems engineering would enhance the performance of emergency management systems.

Table 2: Summary ranks of professional groups of key emergency leadership properties

	GROUP A	GROUP B	GROUP C	GROUP D	R_J	$(R_J-(\Sigma R_J/N)$	S
1. STRATEGIC COMMUNICATION	**1**	**2**	**4**	**2**	**9**	**-5.5**	**30.25**
2. **STRATEGIC COLLABORATION**	**2**	**1**	**5**	**1**	**9**	**-5.5**	**30.25**
3. **COURAGE AND EQUANIMITY**	**1**	**2**	**6**	**2**	**11**	**-3.5**	**12.25**
4. AUTHENTICITY *	**3**	**6**	**2**	**3**	**14**	**- 0.5**	**.25**
5. **EXPERIENTIAL KNOWLEDGE**	**2**	**6**	**3**	**3**	**14**	**-0.5**	**.25**
6. COMPASSION AND INTEGRITY	**6**	**5**	**1**	**2**	**15**	**0.5**	**.25**
7. **TRANSFORMATIVE SKILLS ****	**5**	**5**	**2**	**3**	**15**	**0.5**	**.25**
8. **EMERGENCY PREPAREDNESS PRAXIS**	**5**	**3**	**5**	**4**	**17**	**2.5**	**6.25**
9. **STRATEGIC DECISIVENESS**	**4**	**7**	**6**	**2**	**19**	**4.5**	**20.25**
10. **STRATEGIC FORESIGHT**	**6**	**4**	**7**	**5**	**22**	**7.5**	**56.25**
TOTAL					**145**		**156.75**

Caring and compassion. The key informants emphasized that caring values and compassion must be integral to the behaviours and decisions of emergency leaders. Leaders with compassion and humility, they believed, also inspire others to act ethically. Honesty and integrity were deemed of paramount importance. These attributes built respect and trust that helped build solid collaboration across emergency management systems.

Transformative skills. Key informants recognized the central importance of transformative skills, such as change management, conflict resolution, creative thinking and negotiation. They asserted that emergency leaders need to challenge the status quo in emergency management systems and introduce transformative changes. Moreover, over 95 per cent of the key informants underscored the importance of building collaborative partnerships with the private technological sector in other to benefit from innovative technologies. At the same time, they acknowledged that inter-sectorial differences of perspectives, priorities and values would make such partnerships challenging, if not impossible. Only leaders with transformative skills could overcome these challenges.

Emergency preparedness praxis. Key informants stressed the importance of emergency preparedness as a professional and social responsibility. They underscored the obligation of leaders to assess risks and analyze threats. Environmental perception, perspicacity, situational awareness and strategic analysis of a range of emergency system management options are all integral to the praxis of emergency preparedness. Emergency response planning, disaster planning and recovery planning together with frequent testing and simulations- all were deemed essential.

Strategic decisiveness. Key informants stressed that decisiveness is of paramount importance for emergency leaders, even in the face of incomplete, or imperfect, information. They felt that leaders must carefully and expeditiously make balanced and rational decisions, based on input from diverse sources. They maintained that in the face of overwhelming time pressures and information overload, decisiveness in emergency leaders was key in helping to save lives and reduce injuries.

Strategic foresight. Key informants stressed that strategic foresight and a compelling vision of emergency management systems are the hallmarks of emergency leaders. The cognitive ability to think and conceptualize beyond the organizational bounds to include regional, national and international perspectives was deemed important for emergency leaders. The ability to predict emergency events and build effective collaborative networks before the actual occurrence such events were part of this critical leadership property.

3.4 Towards the theory of holonic emergency leadership

Using a grounded theory approach in this study, new theory emerged that shed light into emergency management systems as complex adaptive holonic organizations. This is the theory of holonic emergency leadership. The theoretical premise is that emergency leadership is a singular holonic construct with identifiable properties. As such, it is an integral part of a greater and evolving holonomic network of emergency management systems. Moreover, the emergency leadership holon bifurcates into two interacting sub-holons: the humanistic leadership holon and techno-leadership holon. The humanistic leadership holon has inherently human and social properties, such as authenticity, caring and compassion, courage and equanimity, strategic foresight and transformative skills. The techno-leadership holon has properties that have the potential to be leveraged and supported through innovative technologies. These properties include emergency preparedness, experiential knowledge, strategic communications, collaboration and decisiveness- all of which are potentially enhanced through the use of innovative technologies. This holonomic paradigm underscores the symbiotic and synergetic relationship of humans and technology within the holonic construct of emergency leadership. The underlying supposition is as emergency leadership is increasingly dependent on innovative technologies, the humanistic properties of such leadership still remains paramount.

4.0 Discussion

Emergency management systems are essential in response to what Malraux called "la condition humaine", that is the human condition."[38] Emergency leadership plays a central role in the integrity, resilience and sustainability of organizations and communities. Moreover, effective emergency leadership is instrumental in preventing deaths and injuries and fully recovering from mass emergencies, disasters and catastrophic events.

4.1 Towards holonomic emergency management networks

Wilber asserted that holons evolve and transcend by constantly creating new holons. [13] Indeed, the theory of holonic emergency leadership points to the continued evolution of a larger holonomic construct of emergency management systems. This includes comprehensive emergency services, including: fire and rescue services, prehospital care, transportation, emergency and critical care, rehabilitation, disaster recovery and aftercare. Emergency leaders essentially orchestrate the high-order choreography of the plethora of emergency professionals within these settings. Such professionals includes fire and rescue personnel, paramedics, police, emergency physicians, critical care nurses, physiotherapists, social workers, mental health specialists, disaster relief workers and coroners. Figure 1 suggests a holonomic framework that depicts the synergistic interactions between the emergency leadership holon, the emergency management systems holon and the technological holon. All holons can subdivide into sub-holons. In the model presented, the emergency leadership holon that is bifurcated into humanistic leadership and techno-leadership. Moreover, all holons are interdependent and influence each other as they evolve and transform. What results is a highly dynamic family of constantly changing holons that influence the evolution of emergency management systems.

4.2 Towards humanistic leadership

From this study, humanistic emergency leadership centers on properties of authenticity, caring and compassion, courage and equanimity, strategic foresight and transformative skills. They remain important for the complete full recovery of individuals and communities from emergency events. Authentic leaders are astute, empathic and possess cogent insight into human behaviours. Ethical behaviour, honesty and integrity are of paramount importance. Caring and compassionate leadership must prevail as an inspiration to others in the throes of emergencies. Courage and equanimity are also essential qualities of emergency leaders. Leaders realize that emergency events are cognitively challenging and may lead to shock and paralysis, even in well-seasoned emergency professionals. Emergency leaders must remain objective and decisive in chaotic and volatile emergency situations. Prior emergency experiences, sound emergency preparedness, rigorous threat analysis and situational awareness contribute to decisive leadership behaviours. Strategic foresight and intuition drives strategic thinking. Astute perceptions of the environmental changes, risks, threats and resource needs are integral to strategic foresight. Finally, leaders require transformative skills, such as change management, conflict resolution and negotiation. Humanistic emergency leaders must constantly challenge the status quo and strive for transformational changes in the best interests of the public.

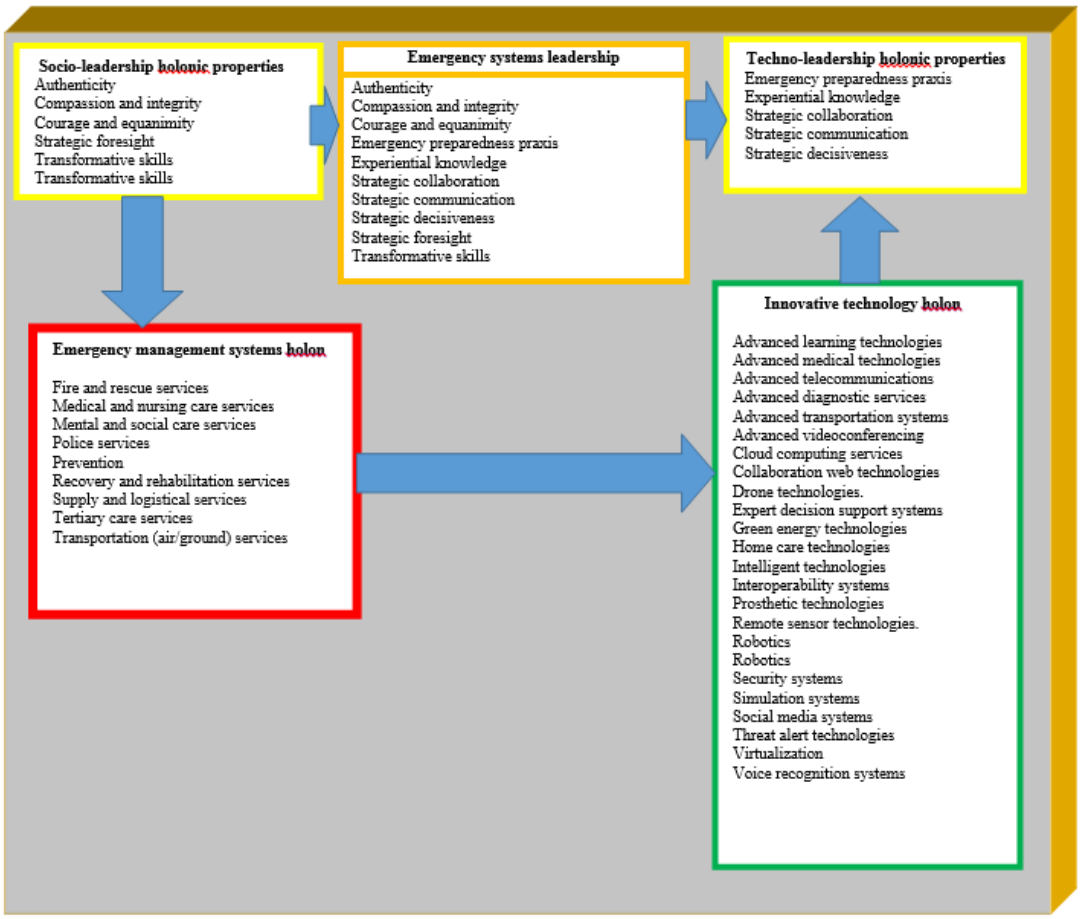
4.3 Towards techno-leadership

Key emergency leadership properties are supported and leveraged through the deployment of innovative technologies. These include emergency preparedness, experiential knowledge, communications, collaboration and decisiveness. Emergency preparedness remains the vital core of planning and the essential praxis of emergency management. It requires access to vital emergency resources and supply chain networks. Effective strategic communications requires message clarity and repetition. Collaborative networks are key in promoting proactive emergency management strategies across jurisdictional and organizational boundaries. Moreover, these emergency networks must engage community organizations, military units, non-governmental organizations and private emergency supply enterprises. Innovative technologies have great potential in leveraging these leadership properties. Technologies such as: "big-data" storage, cloud computing, nanotechnologies, neural networks, sensor technologies and virtualization facilitate the integration of critical environmental and emergency information sharing. Strategic and operational emergency decision-making are enhanced through autonomic systems, data analytics, expert decision support systems and intelligent systems. Advanced telecommunication systems, collaboration technologies and social media facilitate the building and coalescing critical emergency infrastructures regionally, nationally and internationally. Novel technologies, such as advanced learning technologies, robotics and simulation systems enhance and facilitate shared learning regionally, nationally and internationally.

4.4 Towards inter-sectorial collaboration

The study points to the potential of inter-sectorial collaboration between the public emergency sector and private technological sectors respectively. Such collaboration fosters crucial access to dependable resource and supply chain networks and promotes emergency preparedness praxis as social community responsibility. Such collaborative networks call for dynamic, stable and mutually beneficial strategic relationships that promulgate mutual learning, growth and innovation in the public interest. This underscores the need for emergency leaders with cogent collaborative, communication and transformative skill sets. Emergency leaders must encourage and engage in continuous and productive dialogues among all parties to make effective collaboration a reality. Transformative leaders think strategically and embrace complex change and uncertainty positively and proactively for the public good.

Figure 1: Holonic paradigm: Transformational emergency systems leadership in the context of emergency management systems



4.5 Towards continuous learnability

Learnability is the systemic ability to derive knowledge and pragmatic lessons from emergency events. Continuous systemic learning, improvement and adaptability are hallmarks of high performing emergency management systems. It is central in the quest for higher orders of systemic effectiveness, efficiency and performance. Learnability depends on informational exchanges, interoperable and reliable telecommunications systems, effective knowledge diffusion and transfers. Continuous learning for emergency leaders as change agents emphasizes strategic thinking and transformative skill sets. Creative and effective pedagogical approaches that reinforce leadership process skills, such as change management, collaborative network building, conflict resolution and negotiation are important. Prior emergency training and experience reinforced by simulation exercises are also instrumental in reinforcing emergency leadership skills. Sound knowledge of systems engineering techniques, such as activity-based costing, benchmarking, lean design and root causal analysis is also relevant. Given the increasing deployment of innovative technologies, emergency leaders require a cogent knowledge base in emergency informatics and systems management. This prepares them to judiciously deploy and leverage a wide spectrum of growing technologies, from drones to robotic systems, to improve emergency management systems.

4.6 Towards future research in healthcare systems

The theory of holonic emergency leadership holds promise for further leadership research in other healthcare settings internationally. Such studies could explore and validate holonic leadership theory in a range of healthcare contexts. Potential research into leadership dynamics in the battle against cholera, dysentery, ebola, malaria, pancreatic cancer, posttraumatic stress disorder, suicidality and the ziki virus, are only a few potential examples. Qualitative research using a grounded theory approach, thematic analysis and nonparametric statistical analysis also hold promise for other investigations into a myriad of diverse healthcare organizations. Key informant studies in healthcare settings that engage health professionals and leaders hold promising insights and outcomes. Potential qualitative studies could potentially include settings, such as: air ambulance services, coroner services, dialysis units, field hospitals, home care, methadone clinics, military hospitals, prison hospitals and refugee medical clinics. Furthermore, qualitative research studies might be encouraged in healthcare settings in diverse national contexts, such as: Brazil, China, Columbia, the Congo, India, Indonesia, Iran, Japan, Mexico and Nigeria. Healthcare systems research on inter-sectorial collaboration with governments and private sector companies may also be of great potential. Finally, more studies into emergency informatics, innovative technologies and systems engineering all promise to revolutionize healthcare and represent another titanic area of research future investigation.

5.0 Conclusion

Emergency management systems are fraught with competing and complex challenges and priorities. Effective emergency leadership is essential in reducing the scourges of emergency events, including mass emergencies, disasters and catastrophes. This qualitative study that underscored emergency leadership challenges in Canada may well be applicable internationally. The growing complementary role of technology will become more important in the drive for systemic effectiveness and sustainability. The proposed holonomic framework for emergency leadership holds potential as theoretical base for systemic research in other diverse healthcare settings internationally. The proactive identification of community threats, emergency preparedness and systemic collaboration underscore the premise that that emergency leaders must ever be at the ready. As Caro (2015) maintains, emergencies only truly end when victims, communities and care professionals have fully recovered from the ordeals experienced. [37] Mass emergencies and disasters will undoubtedly continue under the shadows of burgeoning global population growths, massive poverty, socio-political anarchy and increased exposure to climatic and other environmental threats. Cogent emergency leadership is essential for the positive transformation of emergency management systems through the deployment of innovative technologies. Caring and ethical emergency leadership that seeks to harmonize effective policies and strategies in the international domain holds greatest promise for humanity in the decades to come.

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7.0 Conflict of interest

There is no conflict of interest in this paper.

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