Journal of Military and Strategic Studies

VOLUME 21, ISSUE 3

The Realm of More or Less: Critical Infrastructure and Public Order Factors for Pandemic Strategy

William McAuley[1]

Actually the issue, as is usual, was not in the realm of "yes or no" but in that of "more or less."

Winston Churchill[2]

Introduction – An Incomplete Theory of Pandemic Response

Multidimensional interests and vulnerabilities have evolved and interwoven throughout the course of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2 or COVID-19) pandemic.[3] This has created an overarching strategic context that has challenged traditional frames of reference and governance structures.[4] As the

[1] This paper is intended to generate discussion, and thus contains facts and opinions that the author alone considered appropriate and correct for the subject. Opinions expressed are those of the author and do not necessarily reflect the policy or the opinion of the author's employer.

[2] Winston Churchill, *The Second World War, Volume Fire: Closing the Ring* (London: The Reprint Society, 1952), p. 189.

[3] The World Health Organization (WHO) declared the outbreak of COVID-19 a Public Health Emergency of International Concern (PHEIC) on 30 January 2020, and subsequently a pandemic on 11 March 2020.

[4] Pandemics result from the emergence of a new human virus or bacteria with global spread. These events are unpredictable, occurring at infrequent intervals throughout human history. Historical records show a prevalence of bacterial pandemics, such as bubonic plague. However, most pandemics within the last

ISSN : 1488-559X

military has no patent on strategy,[5] a strategic studies perspective on this whole-of-society problem appears germane. In the sense that strategy is "the intelligent identification, use, and coordination of resources (or ways and means) for the successful attainment of a specific objective, or end,"[6] pandemic response is merely a form of strategy directed towards balancing public health and socioeconomic order. Strategic thought offers a beachhead for an examination of the complex dynamics of the battle against COVID-19. By distilling out forces, factors, and drivers in the security domain, principally critical infrastructure and public order challenges within Alberta, an enriched understanding of the science and art of pandemic response may be facilitated.

The Clausewitzian twilight of greater or lesser uncertainty would seem an apt starting point. In corollary, response to a global public health emergency can reasonably be described as a "relentless struggle with the unforeseen," and unquestionably calls for leadership with "a sensitive and discriminating judgment" and "a skilled intelligence to scent out the truth" akin to the mature mental aptitude that Clausewitz described as "genius."[7] The twin qualities of *coup d'oeil* (intellect/intuition) and *courage d'esprit* (temperament – or the inward eye and determination) surely have application for weighing pandemic leadership. However, beyond the articulation of the inevitability of friction and the virtues of leadership needed to carry out any complex activity, Clausewitz lacks resonance as a communal frame of reference for a public health crisis. The suppression and mitigation of COVID-19 lack a culminating engagement towards which all activity relates directly or indirectly.[8] It is not a contest between thinking individuals, but one waged against an amorphous biological threat. While remaining firmly within the realms of chance and suffering, it is governed not by a *decision by force*

century have been attributable to viruses. Global impact has ranged from mild (i.e., influenza 2009) to severe (i.e., COVID-19 and influenza 1918). United Kingdom, *National Risk Register* (Whitehall: Cabinet Office, 2020), p. 46.

[5] Colin S. Gray, *Strategy and Defence Planning: Meeting the Challenge of Uncertainty* (Oxford: Oxford University Press, 2014), p. 4.

[6] H.R. McMaster, *Battlegrounds: The Fight to Defence the Free World* (New York: HarperCollins, 2020), p. 431.

[7] Carl von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1989), pp. 100-102.

[8] Mitigation and Suppression are the two basic strategies. Mitigation involves slowing epidemic spread with a view to reducing peak healthcare demand and protecting those at highest risk. Suppression seeks to reverse epidemic growth with a focus on reducing case numbers to low levels and maintaining that situation indefinitely. Neil M. Ferguson et al., "Impact of Non-pharmaceutical Interventions (NPIs) to Reduce COVID-19 Mortality and Healthcare Demand," Imperial College COVID-19 Response Team, London, 2020.

of arms in which the positive aim is to destroy the threat, but intentional protraction through societal disengagement. The highest political object in a pandemic aligns more closely with a negative purpose – self-preservation. There is no moral element of the virus to attack, although there are significant "moral forces" and "effects in the sphere of mind and spirit" to address within one's own society.[9]

A copy of *On War* would not have been expected to serve as a manual of action for pandemic response and would have been extraneous reference material if present during meetings of Alberta's Emergency Management Cabinet Committee (EMCC), Priorities Implementation Cabinet Committee (PICC), or Pandemic Response Planning Team (PRPT).[10] The relevance of commencing with a Clausewitzian reference – beyond providing an initial navigational beacon to readers orientated towards security, defence, and strategic studies – is as a reminder that "[t]heory exists so that one need not start afresh each time sorting out the material and plowing through it, but will find it readily at hand and in good order. It is meant to educate the mind of the future commander, or, more accurately, to guide him in his self-education, not to accompany him on the battlefield."[11] If one accepts that fundamental principles can be distilled and drawn upon as a theoretical aid to the shaping of strategic approaches to novel strategic conditions,[12] it may be posited that a strategic theory of protracted pandemic engagement might exist.[13]

Commentators may contend that the fundamentals of pandemic strategy had already been given form prior to COVID-19. Based on lessons learned from the 2003 severe acute respiratory syndrome (SARS) outbreak and the 2009 H1N1 influenza

[9] Clausewitz, *On War*, p. 137.
[10] Within Alberta, two Cabinet Committees were formed to facilitate decision-making around public health and economic considerations, and to oversee execution of the COVID-19 pandemic response. The Emergency Management Cabinet Committee (EMCC) was in place from 2 March to 9 June 2020. The Priorities Implementation Cabinet Committee (PICC) filled this role from 12 June 2020. A Pandemic Response Planning Team (PRPT) was created to address cross-government planning needs. Both the EMCC and PRPT were disbanded after the pandemic's first wave. KPMG, *Review of Alberta's COVID-19 Pandemic Response: March 1 to October 12, 2020 - Final Report to the Government of Alberta* (Jan 2021), p. 117.
[11] Clausewitz, *On War*, p. 141.
[12] Scott A. Boorman, "Fundamentals of Strategy – The Legacy of Henry Eccles," *Naval War College Review* 62, 2 (2009): Article 8.
[13] In the Clausewitzian tradition, an effort to illuminate the components of pandemic response and their interrelationships. Theory as study rather than doctrine, identifying those core principles and rules that can be demonstrated. Clausewitz, *On War*, p. 177.

pandemic, [14] Canada certainly had a *Public Health Measures Strategy* [15] and a *Federal/Provincial/Territorial (FPT) Public Health Response Plan for Biological Events*, [16] whereas Alberta had a *Pandemic Influenza Plan* at hand.[17] Although these provided a baseline for planning and preparedness built upon some form of rational theory, interim analysis has suggested these existing frameworks were not entirely "fit for purpose" to respond to the COVID-19 crisis.[18] The initial *contain-delay-research* strategy adopted by most jurisdictions is illustrative of the limitations of pre-existent understanding.[19] The shortfall of planning frameworks was not in their epidemiological foundations, but their narrowness of scope and field of application within broader society. They were remarkably process orientated, conceived primarily by and for public health practitioners, and based upon untested assumptions of society being proficiently directed and reacting indefinitely as a homogenous rational entity.[20]

[14] In November 2002, Severe Acute Respiratory Syndrome (SARS), a droplet-spread viral illness, emerged in Asia. From March to August 2003, a Canadian outbreak affected primarily the Greater Toronto Area. There were 375 probable and suspected SARS cases and 44 deaths in Ontario. The H1N1 strain of pandemic influenza was first seen in Mexico and spread globally from April 2009 to February 2010. There were 8,582 hospitalizations, 1,448 cases admitted to the intensive care unit (ICU) and 425 deaths in Canada. *Canadian Disaster Database*, https://www.publicsafety.gc.ca/cnt/rsrcs/cndn-dsstr-dtbs/index-en.aspx.

[15] Canadian Pandemic Influenza Preparedness Task Group, "Canadian pandemic influenza preparedness: Public health measures strategy," *Canada Communicable Disease Report* 45, 6 (2019): pp. 159-63.

[16] Pan Canadian Public Health Network, *Federal/Provincial/Territorial Public Health Response Plan for Biological Events* (Ottawa: 2018). See also R. McNeill and J. Topping, "Federal, provincial and territorial public health response plan for biological events," *Canada Communicable Disease Report* 44, 1 (2018): pp. 1-5.

[17] Alberta Health, *Alberta's Pandemic Influenza Plan* (Edmonton: 2014).

[18] KPMG, *Review of Alberta's COVID-19 Pandemic Response: March 1 to October 12, 2020 - Final Report to the Government of Alberta* (Jan 2021), p. 3.

[19] As illustrated in United Kingdom's *Coronavirus Action Plan*, the standard strategy in early stage of the COVID-19 outbreak was based on three strategic objectives: Contain – detect early cases, follow up close contacts, and prevent the disease taking hold for as long as was reasonably possible. Delay – slow the spread of the virus. Research – better understand the virus and how to lessen its effect on the population; innovate responses including diagnostics, drugs and vaccines; use the evidence to inform the development of the most effective models of care. United Kingdom, *National Risk Register* (Whitehall: Cabinet Office, 2020), p. 51.

[20] Students of strategy may also argue the differences between strategy and a plan. To avoid being bogged down in definitional inertia, I will make analogy to Colin Gray's hypothesis that "in the main, strategy and defence planning are the same subject." Hence, pandemic strategy and pandemic response planning can be considered as synonymous. Colin S. Gray, *Strategy and Defence Planning: Meeting the Challenge of Uncertainty* (Oxford: Oxford University Press, 2014), p. 3.

To illustrate, the *Concept of Operations* contained within the *FPT Biological Events Plan* provided a concise and logical decision-making architecture and process for pandemic response. This framework appropriately covered the five basic activities relevant to cross-jurisdictional pandemic planning, including the development of advice relevant to feasible policy options, the establishment of programming, the preparation of plans, the assessment of risks, and identification of opportunities for collaboration.[21] However, the zero-sum (yes/no) simplicity of the decision points and well-ordered governance structure belied the actual complexity of societal mobilization to fight a prolonged pandemic.[22] Although the accessible frameworks addressed public health system preparedness, they did not extend to the development of *societal readiness*.

What was lacking was something like the foundational *fighting power* concept in defence doctrine, which defines the operational effectiveness of armed forces and guides force development and preparation. The *conceptual*, the *moral*, and the *physical*, the three components of fighting power, reinforce the necessity of sensitivity to the multiple dimensions of forces and factors – social, technical, economic, military, political, legal, environmental, security, demographic, religious, psychological, and other[23] – that define the art of the possible, and ultimately serve to animate whole-of-society strategy.[24] The efficiency of societal response is relative to the ability of governance structures to learn and adapt, the ability of officials to get people to respond appropriately, and the effective leveraging of resources across functional domains. The fighting power concept is a reminder that neatly ordered structures and processes will encounter multidimensional friction when tested in a societal level context. The importance of the conceptual, moral, and physical elements of societal response has

[21] These generally mirror Colin Gray's articulation of the range of defence planning activities. Gray, *Strategy and Defence Planning*, p. 4.
[22] Pan Canadian Public Health Network, *FPT Public Health Response Plan*, p. 7.
[23] The 'STEMPLES Plus' mnemonic used to stimulate thinking about a problem in intelligence analysis. Randolph H. Pherson and John Pyrik, *Analyst's Guide to Indicators* (Pherson Associates, 2018), p. 18.
[24] In military doctrine outside the United States, the conceptual component is the force's knowledge, understanding and application of doctrine – the ideas behind how to operate and fight – kept relevant by its ability to learn and adapt. The moral component is the force's morale, leadership and ethical conduct: the ability to get people to operate and fight and to do so appropriately. The physical component consists of manpower, equipment, sustainability and resources: the means to operate and fight. United Kingdom Army, *Army Doctrine Publication AC 71940: Land Operations* (Warminster: Land Warfare Development Centre, 2017), p. 3-1.

become increasingly evident due to the scale and persistence of the COVID-19 pandemic.

Limitations and Scope

Although thorough scientific analysis of the massifs of empirical data on the efficacy of various public health interventions and their iatrogenic impacts will certainly be forthcoming,[25] any commentary on pandemic response in the absence of this *ex post facto* investigation of intervention efficacy in relation to longer-term societal interests must necessarily remain circumspect. Significant care must be taken against distortion by, or amplification of premature, one-dimensional, or politically motivated critiques of pandemic response that are laden with cognitive biases,[26] misapplied heuristics,[27] and intuitive traps.[28]

A visible representation of this analytical pitfall is apparent in the highly opined and presupposed questions that permeated later stage COVID-19 press conferences in Alberta.[29] Questioning techniques utilized by the media in these sessions demonstrated a significant level of subjectivity and mission creep, manifest in the basic cognitive error

[25] For preliminary studies see: John T. Brooks and Jay C Butler, "Effectiveness of Mask Wearing to Control Community Spread of SARS-CoV-2," *Journal of the American Medical Association* 325, 10 (2021): pp. 998-999; Centre for the Mathematical Modelling of Infectious Diseases COVID-19 working group, "Effects of non-pharmaceutical interventions on COVID-19 cases, deaths, and demand for hospital services in the UK: a modelling study," *The Lancet* 5, 7 (July 2020): pp. 375-385.

[26] The human brain's simplified information processing strategies cause mental errors. Common cognitive bias include: confirmation bias, evidence acceptance bias, hindsight bias, mirror imaging, and vividness bias. Katherine H. Pherson and Ralph H. Pherson, *Critical Thinking for Strategic Intelligence*, 2nd Ed (Thousand Oaks, CA: CQ Press, 2017), pp. 54-55.

[27] Experienced-based techniques that can generate an expedient solution but introduce bias when misapplied. Common heuristics include: anchoring effects, associative memory, availability heuristic, desire for coherence and uncertain reduction, groupthink, mental shotgun, premature closure, and satisfying. Ibid., p. 55.

[28] Common errors made when evaluating information and evidence, estimating probabilities, and describing cause and effect. Well-documented intuitive traps include: assuming inevitability, assuming a single solution, confusing causality and correlation, expecting marginal change, favouring firsthand information, ignoring the absence of information, ignoring base rate possibilities, ignoring inconsistent evidence, judging by emotion, lacking sufficient bins, misstating probabilities, overestimating probability, over-interpreting small samples, overrating behavioural factors, presuming patterns, projecting past experiences, rejecting evidence, and relying on first impressions. Ibid., pp. 55-57.

[29] As an illustrative example, consider the objectivity of the questions posed to officials during the Government of Alberta Update on COVID-19 – 3 September 2021, https://youtu.be/RFxM5aKJrBY?t=1988.

of conflating information with pre-tensioned assumptions, judgments, and assessments.[30] The rise of digital media has generated a market bias towards "System One (or Gut) journalism," which favours intuition, speed, and emotion.[31] As all forms of media have become indebted to algorithms predicated on system one (intuitive thinking) susceptibilities,[32] it has incentivized reporting beyond traditional descriptive analysis of "what is valid or worth noting about the Who, What, How, When, and Where."[33] Daily reporting is no longer limited to generalizing for public comprehension and identifying patterns and trends. Competitors strive to maximize contentious elements of explanatory, evaluative, and estimative analysis that will drive click and view uptake via algorithm-driven filter bubbles.[34] As a result of timeframes and reactive structures that are inconsistent with correction for cognitive biases, misapplied heuristics and intuitive traps, political and ideological commentary without dialectic is being confounded with investigative journalism.

Algorithmic indebtedness has also inhibited an adequate accounting for the reality that judgment in the medical field is inherently "noisy."[35] This observation is particularly relevant to the pandemic response given that different subject matter

[30] *Information* consists of all the facts relevant to the situation. *Assumptions* guide the interpretation of evidence and reasoning about a particular problem. *Judgments* identify a trend, point out what is new, or offer a meaning for the facts. *Assessments* are judgements about unknowns. Pherson, *Critical Thinking*, pp. 145-6.

[31] John Stackhouse, *Mass Disruption: Thirty Years on the Front Lines of a Media Revolution* (Toronto: Random House Canada, 2015), pp. 21, 277. See also Dan Gardner, Risk: *Why We Fear the Things We Shouldn't – and Put Ourselves in Greater Danger* (Toronto: McClelland & Stewart, 2008), p. 31.

[32] For further on the two types of thinking (or dual process theory), see Jonathan Evans and Keith Frankish, *In Two Minds: Dual Processes and Beyond* (Oxford, UK: Oxford University Press, 2009) and Pat Croskerry, "A Universal Model of Diagnostic Reasoning," *Academic Medicine* 84, 8 (August 2009).

[33] Pherson, *Critical Thinking*, p. 50.

[34] As noted in Pherson Associates' "Analytic Spectrum": Explanatory analysis probes the reasons and causes of a situation, getting at *why* it has developed or is transpiring. Argumentation is used to give context for the facts, judgments, and observations about patterns or changes in behaviour. Evaluative analysis examines the significance of an issue as it relates to the interests of a client. Interpretations and judgements are made about various values and meanings behind data. Estimative analysis is forward looking, asking what might happened next. Based upon an underlying framework of drivers, influences, and assumptions that compensate for an absence of hard data, it anticipates courses of actions that decision makers may take in relation to certain stimuli. Pherson, *Critical Thinking*, pp. 51-54.

[35] Noise refers to the influence of chance variability and irrelevant factors on human judgments, causing random scatter from one individual to the next within a similar context (i.e., people in the same role following the same guidelines). Daniel Kahneman, Olivier Sibony, Cass R. Sunstein, *Noise: A Flaw in Human Judgment* (New York: Little, Brown Spark, 2021), p. 6.

experts make different judgments about the efficacy of public health policy. The pundit/opinion panel frugalities of the 24-hour news cycle have arguably increased the relative level of noise relating to the pandemic response. Hence, the significant potential for bias (systematic deviation) and noise (random scatter) on performance commentary and its influence on pandemic response warrants a detailed examination of its own.

Recognizing the absence of a scientific autopsy and rational correction for the impacts of bias and noise on *prima facie* judgements, an analogy between pandemic response and classic strategic theory has utility for bounding present analysis. The *science of [pandemic] war* – "the knowledge of the structure and elements of [pandemic] war and the relationships and interacting forces which exist among these elements"[36] – has not yet been extracted. In the absence of such knowledge, it follows that any hasty critique of the *art of [pandemic] war* – "the practical application of this knowledge toward the attainment of the objectives of the commander or of the nation"[37] – would be inherently biased and noisy. It should also be noted that the Courts have not yet definitely ruled on the constitutionality of the laws imposing certain public health measures.[38] Developing jurisprudence can be anticipated to have a significant bearing on how pandemic response in specific jurisdictions is interpreted and will shape how the lessons of COVID-19 will inform future planning and preparedness.

Sidestepping entanglement in a critique of the artistry of provincial officials leaves a more focused object of articulating drivers (i.e., the resultant of factors, forces, and actions) that might inform a general theory of protracted pandemic engagement. Although an eventual goal of various streams of *ex post facto* analysis – epidemiological, economic, political, and sociological – might be to aggregate and articulate some strategic principles of global pandemic response, the focus here will be limited to two security-related elements of pandemic response: critical infrastructure and public order. Although interrelated to the provincial responsivities for executing health care, this focus provides a level of granularity by tying into arenas where provincial officials exercise decision-making authority, while being sensitive to (and limited by) inherent interdependencies with municipal, federal, and international dynamics.[39]

---

[36] Henry E. Eccles, *Logistics in the National Defense* (Harrisburg, PA: Stackpole, 1959), p. 21.
[37] Ibid.
[38] *R v Coates*, 2021 ABPC 162 at 3. https://canlii.ca/t/jg8sg
[39] Provincial responsibilities are formerly allocated in section 92 of *The Constitution Acts*.

Security realm considerations are interwoven with at least three underlying themes of the COVID-19 battle. These broad undertones can be précised as the *preappointed evidence problem*, the *Cynefin circumstance*, and a *collective-to-individual cognitive arc*. An articulation of core principles associated with the critical infrastructure and public order aspects of pandemic response aids in illuminating these key themes.

The Preappointed Evidence Problem

All dimensions of the COVID-19 pandemic response have suffered from a *preappointed evidence problem*. This terminology is deliberately lifted from John Stuart Mill's commentary on the preventive function of government, which seems uniquely appropriate for a situation in which individual and societal liberties are infringed by the antecedent precautions of a liberal democratic government in an effort to mitigate or supress the spread of communicable disease.[40] Originally articulated by Jeremy Bentham,[41] preappointed evidence is that which is "prescribed in advance…as requisite for the proof of certain facts or the establishment of certain Instruments. It is opposed to casual evidence, which is left to grow naturally out of the surrounding circumstances."[42] The relevance in relation to the COVID-19 pandemic is that there had been a lack of cross-disciplinary dialectic on social or non-pharmaceutical interventions (NPIs) – the actions intended to slow community spread of a communicable disease outbreak[43] – that formed the basis of the COVID-19 public health measures strategy.[44] The problem presented as an urgent need to infringe on liberties without the availability of interdisciplinary preappointed evidence to justify such action.

There is a need for nuance in describing the depth and breadth of the available evidence. Knowledge of NPIs prior to COVID-19 was mainly theoretical, based largely

[40] John Stuart Mill, *On Liberty* [1859] (Kitchener: Batoche Books, 2001), pp. 88-89.
[41] The Works of Jeremy Bentham, published under the Superintendence of his Executor, John Bowring (Edinburgh: William Tait, 1838-1843), 11 vols., Vol. 6. Chapter XIV.: Of Preappointed Evidence.
[42] *Black's Law Dictionary* (Second Edition), p. 927.
[43] Nicola Perra, "Non-pharmaceutical interventions during the COVID-19 pandemic: A review," *Physics Reports* 913 (2021): pp. 1-52, 38.
[44] Canadian Pandemic Influenza Preparedness Task Group, "Canadian pandemic influenza preparedness: Public health measures strategy," *Canada Communicable Disease Report* 45, 6 (2019): pp. 159-63; Tim Colbourn, "Unlocking UK COVID-19 policy," *The Lancet* 5, 7 (July 2020): pp. 362-363.

upon modeling studies[45] that were difficult to validate in the absence of empirical data regarding their efficacy for generating anticipated behavioural changes.[46] These models were designed merely to generate epidemic forecasts useful for public health decision-making, and therefore focussed on transmission characteristics for specific pathogens and social contexts.[47] The deeper economic, social, and political implications of targeted, layered containment (TLC) measures – the implementation of several NPIs that are individually ineffective, but potentially effective together – were well outside the feasibility boundaries of the computational and mathematical models utilized by infectious disease epidemiologists.[48] Nevertheless, social distancing and lockdown strategies had been embraced in the public health sphere circa 2007[49] and trialled in limited form during H1N1,[50] without much notice of implications beyond the public health field.[51] The implication was that interdependent factors and drivers outside of a

[45] The simplest mathematical models of epidemics – SIR models – divide the population into three compartments based on disease status: susceptible (S), infected (I), and recovered or removed (R). W.O. Kermack and A.G. McKendrick, "A Contribution to the Mathematical Theory of Epidemics," *Proceedings of the Royal Society of London. Series A, Containing Papers of a Mathematical and Physical Character* 115, 772 (1927): pp. 700-721.

[46] Caroline E. Walters et al., "Modelling the global spread of diseases: A review of current practice and capability," *Epidemics* 25 (December 2018): pp. 1-8, 5-6. See also the Models of Infectious Disease Agent Study (MIDAS) launched in 2004, https://midasnetwork.us/papers/

[47] Gerardo Chowell et al., "Mathematical models to characterize early epidemic growth: A Review," *Physics of Life Reviews* 18 (2016): pp. 66-97, 67.

[48] S. Eubank et al., "Commentary on Ferguson, et al., 'Impact of Non-pharmaceutical Interventions (NPIs) to Reduce COVID-19 Mortality and Healthcare Demand'" *Bulletin of Mathematical Biology* 82, 52 (2020).

[49] The Centers for Disease Control and Prevention (CDC) made Non-Pharmaceutical Interventions official U.S. policy in February 2007. CDC, *Interim Pre-pandemic Planning Guidance: Community Strategy for Pandemic Influenza Mitigation in the United States— Early, Targeted, Layered Use of Nonpharmaceutical Interventions*, February 2007; World Health Organization Writing Group, "Nonpharmaceutical public health interventions for pandemic influenza, International Measures" *Emerging Infectious Diseases* 12, 1 (2006): pp. 81-87; World Health Organization Writing Group, "Nonpharmaceutical public health interventions for pandemic influenza, National and Community Measures" *Emerging Infectious Diseases* 12, 1 (2006): pp. 88-94; CDC, *Interim Pre-pandemic Planning Guidance: Community Strategy for Pandemic Influenza Mitigation in the United States— Early, Targeted, Layered Use of Nonpharmaceutical Interventions*, February 2007.

[50] J. Alexander Navarro et al., "A Tale of Many Cities: A Contemporary Historical Study of the Implementation of School Closures during the 2009 pA (H1N1) Influenza Pandemic," *J Health Polit Policy Law* 41, 3 (Jun 2016): pp. 393-421.

[51] Thomas V. Inglesby et al., "Disease Mitigation Measures in the Control of Pandemic Influenza," *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* 4, 4 (2006): pp. 366-375; Edward Peter Stringham, "How a Free Society Deals with Pandemics, According to Legendary Epidemiologist and Smallpox Eradicator Donald Henderson," American Institute for Economic Research, 21 May 2020.

narrow epidemiology frame remained unexplored, providing little *aggregated preappointed knowledge* to inform interdisciplinary discourse and balance an expansive set of polycentric interests.[52]

The Cynefin Circumstance

Any novel virus pandemic is likely to be plagued with a preappointed evidence problem that fundamentally changes the governing context for policymakers, particularly in liberal democracies. The unavailability of interdisciplinary preappointed knowledge at the commencement of the COVID-19 pandemic is illustrative of the shifting governing context within which provincial officials found themselves. The Clausewitzian theme of a leader needing to understand the nature of the conflict in which they are engaged is a useful cue.[53] The modern version of this principle, packaged for a business audience, is articulated by Richard Rumelt as "[a] great deal of strategy work is trying to figure out what is going on. Not just deciding what to do, but the more fundamental problem of comprehending the situation."[54] The characteristics of COVID-19 made this extremely difficult.

Although disease transmission models had become increasingly sophisticated, both computationally and in terms of relevance to public health policy decisions, the COVID-19 outbreak had some significant glitches. With no vaccine or effective antivirals for treating illness or reducing transmissibility available, NPIs were the only relevant measures available. Unlike the influenza virus upon which much of existing

[52] Early rebuttals of extensive NPI measures tended to highlight the unknown socioeconomic consequences. The general theory was that "[e]xperience has shown that communities faced with epidemics or other adverse events respond best and with the least anxiety when the normal social functioning of the community is least disrupted. Strong political and public health leadership to provide reassurance and to ensure that needed medical care services are provided are critical elements. If either is seen to be less than optimal, a manageable epidemic could move toward catastrophe." Inglesby, "Disease Mitigation Measures," p. 373.

[53] "The first, the supreme, the most far-reaching act of judgement that the statesman and commander have to make is to establish…the kind of war on which they are embarking; neither mistaking it for, nor trying to turn it into, something that is alien to its nature. This is the first of all the strategic questions and the most comprehensive." Clausewitz, *On War*, pp. 88-89.

[54] Richard P. Rumelt, *Good Strategy/Bad Strategy: The Difference and Why it Matters* (New York: Crown Business, 2011), p. 79. The association with Clausewitz was observed in Thomas E Ricks, "Rumelt on strategy (V): Where he falters, and where he reminds me of Clausewitz in his discussions of 'the hard discipline'," *Foreign Policy*, 21 (October 2011).

modeling had been based, SARS-CoV-2 was an emerging pathogen rather than a novel variant of a familiar human pathogen. A lack of early detection capacity and uncertainly with respect to the demographics of the illness, such as variations in the severity of illness from asymptomatic to ventilator support, complicated effective isolation of infectious people and quarantine of their contacts. The outbreak also coincided with the rapid reorganization of society in terms of near-universal access to high-bandwidth telecommunications and social media. This could greatly facilitate the physical implementation and psychological acceptance of NPIs but also provide pathways for the spread of counter-narratives.[55]

The ability to implement TLC measures overran the scope of pre-pandemic planning and preparations. While these had laid out processes, they did not account for a fundamental change in the governing context. Officials found themselves in an irrational and unpredictable operating context divergent from the one within which these processes had originally been conceived. This was a *Cynefin circumstance*,[56] whereby officials needed to realign to novel operating contexts and adjust decision-making frameworks accordingly.

The Cynefin decision support framework provides a useful illustration of this challenge, as it was designed to allow decision-makers to address real-world problems and opportunities by viewing circumstances from alternate viewpoints and assimilating complexity.[57] The framework is based upon the "principle of bounded applicability," the idea that "there are few if any context-free solutions but many valid context-specific ones."[58] As articulated by Snowden and Boone,

> The framework sorts the issues facing leaders into five contexts defined by the nature of the relationship between cause and effect. Four of these – simple, complicated, complex, and chaotic – require leaders to diagnose

[55] Eubank, "Commentary on Ferguson," p. 5.

[56] As defined by Snowden and Boone: Cynefin, pronounced ku-nev-in, is a Welsh word that signifies the multiple factors in our environment and our experience that influence us in ways we can never understand. David J. Snowden and Mary E. Boone, "A Leader's Framework for Decision Making," *Harvard Business Review*, Nov 2007, Reprint R0711C, p. 2.

[57] Snowden, "Leader's Framework," pp. 1-2. For further on the Cynefin framework see https://www.cognitive-edge.com.

[58] David Snowden and Alessandro Rancati, *Managing complexity (and chaos) in times of crisis: A field guide for decision makers inspired by the Cynefin framework* (Luxembourg: Publications Office of the European Union, 2021), p. 60.

> situations and to act in contextually appropriate ways. The fifth – disorder [or confusion] – applies when it is unclear which of the other four contexts is predominant.[59]

Simple (or clear) contexts are those of *known knowns* with clear causative relationships and self-evident solutions, which require leaders to *sense*, *categorize*, and *respond* within established best practices. Complicated contexts are those of *known unknowns* where cause and effect relationships are more difficult to ascertain, and leaders must *sense*, *analyze*, and *respond* after investigating several *good practice* options. Complex contexts are the realm of *unknown unknowns* where understanding is limited to discerning *instructive patterns* upon which fail-safe experimentation is required to *probe*, *sense*, and *respond* as a path forward emerges. Chaotic contexts lack manageable coherence. This is the domain of "unknowables" where a "leader must first act to establish order, then sense where stability is present and from where it is absent, and then respond by working to transform the situation from chaos to complexity, where the identification of emerging patterns can both help prevent future crises and discern new opportunities."[60]

Leaders may face multiple issue-based contexts at once, and the context may also differ based on the level or specific role within the decision-making architecture.[61] Public health planning and preparation had been conducted within the simple (process orientated) and complicated (the domain of experts) contexts where the environment remained ordered, cause-and-effect relationships could be perceived, and fact-based decision making could deliver *right* answers. But beyond the human health consequences, pandemics cause economic damage and disruption by challenging the continuity of essential services, depressing production levels, and imposing distribution shortages.[62] Lacking preappointed evidence for the wider social, economic, and political dimensions of NPIs and TLC measures, the relationship between cause and effect was not so apparent for whole-of-society governance. The challenge for political leadership within the broader socioeconomic dimensions was more consistent with Cynefin's complex and chaotic contexts.

[59] Snowden, "Leader's Framework," p. 2.
[60] Ibid., pp. 2-6.
[61] Ibid., p. 8.
[62] United Kingdom, *National Risk Register* (Whitehall: Cabinet Office, 2008), pp, 12-13.

Given the limits on timely case detection, isolation of infectious individuals, and quarantine of close contacts associated with initial deficiencies in testing capacity and understanding of variations in the severity of illness, traditional suppression of COVID-19 was unfeasible unless society ceased to function entirely for several weeks. The primary burden for suppressing COVID-19 had to be placed upon NPIs and TLC measures that were virtually untested at a societal scale. This set up a complex public health context under which policymakers had to determine how to reach acceptable outcomes by combining incomplete suppression and feasible controls.[63] This in turn created conditions for a chaotic socio-economic context, since the full consequences of protracted lockdown were unknowable.

The implication for pandemic response is that the fluctuating governing contexts encountered required policymakers at multiple levels and in various roles to think an act outside of normal decision-making contexts. Roadmaps have been developed for leaders navigating these complex and the chaotic domains that may prove useful in interpreting the challenges of policy formulated under these conditions. The original Cynefin literature provides management tools for the complex context that include: opening up interactive communications; setting up barriers to delineate behaviours and regulate systems; stimulating structure and coherence through small stimuli and probes that resonate with people; encouraging dissent and diversity to allow well-forged patterns and ideas to emerge; and managing starting conditions and monitoring for emergence rather than trying to achieve predetermined results.[64] A field guide has also recently been produced to aid in traversing chaotic crises, such as COVID-19, using a Cynefin informed approach. A novel four-stage approach is advocated through which decision-makers assess where they are, adapt to that context, exapt[65] to leverage existing capability, and ultimately transcend the crisis.[66]

Many of these tools and approaches will almost certainly be reflected in some degree as part of the *ex post facto* analysis of governance during Alberta's pandemic

[63] Eubank, "Commentary on Ferguson," p. 5.
[64] Snowden, "Leader's Framework," p. 6.
[65] Within a medical context, *exaptation* is the utilization of a structure or feature for a function other than that for which it was developed through natural selection. Within the Cynefin framework, *exapt* refers to radical re-purposing – repurposing existing structures and working methods to generate radical innovation.
[66] Snowden and Rancati, *Managing complexity*, p. 3.

response. The degree to which novel operating contexts were identified and decision-making frameworks adjusted could provide an indicator of the level of artistry performed by provincial officials. These unsteady circumstances under which decisions relating to critical infrastructure and public order had to be made are important to acknowledge, as this contextual undertone offers a form of resistance against the cognitive biases, misapplied heuristics and intuitive traps previously mentioned.

Challenges in the Critical Infrastructure Sphere

The COVID-19 pandemic's initial encroached upon the traditional domains of security and defence was in relation to critical infrastructure protection (CIP). While tending to be a relatively backwater pursuit in comparison to mainstream military, security, and strategic studies, the CIP lens illustrates oft-overlooked domestic factors that are foundational elements of national security. The Latin *infra*, meaning below or beneath, is a subtle reminder of the importance of this substructure of interdependent networks and manmade systems comprised of industries, institutions, people, processes, and distribution capabilities that collaboratively and synergistically function to provide a reliable flow of products and services essential to the economy, the smooth functioning of government, and society.[67]

Although the epidemiological perspective has tended to dominate *in vitro* COVID-19 discourse, much of what Albertans have experienced relates back to national security considerations. The origins of the conceptual foundation of NPI measures germinated, to a significant degree, from a post-9/11 bioterrorism concern within the George W. Bush Administration.[68] However, this biosecurity spark did not permeate far enough into the security field to catalyze cross-disciplinary analysis of the non-epidemiological domestic effects and challenges of NPI/TLC strategies in the critical infrastructure and other public security contexts. As NPI simulations without socioeconomic dimensions became the basis for pandemic planning for public health agencies throughout Canada, this shift went relatively undetected by security

[67] This definition of *infrastructure* has been adapted from United States President's Commission on Critical Infrastructure Protection, *Critical Foundations: Protecting America's Infrastructures, The Report of the President's Commission on Critical Infrastructure Protection* (Washington, DC: October 1997), p. B-2.
[68] Jeffrey A. Tucker, "The Origins of the Lockdown Idea," American Institute for Economic Research, 15 May 2020.

practitioners.[69] This is apparent in the absence of any mention of *critical infrastructure* or *essential services* in Canada's *Learning from SARS* report.[70]

Security community inattention to NPI/TLC strategies relates to both cognitive and structural drivers. A vividness bias, availability heuristic, and anchoring effect were certainly at play within Canada's post-9/11 security community primarily fixated on terrorism, insurgencies, and more recently cyber.[71] While bioterrorism received attention as a possible threat vector, mainstream CIP – already a relatively backwater pursuit – remained predominantly focussed on protecting physical assets and systems. The protection of humans and livelihoods was merely the by-product of successful CIP. The field in effect focussed on the organs and assumed the blood flow. This manifests structurally as a critical node/link approach to CIP that will subsequently be explained as optimized to parry a guillotine-style terrorist or cyber attack. The broader implication in relation to the pandemic was that this approach created a systemic vulnerability by diminishing the need to understand logistics at local, regional, and national scales.

In the military sense, Henry Eccles viewed logistics as permeating strategy and serving as "the bridge" between the national economy and the operation of military forces in the field.[72] Eccles defined national logistics as "the process of planning for and providing goods and services for the support of the nation's military forces and its operations, a nation's civilian economy, and its international obligations and requirements."[73] In the pandemic circumstance, the challenge has been to intentionally idle the national economy to prevent a collapse of the healthcare system, while

[69] This statement is based on the author's personal experience as a member of the critical infrastructure protection community. While pandemic risks had been articulated in standard risk registers, these risks were generally seems as peripheral or out-of-scope to security community discourse. Likely as a result of communal vividness bias, terrorism, cybersecurity, and natural hazards such as floods and fires tended to dominate.

[70] Health Canada, *Learning from SARS: Renewal of Public Health in Canada, A report of the National Advisory Committee on SARS and Public Health* (Ottawa: 2003).

[71] The vividness bias involves focussing on one vivid scenario while other possibilities or potential alternative hypotheses are ignored. The availability heuristics is characterized by judging the frequency of an event or category by the ease with which instances come to mind. The anchoring effect is characterized as accepting a given value of something unknown as a proper starting point for generating an assessment. Pherson, *Critical Thinking*, pp. 55.

[72] Eccles, *Logistics*, p. 315.

[73] R.B. Hunt, "George Washington University Logistics Research Project 1956, under contract with the Office of Naval Research," cited in Eccles, *Logistics*, p. 45.

simultaneously providing goods and services for the support of the population.[74] The strategic objectives that can be pursued are constrained by what is logistically feasible.

The need to develop a strategy towards acceptable outcomes using incomplete suppression and control relied upon estimates of the situation in which logistics planning, "the incorporation of logistics considerations into the formulation of strategy and tactics," was paramount.[75] Although a form of logistics in support of a negative purpose (i.e., protracted economic demobilization), this challenge has cognitive consistency with Eccles' insight that "command must see strategy in relation to logistics and must see logistics in relation to strategy."[76] Logistical, psychological, and bureaucratic challenges permeate and shape the practice of strategy.[77] Intimate knowledge of the nested provincial economy, how it could be realigned on dissonant objectives, and its resilience to certain forms of intervention was central to polycentric decision-making around public health measure strategies.

As existing CIP frameworks focussed on critical nodes rather than logistical flows through the system, they could contribute only limited knowledge. The CIP community was aware of the three cross-cutting risks – dependence on the workforce to deliver essential products and services; interdependencies within and across sectors affecting the delivery of vital goods and services to innumerable end-users; and reliance on cyberspace, industrial control systems, and information technology to carry out its business functions[78] – but had no information advantage for providing insight and foresight into how NPI/TLC strategies might interplay with these risks.

The critical infrastructure protection programming existing in Alberta at the outbreak of COVID-19 was designed to respond to a legacy threat of terrorist activity[79]

[74] Eubank, "Commentary on Ferguson," p. 5.
[75] Eccles, *Logistics*, p. 69.
[76] Ibid., p. 315.
[77] Boorman, "Fundamentals of Strategy," p. 2.
[78] Public Safety Canada, *National Risk Profile for Critical Infrastructure* (Ottawa: 2014), p. 4.
[79] In March 2003, Alberta's Cabinet approved an inaugural counterterrorism crisis management plan focussed on identifying critical infrastructure in the province and putting in place appropriate security measures. This Plan has also been referred to as "an overall security/antiterrorism prevention or mitigation or defence plan [for] Alberta." Comments by Minister of Intergovernmental Relations Halvar Jonson in Legislative Assembly of Alberta, *Alberta Hansard,* 20 March 2003, p. 643; *Alberta Hansard,* 29 March 2004, p. 758.

and was highly skewed towards the energy sector.[80] While Alberta's *Pandemic Influenza Plan* made brief mention of "Continuity of Services" and identified essential government services, critical municipal services, and business and industry sectors critical to the basic needs of Albertans,[81] there was no existing framework for the complex challenge of identifying essential services, assessing NPI intervention impacts and interdependencies, and then communicating restrictions and supports at a societal level. Like most other jurisdictions, an absence of prior efforts to understand the second and third-order societal implications of implementing NPI/TLC strategies on security sphere domains such as CIP contributed to the scale and scope of the *predetermined evidence problem* and *Cynefin circumstance* confronting Alberta's policymakers.

The underlying anxiety driving contemporary CIP has been the potential for failure of one or multiple infrastructure elements of an interconnected *system of systems* to cascade and affect the resilience of an entire system, industry sector, or region.[82] Given the overwhelming complexity of the aggregate system, CIP has generally focused on identifying and prioritizing potential failure points within delineated sectors that would have the most severe consequences.[83] A guillotine (i.e., complete break or removal) philosophy has dominated, whereby proactive risk management measures are intended to prevent a threat from destroying or incapacitating critical components of interdependent systems.[84] This focus has practical purposes, as it helps estimate whether a component is critical to the operational integrity of the system.[85] Holding the

[80] Government of Alberta, Alberta Regulation 91/2013, *Security Management for Critical Upstream Petroleum and Coal Infrastructure Regulation*. See also Comments by Premier Ed Stelmach in Legislative Assembly of Alberta, *Alberta Hansard,* 7 May 2008, p. 524; Comments by Solicitor General and Minister of Public Security Fred Lindsay in Legislative Assembly of Alberta, *Alberta Hansard,* 19 February 2009, p. 136.
[81] Alberta Health, *Pandemic Influenza Plan*, p. 49.
[82] Duane Verner et al., "Incorporating Prioritization in Critical Infrastructure Security and Resilience Programs," *Homeland Security Affairs* 13, 7 (October 2017): p. 7.
[83] Ibid., p. 11.
[84] As defined by the US President's Commission on CIP: *Destruction* is a condition when the ability of a critical infrastructure to provide its customers an expected upon level of products and services is negated. Typically, a permanent condition. An infrastructure is considered destroyed when its level of performance is zero. *Incapacitation* is an abnormal condition when the level of products and services a critical infrastructure provides its customers is reduced. While typically a temporary condition, an infrastructure is considered incapacitated when the duration of reduced performance causes a debilitating impact. President's Commission on Critical Infrastructure Protection, *Critical Foundations*, p. B-1-2.
[85] Verner, "Incorporating Prioritization," p. 7.

output of a component at zero serves to highlight its criticality as an input. This is a simpler equation to solve than attempting to trace the cascading consequences of fluctuating output within the system, which requires a considerably greater logistical understanding of system dynamics at micro, meso, and macros scales.

Given the need to dissect the complexity of infrastructure systems into opportunities for practical action, CIP practitioners developed a critical node/link approach based on a theory of critical infrastructure evolution known as scale-free network (SFN) theory.[86] Sector networks are comprised of *nodes* (or hubs) joined by *links* (or spokes). The term scale-free is used because the degree distribution – the degree of a node is simply the number of links attached to that node – looks essentially the same at any scale. With most critical infrastructure networks, this scale-free property is the result of the network growing over time with high degree nodes preferring to create links to new nodes rather than attaching to low degree nodes.[87]

Current CIP strategy rests upon three properties exhibited by SFNs. *Small-world property* – meaning that in comparison to the overall size of the network, the relative length of the shortest path between any two nodes is small. *Clustering* – meaning that there is a high density of links within clusters and a much lower density of links between clusters. *Network resilience* – the removal of one or more nodes will diminish the efficiency of the network if it results in a disconnection of some nodes or a significant increase in the distance between nodes. This means that the network is resilient against the removal of a random node, but nodes of the highest degree are highly vulnerable to deliberate attack.[88] This theory supports *critical node analysis*, the identification, and protection of critical nodes or hubs, as the best strategy for infrastructure protection.[89] As is the case with Alberta's legacy CIP programming, this approach tends to utilize sector critical facility lists as the basis for CIP attention.

While a critical node strategy provides efficiency for defence against targeted human-induced intentional threats, it has a two-degree Pareto principle problem in a

[86] Ted G. Lewis, *Critical Infrastructure Protection in Homeland Security: Defending a Networked Nation* (Hoboken, NJ: John Wiley & Sons, 2006), pp. 71-72.
[87] Réka Albert and Albert-László Barabási, "Statistical mechanics of complex networks," *Reviews of Modern Physics* 74 (2002): pp. 47-97; Albert-Laszlo Barabási, *Linked: How Everything Is Connected to Everything Else and What It Means for Business, Science, and Everyday Life* (Cambridge, MA: PLUME, 2003).
[88] Albert, "Statistical mechanics." Barabási, *Linked.*
[89] Lewis, *Critical Infrastructure Protection*, p. 2.

pandemic context. Eighty percent of CIP programming is essentially focussed on 20 percent of sectors,[90] with 80 percent of in-sector programming focussed at just 20 percent of infrastructure. The workings of systems along links and at non-critical nodes and smaller clusters receive little attention as a guillotine attack would be assumed inconsequential the functioning of the network. These assumptions underlying CIP programming were invalidated by the societal level implications of a pandemic. Sector critical facility lists held little utility for pandemic planning and response. The ten sector framework that focussed on critical nodes was also an awkward policy lens for the challenge of an idle economy while protecting interfaces between lifeline products/essential services and end-users. Societal critical functions such as retail and food services were not well allocated.

From an operational perspective, the lack of relevance of CIP programming was not particularly relevant as key protective factors were already in play within Alberta's critical infrastructure community. Recent provincial emergencies, such as the 2013 floods in Southern Alberta and the 2016 Wood Buffalo Wildfire, had tested and refined emergency management systems across major industries.[91] This was an experiential confirmation of two key developments within the community during the preceding decades. The development and broad acceptance of various standards, specifically Canadian Standards Association (CSA) standards *Z731 Emergency Preparedness and Respons*e, *Q850 Risk Management*, and *Z1600 Emergency Management and Business Continuity Programs*, since the early 2000s provided a strong foundation for adaptive planning, preparedness, and response across sectors. The second protective factor was the adoption of the Incident Management System (ICS) within many industries, which streamlined crisis and consequence management activities.[92] These pre-loaded factors

[90] Canadian CIP delineates ten critical infrastructure: Energy and utilities, Finance, Food, Transportation, Government, Information and communication technology, Health, Water, Safety, and Manufacturing. Public Safety Canada, *National Strategy for Critical Infrastructure* (Ottawa: Her Majesty the Queen in Right of Canada, 2009), p. 2.

[91] Flood Recovery Task Force, *Southern Alberta 2013 Floods: The Provincial Recovery Framework* (Government of Alberta, July 2013); MNP LLP, *A Review of the 2016 Horse River Wildfire: Alberta Agriculture and Forestry Preparedness and Response* (2017); KPMG, *May 2016 Wood Buffalo Wildfire Post-Incident Assessment Report* (May 2017).

[92] The Incident Command System (ICS) is a standardized on-site management system designed to enable effective, efficient incident management by integrating a combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure. ICS Canada, *Incident Command System Operational Description* (2012), p. 1.

enabled Alberta's traditional CI sector stakeholders to adapt to and compensate for various NPI/TLC interventions without appreciable disruption to vital outputs. Ingrained business continuity planning and management structures provided a secure foundation for Continuity of Operations Planning (COOP) addressing specific vulnerability, location, and other risk factors in relation to the anticipated impacts of the pandemic.

Although there had been a lack of attention to pandemic response preparations with the Canadian and Alberta CIP frameworks, the offshoots of the Bush Administration's bioterrorism inquiries had produced a US-based CIP model for a pandemic response that was easily accessible. This provided useful initial planning assumptions for CI stakeholders, such as an absenteeism rate of up to 40 percent (attributable to illness, self-isolation, the need to care for family members, etc.) for a duration of 8 weeks and the potential for multiple waves of community outbreak with each wave lasting two to three months.[93] A roadmap for a Pandemic Continuity of Operations-Essential (COP-E) planning process had also been developed by the US Department of Homeland Security (DHS), which provided some granularity for analysis and flexible response to worsening pandemic scenarios.[94]

Infrastructure owners and operators generally remained in the *complicated* Cynefin domain. There was a need to assess and analyze the impacts of absenteeism, supply chain disruptions (both upstream and downstream), and government interventions on their operations, which was relatively straightforward given their intimate knowledge of their own systems. Their response was predicated on reducing three *known unknowns* relating to government intervention: whether special considerations or exemptions would apply to their sector or operation; what forms of regulatory relief would be authorized; and what supports (economic and material) would be available. Responsive liaison and strategic communications, therefore, became the primary roles of provincial and federal governments.

The resultant was that, apart from understandable attention to primary health care networks, deep-seated emergency management and business continuity planning cultures ensured the resilience in all ten critical infrastructure sectors and associated

[93] US Department of Homeland Security, *Pandemic Influenza Preparedness, Response, and Recovery: Guide for Critical Infrastructure and Key resources* (Washington: 2006), p. 13.
[94] Ibid., p. 26.

subsectors throughout the pandemic.[95] Systemic resilience also allowed infrastructure owners and operators to simultaneously risk manage supernumerary threats. Most of these were cyber threat vectors, such as malicious cyber activity impacting the SolarWinds Orion Platform detected in December 2020,[96] the targeting of unpatched remote access services, security appliances and application servers of systems by well-coordinated Advanced Persistent Threat (APT) actors,[97] and opportunistic efforts of APT groups to target organizations involved in the response to COVID-19.[98] That Albertans experienced no tangible outages in lifeline functions such as energy, water, communications, and transportation is a strong indicator of the level of organizational resilience cooked into these systems. However, an increasing vulnerability to a concurrent emergency – such as a natural disaster – was created as workers in many sectors were severely strained and some supply chains compromised.[99]

For policymakers, there was a need to pivot legacy CIP programming to a pandemic context. Given the effectiveness of industry's business continuity planning, there was no concrete infrastructure protection problem for the provincial government to address. Even the typical crisis-related infrastructure assurance problem, the preparatory and reactive risk management actions intended to maintain public confidence in the continued operation of critical infrastructure systems, was effectively blunted by industry planning and adaptability.[100] However, the challenge in idling the economy via an NPI/TLC strategy dictated the identification of the non-essential elements of a complex system of systems. The critical node analysis approach

[95] This observation is based on sector updates to critical infrastructure stakeholders as part of the Alberta Emergency Management Provincial Operations Centre (POC) External Relations – Stakeholder Updates (weekly from 31 March 2020 to 27 May 2020) and recurring National Cross Sector Forum - COVID-19 Teleconferences.

[96] Canadian Centre for Cyber Security, *Alert AL20-029 - SolarWinds Security Incident*, 14 December 2020.

[97] Canadian Centre for Cyber Security, *Alert AL20-025 - Continued Exploitation by APT Actors of Multiple Vulnerabilities*, 21 October 2020.

[98] Canadian Centre for Cyber Security, Alert AL20-016 - APT Groups Target Healthcare and Essential Services – CISA/NCSC, 6 May 2020.

[99] For further on this risk see Aaron Clark-Ginsberg et al., "Maintaining critical infrastructure resilience to natural hazards during the COVID-19 pandemic: hurricane preparations by US energy companies," *Journal of Infrastructure Preservation and Resilience* 1, 1 (2020).

[100] In this context, public confidence has been defined as the trust bestowed by citizens based on demonstrations and expectations of their critical infrastructures' ability to provide products and services at expected levels and to behave consistent with their customers' best interests. President's Commission on Critical Infrastructure Protection, *Critical Foundations*, p. B-2.

underpinning existing critical infrastructure lists provided little utility for this problem. "Essential Services" was a sister, but separate, concept from critical infrastructure in Alberta's *Pandemic Plan*.[101] It was limited in scope to the designation of government essential services and workers in a labour relations context. "Essential Services" was a legal construct for addressing the ability of the public service (the Employer) to provide essential services to the public during a work stoppage as per Division 15.1 of Alberta's *Labour Relations Code* and the *Public Service Employee Relations Act*.[102] Lists of essential public service workers existed within provincial ministry business continuity plans, but an equivalent economy-wide list was out of scope.

Conceptually, the production of a national or provincial level essential services list is akin to reverse engineering, at full economic scale, a *network interdiction problem*.[103] This represents a return to non-scale-free network theory traditionally used by military strategist to attack enemy supply lines.[104] This approach focusses on identifying the least number of segments, or *cut sets*, which will render the network inoperable if removed. The interdiction approach focussed on disrupting the flow through the network with a minimum of effort.[105] Algorithmic modeling is often utilized to accurately determine the best *cut sets*.[106] This approach has a significant scale problem,

[101] Alberta Health, *Pandemic Influenza Plan*, p. 48.
[102] For legal context see *Saskatchewan Federation of Labour v. Saskatchewan*, 2015 SCC 4, [2015] 1 S.C.R. 245.
[103] For a description of the classical network interdiction problem see R. Kevin Wood, "Deterministic Network Interdiction," *Mathematical and Computer Modeling* 17, 2 (1993): pp. 1-18; D.R. Fulkerson and G.C. Harding, "Maximizing the minimum source-sink path subject to a budget constraint," *Mathematical Programming* 13 (1977): pp. 116-118.
[104] For examples in a military context see A.W. McMasters and T.M. Mustin, "Optimal interdiction of a supply network," *Naval Research Logistics Quarterly* 17, 3 (1970): pp. 261-268; P.M. Ghare, D.C. Montgomery and W.C. Turner, "Optimal interdiction policy for a flow network," *Naval Research Logistics Quarterly* 18, 1 (1971), p. 37.
[105] Lewis, *Critical Infrastructure Protection*, p. 102.
[106] Applied to classic decision-making problems involving public transportation, critical infrastructure protection, control of infectious disease, disruption of terrorist networks, and public security, simplified network interdiction problems are commonly modelled as a Stackelberg game (i.e., static two-player, two-stage, master-slave game with perfect information) where an evader attempts to circumvent interdiction resources while moving through a network from a source to a terminus. See Brian J Lunday and Hanif D Sherali, "A dynamic network interdiction problem," *Informatica* 21, 4 (2010): pp. 553-574; Gilbert Laporte, Juan A. Mesa, and Federico Perea, "A game theoretic framework for the robust railway transit network design problem," *Transportation Research Part B: Methodological* 44, 4 (2010): pp. 447-459; Maria P. Scaparra and Richard L Church, "A bilevel mixed-integer program for critical infrastructure protection planning," *Computers & Operations Research*, 35, 6 (2008): pp. 1905-1923; Paola Cappanera and Maria P. Scaparra, "Optimal allocation of protective resources in shortest-path networks," *Transportation*

as larger networks are difficult to effectively model, and determining optimum cut sets requires significant computational power.[107]

In theory, an economy-scale essential services problem needed to identify all flows and cross-sector interdependencies of goods and services (at federal, provincial, and municipal levels) vital to maintaining basis societal function at an economic idle condition, and then compute something akin to an interdependent cut set matrix to determine limits of upstream, midstream, and downstream intervention.[108] These limits represent the maximum degree to which flows could be constrained without choking out immediate lifeline functions. They also represent the need for reversibility of temporary impediments to relative global economic competitiveness (or economic security) – the need to maintain confidence that the flows of goods and services can recover sufficiently to compete in global markets and ensure the return of real incomes. Given the provincial CIP baseline that existed (i.e., in terms of knowledge, frameworks, and capacity) and the need to impose NPI/TLC measures forthwith, such an exercise was wholly unfeasible. What appears to have occurred, was something closer to *first mover imitation*, as an evolution in CIP philosophy that addressed this problem outside of Canada was quickly adopted.

Around the mid-2010s, practitioners began to recognize the limits of the legacy sector and asset approach to CIP. This was driven by technological vulnerabilities and evolving threats such as cyber and foreign actor interference, which represented cross-cutting, cross-sector risks, and associated dependencies that were not easily recognized, understood or analyzed within existing CIP risk management structures. This resulted

---

Science 45, 1 (2011): pp. 64–80; J.D. Farley, "Breaking Al Qaeda cells: A mathematical analysis of counterterrorism operations (a guide for risk assessment and decision making)," *Studies in Conflict and Terrorism* 26 (2003): pp. 399-411; B. Pourbohloul et al., "Modeling control strategies of respiratory pathogens," *Emerging Infectious Diseases* 11, 8 (2005): pp. 1246-1256.

[107] Artificial intelligence is now being applied to such problems to attempt to account for real-world complexity and dynamic versus static conditions. See Kai Xu et al., "Bridging the Gap between Observation and Decision Making: Goal Recognition and Flexible Resource Allocation in Dynamic Network Interdiction," *Proceedings of the Twenty-Sixth International Joint Conference on Artificial Intelligence* (IJCAI-17), p. 4477.

[108] There are three general components to this: 1) identifying and defining critical goods and services; 2) prioritization of critical goods and services; 3) identification of critical workers related to each priority service. U.S. National Infrastructure Advisory Council (NIAC), *The Prioritization of Critical Infrastructure for a Pandemic Outbreak in the United States Working Group, Final Report and Recommendations by the Council* (2007), pp. 26-29.

in renewed interest in a functional level approach, as key dependencies and interdependencies highlighted at this level were not apparent within the sector-based critical node approach.[109] Some jurisdictions began to differentiate "lifelines" and Societal Critical Functions (SCF), or Vital Societal Functions (VSF), as activities maintained by one or more critical infrastructures that provided a given functionality.[110] This approach, which had not yet been adopted in Canada or Alberta, shifted the CIP risk management perspective from the entity level of assets and organizations to "understanding how entities come together to provide services and functions."[111] This provided a critical lodgement for the economy-scale essential services challenge facing provincial policymakers during a pandemic.

American policymakers had the advantage of being informed by a recent societal level disaster in Puerto Rico and a previous examination of critical infrastructure sustainment under pandemic conditions that was part of the Bush Administration's bioterrorism initiative. The need for the contingency identification of critical workers had been reported on by the National Infrastructure Advisory Council (NIAC) in 2007.[112] This work identified a "sharp disparity between the need to protect critical workforce populations and the strategies of current government plans. While current plans tend to prioritize protecting the most at-risk populations, many plans overlook workers who are critical to maintaining the country's infrastructure and critical

[109] United States Department of Homeland Security, *A Guide to Critical Infrastructure Security and Resilience* (Washington: Cybersecurity and Infrastructure Security Agency, 2019), p. 8.

[110] Societal Critical Functions (SCF) focus on what is achieved by critical infrastructure rather than the assets themselves; the functions essential to ensure the basic needs of society (i.e., food, water, heating and cooling, safety and security). SCFs depend on infrastru8cture components such as the power grid, communication networks, road and rail networks, water and sewage systems, fuel supply and logistics, and international shipping routes. These functions have several input factors such as labour, energy, goods and products, transportation services, and information technology. Per Hokstad, Ingrid B. Utne, and Jørn Vatn, eds., *Risk and Interdependencies in Critical Infrastructures: A Guideline for Analysis* (London: Springer-Verlag, 2012), pp. 19-20. See also Swedish Civil Contingencies Agency, *Action Plan for the Protection of Vital Societal Functions & Critical Infrastructure* (Karlstad: 2014), p. 12.

[111] Cybersecurity and Infrastructure Security Agency (CISA), National Risk Management Center (NRMC), "National Critical Functions (NCF) fact sheet," https://www.cisa.gov/publication/ncf-fact-sheet

[112] The National Infrastructure Advisory Council (NIAC) was created by Executive Order in October 2001 to provide the U.S. President, through the Secretary of the Department of Homeland Security (DHS), with critical infrastructure security advice to support the economy. See Executive Order 13231 (16 October 2001), Executive Order 13286 (28 February 2003), Executive Order 13385 (29 September 2005), and Homeland Security Presidential Directive-7 (HSPD-7).

services."[113] A detailed study of critical infrastructure prioritization had advocated the development of mechanisms to clearly identify the priority workforce groups, principally to inform distribution strategies for the efficient use of limited pharmaceutical countermeasures (i.e., vaccines and antivirals) and justify changes in workplace behaviour. Sector-by-sector profiles differentiated and estimated numbers of essential workers using a tiered approach. Tier One encompassed high-value, low-density experts occupying a single point of failure in a complex system (i.e., industrial control and process experts). Tier Two critical workers included limited pools of specific expertise (i.e., specialist doctors, nurses) with specialized training. Tier Three represented a larger pool of "fungible" employees with redundant skills, such as police, fire, paramedics, transportation workers, and tradespeople.[114]

The 2017 Hurricane Maria in Puerto Rico also provided societal-scale lessons regarding how lifeline functions/lifeline systems interacted during and after cascading failures, and the corresponding impacts on the population and the economy. This data provided a mechanism for analyzing critical infrastructure dependencies and interdependencies at a regional level. Analysis of naturally imposed cut sets on regional manufacturing clusters, healthcare supply chains, agriculture, and food supply distribution systems allowed for refined characterization of interdependencies between sectors, sub-sectors, and systems.[115] While the primary goal was to support long-term recovery planning by prioritizing recovery investments, such analysis generated recent and relevant understanding of regional level VSFs that could be coupled to the earlier NIAC work relating to pandemics.

Based on the American's first mover informational advantage, it is logical that the conceptual basis of many of the provincial essential services designations used to implement NPI/TLC strategies appears to relate to the US Cybersecurity and Infrastructure Security Agency's (CISA) released of a set of 55 National Critical

[113] NIAC, *Prioritization of Critical Infrastructure*, p. 39.
[114] 2007 estimates suggested 12,389,077 Tier One employees in the United States, representing approximately 4 percent of the total population. All critical employees (tiers one-three) were estimated at 16,931,725, or 5.6 of the US population. Ibid., p. 9, Appendix C.
[115] U.S. Department of Homeland Security, National Protection and Programs Directorate, *Infrastructure Interdependency Assessment: Puerto Rico (Washington:* Office of Infrastructure Protection, 2018), pp. 172-211.

Functions (NCF) in April 2019.[116] NCFs, grouped into broad categories of *Connect-Distribute-Manage-Supply*, were defined as "the functions of government and the private sector so vital to the United States that their disruption, corruption, or dysfunction would have a debilitating effect on security, national economic security, national public health or safety, or any combination thereof."[117] Adoption of this approach appears to have provided CISA the foundational research and understanding to be a first mover in the identification of "Essential Critical Infrastructure Workers during COVID-19 Response."[118] While the various provincial essential service worker lists subsequently released by Ontario and Quebec (23 March 2020), British Columbia (26 March 2020), and Alberta (27 March 2020) represent regional economic realities and sector delineations, their general resemblance to the CISA roadmap is undeniable. It is also notable that in Canada, the various provincial lists preceded the release of national guidance on essential services and functions on 2 April 2020.[119] The inverse of these lists represents where network interdiction has been applied in order to suppress community spread. The level of reversibility of these self-inflicted cut lines in relation to longer-term economic security is yet to be determined.

What the forgoing chronology of the unearthing of essential services and workers suggests is a need to reassess the utility and focus of CIP programming. Demonstration of the inherent resilience of CI operations undermines many of the legacy assumptions regarding the need for government involvement in the detailed risk management of specific assets, at least in relation to a protracted whole-of-society emergency. There is a parallel here to Henry Eccles' observations about the dangers of self-deception in the importance of logistic effectiveness and "a delusion based upon a failure to understand the nature and magnitude of the logistics base on which the combat forces must rest before they can begin to fight."[120] This typifies the interdependence that Eccles articulated within the military factors of conflict – strategy,

[116] Cybersecurity and Infrastructure Security Agency (CISA), National Risk Management Center (NRMC), *National Critical Functions: An Evolved Lens for Critical Infrastructure Security and Resilience*, 30 April 2019); CISA, "National Critical Functions Status Update to the Critical Infrastructure Community," 2020.
[117] CISA, "NCF fact sheet."
[118] CISA, "Memorandum on Identification of Essential Critical Infrastructure Workers during Covid-19 Response," 19 March 2020; CISA, "Advisory Memorandum on Identification of Essential Critical Infrastructure Workers during Covid-19 Response," 28 March 2020.
[119] Public Safety Canada, "Guidance on Essential Services and Functions in Canada during the COVID-19 Pandemic," originally posted 2 April 2020.
[120] Eccles, *Logistics*, p. 321.

logistics, tactics, communications, and intelligence.[121] The core of the critical infrastructure and essential services challenge within a pandemic context has an *economic understanding* element – being aware of the economic context, implications, and consequences of supply, demand, regulation, competition, and risk factors. This can also be seen as interdependent with Eccles' intelligence aspect.

Intelligence is crucial to the development of *understanding* – the perception and interpretation of a particular situation in order to provide the context, insight, and foresight required for effective decision-making.[122] Military concepts and doctrine provide a useful guide:

> Whatever the context, understanding refers to the acquisition and development of knowledge to enable *insight* (*knowing **why** something has happened or is happening*) and *foresight* (*being able to identify and anticipate what **may** happen*). Developing understanding relies initially on gaining the situational awareness to identify the problem. Analysis of this situational awareness provides greater comprehension (insight) of the problem. Judgements based on this comprehension provide understanding of the problem (foresight).[123]

The *predetermined evidence problem* and *Cynefin circumstance* confronting Alberta's policymakers during COVID-19 were directly related to the level of understanding that could be generated in short order. Mere situational awareness was not enough to address the full socio-economic dimensions of the problem.[124] While *ex post facto* analysis of the decisions that were made in relation to the economy-scale self-imposed network interdiction activities need to be sensitive to this, the key lesson for CIP programming in Alberta is the need to supplant a legacy guillotine philosophy with a lens predicated on developing an understanding of the system-of-system at a functional level.

---

[121] Ibid., p. 315.

[122] United Kingdom Ministry of Defence (UK MOD), *Joint Publication 04: Understanding* (Swindon: Development, Concepts and Doctrine Centre, 2010), p. 2-1.

[123] UK MOD, *Joint Publication 2-00: Understanding and Intelligence Support to Joint Operations*, 3rd Ed. (Swindon: Development, Concepts and Doctrine Centre, 2011), p. 1-7.

[124] In military doctrine, situational awareness is the appreciation of what is happening, but not necessarily, why it is happening. It is the ability to identify trends and linkages over time, and to relate these to what is happening and not happening. UK MOD, *Joint Publication 04.*

The Pandemic's Cognitive Arc towards Public (Dis)Order

The system-level challenges of identifying essential services dissipated near the end of Alberta's first COVID-19 wave, when the frame of reference shifted towards initial reopening strategies. However, these decisions set the conditions for a *collective-to-individual cognitive arc* in the COVID-19 response. Viewing the entirety of the COVID-19 pandemic response in Alberta – from the activation of *Coronavirus Info for Albertans* public communications on 24 January 2020[125] to Stage Three of the *Open for Summer Plan* on 1 July 2021[126] and the ensuing *fourth-wave* commencing in August 2021 – a gradual transition is observable from an institutional/asset focus to a citizen/rights focus. From a security perspective, this arc corresponds with a gradual transition from assuring society critical functions towards peace, order, and good government (POGG) as the matter of primary concern. This represents a shift from the physical and conceptual components of societal readiness into the moral element, and highlights a pandemic timescale element in relation to policy focus that roughly aligns with Maslow's "Hierarchy of Needs."[127]

There is a linear progression from basic (physiological and safety), through psychological (belongingness and esteem), to self-fulfillment (self-actualization) needs as environmental drivers, which is interdependent with the preceding undertones of pre-determined evidence and governing context. This is a logical process, as causal evidence and confidence in satisfying lower-level needs would be expected to grow

[125] The initial timeline for COVID-19 in Alberta was as follows: 17 November 2020: 1st Case in Hubei, CN (Source: *South China Morning Post*); 7 January: China confirms COVID19; 24 January: Coronavirus Information for Albertans website active. Alberta's Provincial Operations Centre (POC) begins tracking as Significant Incident; 25 January: 1st Presumptive Case in ON; 30 January: Situational Awareness to Alberta Critical Infrastructure Stakeholders Commences; 30 Jan: POC moves operational state to Level 2 Augmented - Incident of Potential Significance; 5 March: 1st Presumptive Case in AB; 11 March: WHO declares global pandemic; 12 March: Public Health Restrictions Commence in AB; 14 March: POC moves to Level 3 – Mandatory coordination of key Government of Alberta (GoA) organizations to respond to a Significant Incident; 15 March: Community transmission confirmed in AB; 17 March: State of Public Health Emergency declared in AB. POC moves to Level 4 – Mandatory full GoA coordination for a Significant Incident; 19 March 2020: 1st COVID-19 death confirmed in Alberta.

[126] www.alberta.ca/opensummer

[127] Abraham H. Maslow, "A theory of human motivation," *Psychological Review*, 50, 4 (1943): pp. 370-96.

over time. The significance of this cognitive arc is the suggestion that the moment at which society is closest to transcending the crisis corresponds with a re-emergence of behaviours motivated more heavily by self-fulfillment needs suppressed in early phases of the pandemic. As motivational states for esteem and self-actualization lead individuals in different directions,[128] and as these fundamental motives are connected to immediate situational threats and opportunities,[129] the later stages of the pandemic arc are prone to increasing cognitive and behavioural fragmentation. Egocentric motives can assume priority in some elements of society. Effectively balancing this divergence of interests is impeded by the predetermined evidence problem, and cumulative effects of pandemic response can regress operating contexts back towards complexity and chaos. Earlier decisions in delineating essential services and workers eventually manifest as a public order test.

Collective questioning of the necessity and proportionality of NPI/TLC strategies began to emerge during the second wave of COVID-19 in Alberta. Organizations such as the Canadian Civil Liberties Association reviewed the public health actions of the pandemic's first wave – which they dubbed the "spring of fear" – and suggested that "the government was overreaching, neglecting vulnerable populations, and not following the law."[130] This was a manifestation of the predetermined evidence problem that was most acute at the commencement of the outbreak. It is anchored in John Stuart Mill's classical theory of liberty:

> …the proper limits of what may be called the functions of police; how far liberty may legitimately be invaded for the prevention of crime, or of accident. It is one of the undisputed functions of government to take precautions against crime before it has been committed, as well as to detect and punish it afterwards. The preventive function of government, however, is far more liable to be abused, to the prejudice of liberty, than the punitory function;—for there is hardly any part of the legitimate freedom of action of a human being which would not admit of being represented, and fairly too,

[128] Douglas T. Kenrick et al., "Goal-driven cognition and functional behavior: The fundamental-motives framework," *Current Directions in Psychological Science* 19, 1 (2010): pp. 63-67, 63.
[129] Douglas T. Kenrick et al., "Renovating the Pyramid of Needs: Contemporary Extensions Built Upon Ancient Foundations," *Perspectives on Psychological Science* 5, 3 (2010): pp. 292-314, 292.
[130] The CCLA gave an 'F' Civil Liberties Grade to *Alberta Public Health Act* and *Public Health (Emergency Powers) Amendment Act 2020* (Bill 10). Canadian Civil Liberties Association, "Canadian Rights during COVID-19: CCLA's Interim Report on COVID's First Wave," June 2020, p. 46.

> as increasing the facilities for some form or other of delinquency. Nevertheless, if a public authority, or even a private person, sees any one evidently preparing to commit a crime, they are not bound to look on inactive until the crime is committed, but may interfere to prevent it. … Again, it is a proper office of public authority to guard against accidents. If either a public officer or any one else saw a person attempting to cross a bridge which had been ascertained to be unsafe, and there were no time to warn him of his danger, they might seize him and turn him back, without any real infringement of his liberty; for liberty consists in doing what one desires, and he does not desire to fall into the river. Nevertheless, when there is not a certainty, but only a danger of mischief, no one but the person himself can judge of the sufficiency of the motive which may prompt him to incur the risk: in this case, therefore (unless he is a child, or delirious, or in some state of excitement or absorption incompatible with the full use of the reflecting faculty), he ought, I conceive, to be only warned of the danger; not forcibly prevented from exposing himself to it.[131]

Human judgement with respect to certainty of danger and the "right inherent in society, to ward off crimes against itself by antecedent precautions" is inherently *noisy*.[132] This was certainly the case in balancing between the uncertain dynamics of the COVID-19 virus and NPI/TLC measures considered necessary to: 1) suppress the disease in those who may already have been infected with it; 2) protect those who have not already been exposed to the disease; 3) break the chain of transmission and prevent the spread of the disease; and 4) and remove the source of infection.[133] The high-bandwidth telecommunications that worked as a protective factor for the physical implementation of NPI/TLC strategies increasingly acted as a risk factor for cognitive and behavioural fragmentation as a result of amplification of systematic deviation (bias) and random

[131] Mill, *On Liberty*, p. 88.
[132] Ibid., p. 89.
[133] Alberta, *Public Health Act* (RSA 2000, Ch. P-37), s.29 (2). Authorities also allowed orders to prohibit a person from attending a school, prohibit a person from engaging in the person's occupation, and prohibit a person from having contact with other persons or any class of persons for any period and subject to any conditions that the medical officer of health considers appropriate, where the medical officer of health determines that the person's engaging in that activity could transmit an infectious agent.

scatter (noise) as antecedent precautions entangled with sections two and seven of the *Canadian Charter of Rights and Freedoms*.[134]

As voluntary and consensual compliance with these measures is preferred within liberal democracies, policing of NPI/TLC measures in most jurisdictions was initially limited to the margins. Enforcement activity was a last resort within the typical engage-explain-encourage-enforce continuum.[135] This corresponded with a period of crisis solidarity – a form of "collective effervescence"[136] – in which the population was grounded in a cooperative project to ensure physiological and safety needs. By the fall of 2020, a societal baseline for public confidence in securing these basic needs had been established and segments of Alberta's population began to fragment (or tribalize) cognitively and behaviourally in their pursuit of psychological and self-fulfillment needs that had been suppressed in early phases of the pandemic. This manifested in the emergence of two principal lines of protest activity delineated by those demanding greater government interventions to mitigate the virus and those opposing intervention on intermingling grounds of fundamental freedoms, economics, and anti-government sentiment. Although the primary focus of protest activity shifted to pubic health and tactical adjustments were initially made by some to account for pandemic conditions,

[134] For a discussion of the numerous constitutional issues that emerged in relation to government policy responses to COVID-19 see Sujit Choudhry, "COVID-19 & the Canadian Constitution," *CanLII Connects*, 10 June 2020. For an example of specific arguments (not yet been tested in the Courts) made in Alberta relating to s.2(a) freedom of religion, s.2(b) freedom of expression, s.2(c) freedom of peaceful assembly, s.2(d) freedom of association, and s.7 interests of life, liberty, and security of person see *R v Coates, 2021 ABPC 162*, Docket No. E12837926A, "Notice of Intention to Raise Constitutional Argument," Filed in ABPC Stoney Plain, 14 April 2021.

[135] The strongest predictors of compliance behaviours appear to be associated with moral judgements (i.e., believing proscribed behaviour is wrong), group solidarity and desire to uphold social norms, a moral duty to obey legitimate authority, and habit. Research suggests only a weak correlation between deterrence (i.e., fear of the legal consequences and severity of punishment) and compliance in various situations. Current research suggests that compliance can be enhanced by procedurally just (i.e., respectful, open and accountable) policing activity that focussed on explaining decisions and listening to people, making unbiased decisions, and conveying trustworthy motives. Ben Bradford et al., "Policing the lockdown: compliance, enforcement and procedural justice," University College London (UCL) Jill Dando Institute of Security and Crime Science Special Series on COVID-19, No. 3.

[136] Coined by French sociologist Émile Durkheim, "collective effervescence" refers to moments in societal life, such as religious rituals, where groups unify through the engagement in similar thought and action. See Tim Olaveson, "Collective Effervescence and Communitas: Processual Models of Ritual and Society in Emile Durkheim and Victor Turner," *Dialectical Anthropology* 26 (2001): pp. 89-124.

overall protest repertoires did not change significantly as a result of COVID-19.[137] The key change over the course of the pandemic was a gradual escalation in divisiveness between these movements.[138]

Two activist tribes emerged out of polarization that was driven by a divergence in core beliefs, values, and identity centred on personal agency and responsibility. Membership in these tribes was not necessarily aligned with traditional political ideology or demographic measures. The *interventionist* tribe, focused more on collective responsibilities and injustices associated with noncompliance with public health measures, represented the pro-lockdown position. The *traditionalist* tribe, tending to emphasize independence and self-reliance, represented the anti-Public Health Order (anti-PHO) position. [139] Although relatively small in proportion to the broader population, these entrenched activist tribes subjugated public discourse on pandemic response with the most extreme viewpoints.

The divisive protest and civil disobedience activity that emerged in Alberta, which became a significant public order challenge for policymakers, police, and public health officials alike, had deeper roots than the COVID-19 crisis itself.[140] As Benski *et al* have observed:

> …structural crises do not simply foster social movements per se. These crises need to elicit emotional reactions that in turn can be easily interpreted within existing frames of understanding, or perhaps, people can negotiate

[137] As survey of protest activity in Alberta has not be conducted; however, activity was generally observed to be roughly analogous to U.S. patterns. See Jeremy Pressman and Austin Choi-Fitzpatrick, "Covid19 and protest repertoires in the United States: an initial description of limited change," *Social Movement Studies* (2020).

[138] This divisiveness was not solely catalyzed by the pandemic. Concurrent factors that bled-into pandemic protest cycles in Alberta included: a reinvigorated global Black Lives Matter (BLM) movement in response to the 25 May 2020 death of George Floyd; labour grievances involving health sector workers; solidarity movements in relation to the Indian farmers' protests and the 2021 Israel-Palestine crisis; and the federal election cycle.

[139] This characterization is based upon Stephen Hawkins et al., *Hidden Tribes: A Study of America's Polarized Landscape* (New York: More in Common, 2018).

[140] For an illustration of the public order challenges associated with COVID-19 protests see Greg Martin, "Protest, policing and law during COVID-19: On the legality of mass gatherings in a health crisis," *Alternative Law Journal* (2021); Louise Boon-Kuo et al., "Policing biosecurity: police enforcement of special measures in New South Wales and Victoria during the COVID-19 pandemic," *Current Issues in Criminal Justice* 33, 1 (2021): pp. 76-88; Stephen Reicher and Clifford Stott, "Policing the Coronavirus Outbreak: Processes and Prospects for Collective Disorder," *Policing* (2020).

> and construct new frames that resonate with actors' social/network locations, identities, character structures, and values. Thus emotions such as anger joined with powerlessness may impel actors to claim or reclaim agency by joining/creating networks where alternative visions can be negotiated and actors engage in collective struggles to work toward social change.[141]

The affective reactions and disempowerment associated with NPI/TLC strategies appear to have resulted in the incubation of bespoke ideologies centred in either *personal agency* or *conformity* – both of which represent *a quest for significance*.

The pandemic crisis represented a coalescence of degraded protective factors and increasing risk factors related to socioeconomic cohesion that generated resistance to strategic communications within polarized activist tribes. This was essentially a radicalization process involving motivation, cultural, and social components. Tribal adherents appeared motivated to account for perceptions of loss of significance in individual and social identities, experienced as transgressions against freedoms, beliefs, and values. The cultural component revolved around group narratives that identified the means to regain significance (a justifying ideology) with three components: a grievance –harm suffered by the group; a culprit – an out-group seen as perpetrating the aforesaid grievance; and a method or behaviour – a solution to the problem that appears cognitively justified within the group. The grievances correlated with either public health measure infringement on personal freedoms or noncompliance with interventions. The culprits correlated with government, the Chief Medical Officer of Health (CMOH), Alberta Health Services (AHS), law enforcement, and/or opposing activists. The methods ranged from online activism and lawful protest into civil disobedience, harassing communications, and threats against public officials.[142] The social component revolved around group dynamics, such as social influences and peer pressure, which nurtured a commitment to the bespoke justifying ideology.[143]

---

[141] Tova Benski et al., "From the streets and squares to social movement studies: What have we learned?" *Current Sociology* 61, 4 (2013): pp. 541-561, 545.

[142] Tyler Dawson, "Hinshaw Faced Threats," *Calgary Herald*, 17 September 2021.

[143] This is COVID-19 informed adaption of radicalization to riotous behaviour based on Arie W. Kruglanski and David Webber, "The Psychology of Radicalization," *Zeitschrift für Internationale Strafrechtsdogmatik* 9 (2014): pp. 379-388.

Space limitations preclude the detailed examination of each variation of ideology that appeared within Alberta and the associated levels of personal attachment to them. However, the tactical tribal behaviours within the pandemic can be seen as merely the visible portions of a societal iceberg. Similar to the economic understanding highlighted in relation to critical infrastructure and essential services, the "existing frames of understanding" suggested by Benski *et al* have greater strategic significance. This is embodied in the compendium of risk factors related to socioeconomic cohesion upon which judgments relating to antecedent precautions intermingled. These risks can be categorized as informational, moral, cultural, adversarial, and behavioural.

The proliferation of online echo chambers, epistemic bubbles, and filter bubbles highlights the primary information risk factor.[144] These provide fertile ground for the transmission of cognitive biases, misapplied heuristics, and intuitive traps while simultaneously amplifying communal noise.[145] These human judgement fault lines interface with individual senses of morality and belief. Forces such as political and religious moral foundations, moral narratives, secularism of belief, extreme overvalued beliefs, and moral panics coalesce with the informational factors.[146] Further interactions occur with cultural underpinnings that can shift between Geert Hofstede's dimensions of individualism vs. collectivism, uncertainty avoidance vs. risk embracement, long-

[144] A filter bubble is an isolating algorithmic assumption associated with an online user. An epistemic bubble is an intentional or unintentional avoidance of exposure to opposing view or sources. An echo chamber is active exclusion of information or discrediting of sources outside an affinity group. Eli Pariser, *The Filter Bubble: How the New Personalized Web Is Changing What We Read and How We Think* (Penguin, 2012).

[145] Kahneman, *Noise*, Chapter 8 – How Groups Amplify Noise.

[146] For detailed discussion of these forces, factors, and events see Jonathan Haidt, *The Righteous Mind: Why Good People are Divided by Politics and Religion* (Pantheon, 2012); George Parker, "How America Fractured into Four Parts," *The Atlantic*, July/Aug 2021; Helen Pluckrose and James Lindsay, *Cynical Theories: How Activist Scholarship Made Everything about Race, Gender, and Identity – and Why This Harms Everybody* (Pitchstone Publishing, 2020), p. 263; Tahir Rahman et al., "Extreme Overvalued Beliefs," *Journal of the American Academy of Psychiatry Law* 48, 3 (2020); Jeffrey Victor, "Moral Panics and Social Construction of Deviant Behavior: A Theory and Application to the Case of Ritual Child Abuse," *Sociology Perspectives* 41, 3 (1998): pp. 541-565; Stanley Cohen, *Folk Devils and Moral Panics: The creation of the Mods and the Rockers* (Oxford: Basil Blackwell, 1972); Erich Goode and Nachman Ben-Yehuda, *Moral Panics: The Social Construction of Deviance* (Malden: Blackwell Publishing, 1994); Bradley Campbell and Jason Manning, *The Rise of Victimhood Culture: Microaggressions, Safe Spaces, and the New Culture Wars* (Palgrave, 2018), p. 133; Gad Saad, *The Parasitic Mind: How Infectious Ideas are Killing Common Sense* (Regnery Publishing, 2020).

term orientation vs. short-term orientation, and indulgence vs. restraint.[147] Such cultural forces also have an underlying geographic character[148] and may have been manipulated by external adversarial interests.[149] The entire cognitive stew manifested in bespoke social attitudes and behavioural patterns with variable affective-cognitive-conative consistency imprints[150] and collective action thresholds.[151] The aggregate influence of these factors and forces was the filter through which tribal interpretations of the necessity and proportionality of NPI/TLC strategies were shaped. While these provide a framework for deeper analysis of tribal dynamics that emerged during COVID-19, the level of divisiveness that occurred is a strategic indicator of a degraded "common consciousness" within Alberta (and Canada).[152]

There is an apparent correlation between pandemic tribalism and Lord Durham's 1839 observation of "two nations warring in the bosom of a single state"[153] and the stream of Royal Commissions relating to federal-provincial relations, economic union, bilingualism and biculturalism, and aboriginal affairs.[154] As the Task Force on Canadian

[147] For discussion of the dimensions of cultural variance see Geert Hofstede, "Dimensionalizing Cultures: The Hofstede Model in Context," *Online Readings in Psychology and Culture* 2, 1 (2011).
[148] Joel Garreau, *The Nine Nations of North America* (Houghton Mifflin, 1981); Colin Woodard, *American Nations: A History of the Eleven Rival Regional Cultures of North America* (Penguin, 2012); Dante Chinni and James Gimpel, *Our Patchwork Nation: The Surprising Truth About the "Real" America* (Avery, 2011).
[149] For examples see Alliance Canada Hong Kong, "In Plain Sight: Beijing's unrestricted network of foreign influence in Canada," May 2021; and RAND, "Russian Social Media Influence," 2018.
[150] The *ABC model of attitudes* articulates three components of attitudes: The cognitive component focuses on knowledge. The affective component represents emotions. The conative (or behavioural) component is how the attitude influences behaviour. Sam McLeod, "Attitudes and Behaviours," *Simple Psychology* (21 May 2018). The foundational research is provided in M.J. Rosenberg, "A structural theory of attitude dynamics," *Public Opinion Quarterly* 24 (1960): pp. 319-341. M.J. Rosenberg and C.I. Hovland, "Cognitive, affective, and behavioral components of attitudes," in M. J. Rosenberg, et al. (Eds.), *Attitude organization and change* (New Haven, Conn.: Yale University Press, 1960). I. Ajzen and M. Fishbein, *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research* (Reading, MA: Addison-Wesley Publishing, 1975). Richard T. LaPiere, "Attitudes vs. Actions" *Social Forces* 13 (1934): pp. 230-237.
[151] Mark Granovetter, "Thresholds of Collective Behavior," *American Journal of Sociology* 83, 6 (1978).
[152] As defined by Émile Durkheim: "The totality of beliefs and sentiments common to the average members of a society forms a determinate system with a life of its own." Kenneth Allan, *Explorations in Classical Sociological Theory: Seeing the Social World* (Thousand Oaks: Pine Force Press: 2005), p. 108.
[153] John George Lambton (1st Earl of Durham), *Report on the Affairs of British North America* (London: J.W. Southgate, 1839), p. 7.
[154] For an analysis of the policy implications of Royal Commissions see Gregory J. Inwood and Carolyn M. Johns, eds., *Commissions of Inquiry and Policy Change: A Comparative Analysis* (Toronto: University of Toronto Press, 2014). The Royal Commissions listed above include: Royal Commission on the Indian Act and Indian Administration in General (1947); Royal Commission on Corporate Concentration (1978);

Unity observed in 1979, "[t]here are in Canada…real conflicts, major differences of philosophies, attitudes, objectives and interests among groups and regions."[155] This enduring theme was captured in the celebrated 1947 University of Toronto Gray Lecture, in which Louis St. Laurent's expressed the basic reality that characterizes and limits the pursuit of national interest in Canada: the requirement to contextualize that interest and execute policymaking with constant reverence to the impact of geographic, historical, economic, social, and cultural fault-lines on national unity.[156] This context is critically important, as the peak of the collective-to-individual cognitive arc is merely the beginning of the pandemic recovery stage. This is likely to be an ever-greater strategic challenge, as Alberta will enter this phase with both a wounded economy and corroded consciousness.

Although the Franco-Anglo rift has been the historically dominant theme for national unity,[157] it is worth revisiting the foundational realities of the Canadian condition in a modern light. The cognitive and behavioural fragmentation witnessed during the pandemic is a warning that globalization has overlaid new informational, moral, cultural, adversarial, and behavioural wedges upon a fundamentally unstable common consciousness. The long-term consequences of the pandemic on Alberta's socioeconomic cohesion, and perhaps even its place within the Federation, may depend on the degree to which COVID-induced tribalism can be counteracted. Pandemic recovery will represent a further alteration of the strategic context, which will require

Royal Commission on Canada's Economic Prospects (1957); Royal Commission on the Economic Union and Development Prospects for Canada (1985); Royal Commission to Inquire into Railways and Transportation in Canada (1917); Royal Commission on Dominion-Provincial Relations (1940); Royal Commission on Bilingualism and Biculturalism (1967-70); Royal Commission on Aboriginal Peoples (1996); and The Task Force on Canadian Unity (1979).

[155] Privy Council, *The Task Force on Canadian Unity – Coming to Terms: The Words of the Debate* (Ottawa: Supply and Services Canada, 1979), p. vii.

[156] Secretary of State for External Affairs Louis St. Laurent, "The Foundations of Canadian Policy in World Affairs," Inaugural Duncan and John Gray Memorial Lecture, University of Toronto, 13 January 1947. The lecture was established by George Leishman Gray and an Ontario Department of Education official with the intent of developing "a clearer understanding of the contribution that the French element of our population has made and is making to Canada in the hope that with wider knowledge a sounder citizenship may develop." Adam Chapnick, "The Gray Lecture and Canadian Citizenship in History," *American Review of Canadian Studies* 37, 4 (Winter 2007), p. 446.

[157] St. Laurent's Gray lecture was part of a wider campaign to promote the new Canadian Citizenship Act. For further interpretation of the Gray Lecture see Hector Mackenzie, "Shades of Gray? 'The Foundations of Canadian Policy in World Affairs' in Context," *The American Review of Canadian Studies* 37, 4 (Winter 2007): 459-473.

further evolution of science and art. Understanding the divisive influences of the abovementioned drivers upon identities, character structures, and values is the follow-on *understanding* challenge that will be interrelated to the strategy, tactics, logistics, and communications components of pandemic recovery.

Conclusion

Until such time as the full casual evidence of pandemic response has been deduced and digested, the instinct to critique the artistry of provincial officials in responding to COVID-19 should be suppressed. The critical infrastructure and public order dimensions of pandemic response highlight the undercurrents shaped by the *preappointed evidence problem*, the *Cynefin circumstance*, and a *collective-to-individual cognitive arc*. These provide subplots to the ends-ways-means calculations that had to be made at a provincial level to respond to COVID-19 in the absence of a multidimensional science of pandemic warfare. Sensitivity to the range and complexity of factors that decision-makers were forced to contend with in these dimensions may aid in the discovery of some strategic principles of global pandemic response. Paramount among these is an appreciation for *understanding* as being something beyond mere situational awareness. This is recognition of a particular knowledge and application problem that parallels military-strategic theory and is heavily reliant on insight and foresight as foundations for complex decision-making. Few assessments regarding pandemic response have lent towards "yes or no" decisions. The whole lot has been conducted within the realm of "more or less."[158]

Beyond identifying key drivers to support *ex post facto* analysis across epidemiological, economic, political, and sociological dimensions of the pandemic, there is a key lesson for security strategists emerging from the COVID-19 crisis. Foundational domestic elements of national security, such as critical infrastructure, national logistics, and national unity (or "common consciousness") have generally been overlooked within the Canadian military, security, and strategic studies community.

[158] Winston Churchill utilized this characterization in describing estimates of whether a German self-propelled weapons developed in the late stage of the war would be annihilating or comparatively unimportant. There was disagreement as to whether V2 rockets or pilotless aircraft would represent the greatest threat. Winston Churchill, *The Second World War, Volume Fire: Closing the Ring* (London: The Reprint Society, 1952), p. 189.

Decades of limited liability expeditionary warfare and terrorism-fixation have ingrained a level of superficial small-scale thinking. COVID-19 has provided a reminder of the importance of acquiring deep knowledge within these dimensions for any serious discussion of national security strategy.

Select Bibliography

Alberta Health. *Alberta's Pandemic Influenza Plan*. Edmonton: 2014.

Canadian Civil Liberties Association. "Canadian Rights during COVID-19: CCLA's Interim Report on COVID's First Wave." June 2020. https://ccla.org/cclanewsite/wp-content/uploads/2020/08/2nd-Interim-Report-Working-Document-August-2020-1.pdf

Canadian Pandemic Influenza Preparedness Task Group. "Canadian pandemic influenza preparedness: Public health measures strategy." *Canada Communicable Disease Report* 45, no. 6 (2019). https://doi: 10.14745/ccdr.v44i01a02

Center for Disease Control. *Interim Pre-pandemic Planning Guidance: Community Strategy for Pandemic Influenza Mitigation in the United States— Early, Targeted, Layered Use of Nonpharmaceutical Interventions*. February 2007. https://www.cdc.gov/flu/pandemic-resources/pdf/community_mitigation-sm.pdf

Centre for the Mathematical Modelling of Infectious Diseases COVID-19 working group. "Effects of non-pharmaceutical interventions on COVID-19 cases, deaths, and demand for hospital services in the UK: a modelling study." *The Lancet* 5, vol. 7 (July 2020): pp. 375-385.

Chowell, Gerardo, Lisa Sattenspiel, Shweta Bansal, and Cécile Viboud. "Mathematical models to characterize early epidemic growth: A Review." *Physics of Life Reviews* 18 (2016): pp. 66-97. https://doi: 10.1016/j.plrev.2016.07.005

Colbourn, Tim. "Unlocking UK COVID-19 policy." *The Lancet* 5, no. 7 (July 2020): pp. 362-363.

Cybersecurity and Infrastructure Security Agency. "Advisory Memorandum on Identification of Essential Critical Infrastructure Workers during Covid-19 Response." 28 March 2020. https://www.cisa.gov/sites/default/files/publications/CISA_Guidance_on_the_Essential_Critical_Infrastructure_Workforce_Version_2.0_1.pdf

Cybersecurity and Infrastructure Security Agency. "Memorandum on Identification of Essential Critical Infrastructure Workers during Covid-19 Response." 19 March 2020. https://www.cisa.gov/sites/default/files/publications/CISA-Guidance-on-Essential-Critical-Infrastructure-Workers-1-20-508c.pdf

Cybersecurity and Infrastructure Security Agency. "National Critical Functions Status Update to the Critical Infrastructure Community," 2020.

https://www.cisa.gov/sites/default/files/publications/ncf-status-update-to-critical-infrastructure-community_508.pdf

Cybersecurity and Infrastructure Security Agency. National Risk Management Center. "National Critical Functions (NCF) fact sheet." https://www.cisa.gov/publication/ncf-fact-sheet

Eccles, Henry E. *Logistics in the National Defense*. Harrisburg, PA: Stackpole, 1959.

Eubank, S., I. Eckstrand, B. Lewis, S. Venkatramanan, M. Marathe, and C. L. Barrett. "Commentary on Ferguson, et al., "Impact of Non-pharmaceutical Interventions (NPIs) to Reduce COVID-19 Mortality and Healthcare Demand," *Bulletin of Mathematical Biology* 82, no. 52 (2020). https://doi.org/10.1007/s11538-020-00726-x

Health Canada. *Learning from SARS: Renewal of Public Health in Canada, A report of the National Advisory Committee on SARS and Public Health*. Ottawa: 2003.

Inglesby, Thomas V., Jennifer B. Nuzzo, Tara O'Toole, and D. A. Henderson. "Disease Mitigation Measures in the Control of Pandemic Influenza." *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* 4, no. 4 (2006): pp. 366-375. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.552.1109&rep=rep1&type=pdf

Kahneman, Daniel, Olivier Sibony, and Cass R. Sunstein. *Noise: A Flaw in Human Judgment*. New York: Little, Brown Spark, 2021.

KPMG. *Review of Alberta's COVID-19 Pandemic Response: March 1 to October 12, 2020 - Final Report to the Government of Alberta*. January 2021.

Lewis, Ted G. *Critical Infrastructure Protection in Homeland Security: Defending a Networked Nation.* Hoboken, NJ: John Wiley & Sons, 2006.

Martin, Greg. "Protest, policing and law during COVID-19: On the legality of mass gatherings in a health crisis." *Alternative Law Journal* (2021). https://journals.sagepub.com/doi/pdf/10.1177/1037969X211029963;

McNeill R. and J. Topping. "Federal, provincial and territorial public health response plan for biological events." *Canada Communicable Disease Report* 44, no. 1 (2018). https://doi.org/10.14745/ccdr.v44i01a01

Mill, John Stuart, *On Liberty [1859]*. Kitchener: Batoche Books, 2001.

Pan Canadian Public Health Network. *Federal/Provincial/Territorial Public Health Response Plan for Biological Events*. Ottawa: 2018.

Perra, Nicola. "Non-pharmaceutical interventions during the COVID-19 pandemic: A review." *Physics Reports* 913 (2021): pp. 1-52. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7881715/pdf/main.pdf

Pherson, Katherine H. and Ralph H. Pherson. *Critical Thinking for Strategic Intelligence*, 2nd Ed. Thousand Oaks, CA: CQ Press, 2017.

Public Safety Canada. "Guidance on Essential Services and Functions in Canada during the COVID-19 Pandemic." 2 April 2020. https://www.publicsafety.gc.ca/cnt/ntnl-scrt/crtcl-nfrstrctr/esf-sfe-en.aspx/

Public Safety Canada. *National Risk Profile for Critical Infrastructure*. Ottawa: 2014.

Public Safety Canada. *National Strategy for Critical Infrastructure*. Ottawa: 2009.

Snowden, David and Alessandro Rancati. *Managing complexity (and chaos) in times of crisis: A field guide for decision makers inspired by the Cynefin framework*. Luxembourg: Publications Office of the European Union, 2021.

Snowden, David J. and Mary E. Boone. "A Leader's Framework for Decision Making." *Harvard Business Review* (Nov 2007). Reprint R0711C.

St. Laurent, Louis. "The Foundations of Canadian Policy in World Affairs." Inaugural Duncan and John Gray Memorial Lecture. University of Toronto. 13 January 1947.

United Kingdom Army. *Army Doctrine Publication AC 71940: Land Operations*. Warminster: Land Warfare Development Centre, 2017.

United Kingdom Ministry of Defence. *Joint Publication 04: Understanding*. Swindon: Development, Concepts and Doctrine Centre, 2010.

United Kingdom Ministry of Defence. *Joint Publication 2-00: Understanding and Intelligence Support to Joint Operations*, 3rd ed. Swindon: Development, Concepts and Doctrine Centre, 2011.

United States Department of Homeland Security. National Protection and Programs Directorate. *Infrastructure Interdependency Assessment: Puerto Rico*. Washington: Office of Infrastructure Protection, 2018.

United States Department of Homeland Security. *Pandemic Influenza Preparedness, Response, and Recovery: Guide for Critical Infrastructure and Key Resources*. Washington: 2006.

United States National Infrastructure Advisory Council. *The Prioritization of Critical Infrastructure for a Pandemic Outbreak in the United States Working Group, Final Report and Recommendations by the Council*. 2007.

United States, President's Commission on Critical Infrastructure Protection. *Critical Foundations: Protecting America's Infrastructures, The Report of the President's Commission on Critical Infrastructure Protection.* Washington, DC: October 1997.

Verner, Duane, Frederic Petit, and Kibaek Kim. "Incorporating Prioritization in Critical Infrastructure Security and Resilience Programs." *Homeland Security Affairs* 13, vol. 7 (October 2017).

Walters, Caroline E., Margaux M.I. Meslé, and Ian M. Halla. "Modelling the global spread of diseases: A review of current practice and capability." *Epidemics* 25 (December 2018): pp. 1-8.

World Health Organization Writing Group. "Nonpharmaceutical public health interventions for pandemic influenza, International Measures." *Emerging Infectious Diseases* 12, no. 1 (2006): pp. 81-87. https://doi.org/10.3201/eid1201.051370

World Health Organization Writing Group. "Nonpharmaceutical public health interventions for pandemic influenza, National and Community Measures." *Emerging Infectious Diseases* 12, no. 1 (2006): pp. 88-94. https://doi.org/10.3201/eid1201.051371