

Supply chain capacity to respond to COVID-19 in Newfoundland and Labrador: An integrated leadership strategy

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Abstract

This provincial case study, one of seven conducted as part of a national research program on healthcare supply chain management during COVID-19, focuses on Newfoundland and Labrador (NL). Faced with the destabilization of its traditional supply chain, NL leveraged an existing centralized healthcare supply chain structure to organize its supply chain response to the pandemic. To overcome product shortages, health leaders collaborated with their local business community and industries to source and procure personal protective equipment and create domestic manufacturing capacity for critical supplies. The healthcare supply chain response in NL demonstrates the value of a highly integrated and centralized healthcare supply chain management strategy. It also makes clear the value of a diversified healthcare supply chain, one which draws on local manufacturing capacity to create a domestic source of critical supplies and overcome shortages from global suppliers.

Introduction and review of the literature

The COVID-19 pandemic has shone a bright light on the critical importance of healthcare supply chain. Supply chain and logistics infrastructure is a strategic asset in health systems, which ensures that healthcare workers have the products and equipment necessary to deliver care. It creates safe work environments for the health workforce and enables quality care delivery for Canadians. Supply chain in health systems includes the sourcing and distribution of the products that ensure healthcare teams have access to the right products at the right time in order to deliver safe and effective patient care.¹ In health systems, supply chain teams source a complex and diverse array of products and equipment, from ventilators and intravenous pumps, to medications, vaccines, and Personal Protective Equipment (PPE). And yet, the strategic importance of the healthcare supply chain for health system capacity to deliver care is, for the most part, neither reflected in current research literature nor in the development of health supply chain-specific best practices.

Supply chain disruptions can occur due to natural disasters and public health crises, resulting in severe consequences that put health workers and patients at significant risk. For example, during Hurricane Maria in 2017, electrical grids were wiped out in Puerto Rico, which impacted the production of IV bags manufactured by Baxter.² The resulting shortage in supply of IV bags caused an increase in cost by 600%.² Similarly, a flood in 2012 impacted Sanofi Pasteur, the supplier of the cancer drug ImmuCyst. The result was significant delays in cancer treatment for patients, as manufacturers could not increase production of the drug rapidly enough to meet the demand.³ Public health crises, such as the SARS epidemic, also put extreme pressure on health system supply chains, due to an increase in demand for the critical products required to keep health workers and patients safe. Not only do these crises put the physical health of these essential workers at risk—three of the 44 Canadians who died from SARS were healthcare workers⁴—emerging evidence also

identifies significant impact on the mental health of the workforce. The inadequate supply of PPE and the uncertainty these supply shortages created among Canada's healthcare workforce greatly impacted their mental health during the COVID-19 pandemic.⁵

Healthcare supply chains involve a diversity of stakeholder groups, including patients, clinicians, suppliers, healthcare organizations, group purchasing organizations, distributors, and insurers, which adds to their complexity.^{6,7} Compared to other sectors, however, research and evidence of best practices for healthcare supply chain processes and management lags far behind.^{8–10} While research dedicated to understanding supply chain and logistics has been well established in the private sector, significant gaps in research remain in the healthcare sector.^{11–14} Where research does exist, it often attempts to apply non-healthcare supply chain-specific insights to healthcare supply chain challenges. However, the attempt to translate industrial or non-healthcare supply chain processes to healthcare supply chain management risks eliding the specificity of the healthcare supply chain, especially its unique end point in the care for human life. Practices that are relevant to industrial supply chain management (such as, for example, just-in-time logistics) may not be readily applicable to healthcare supply chain management because any destabilization of the healthcare supply chain may compromise the quality of care and safety of both patients and the workforce. As Aldrigatti et al.¹⁵ note, the standard by which health supply chain capacity is measured, or the required service level of a health supply chain, is different from that of industrial supply chains: “In the context of HSCs [healthcare supply chains], such disastrous events [as disruptions] can potentially

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have devastating effects because human lives are on the table: these networks cannot afford to register missing drugs in the hospital, i.e. it should always perform with service level equal to 100%.”¹⁵

This need for the capacity of a health supply chain to maintain a “service level equal to 100%” helps to contextualize the urgency of the development of strategies for healthcare supply chain resilience, and it is a key differentiator of the healthcare supply chain from industrial supply chains. When the healthcare supply chain breaks down, the result is a direct impact on human life.¹⁵⁻¹⁷ The COVID-19 pandemic has highlighted the urgent need for healthcare supply chain focused research in order to further understand the nuances evident in this sector and to develop healthcare supply chain specific strategies for supply chain management.

This paper reports on case study research of the province of Newfoundland and Labrador (NL), revealing empirical evidence of supply chain processes and infrastructure within and across this provincial health system, during the first two waves of the COVID-19 pandemic. This evidence is analyzed to document leadership approaches and strategies, supply chain capacity to respond, implications for key lessons and leadership strategies to inform effective, agile, and responsive pandemic management for Canadian health systems. This case study is one of seven provincial case studies (British Columbia, Alberta, Manitoba, Ontario, Quebec, Newfoundland and Labrador, and Nova Scotia) conducted to examine health supply chain capacity and infrastructure across Canada, the first national study of health supply chain, funded by CIHR (Ref. # VR5 172669). The case study was designed to respond to the following research questions:

1. What are the supply chain processes and infrastructure required to optimize effective and timely health services delivery for the current and future phases of the COVID-19 pandemic?
2. What procurement models, approaches, and policy frameworks offer secure sourcing of products to meet the surge in demand for care by COVID-19 patients?
3. What is the digital maturity of supply chain infrastructure (and processes) in Newfoundland and Labrador, that, if strengthened, could optimize management of COVID-19?
4. What are the data infrastructure and analytics strategies needed to strengthen the effectiveness of health system supply chain processes to support COVID-19 management?
5. What is the influence of federal government initiatives, from the perspective of provincial stakeholders, on provincial health system capacity to manage COVID-19?

Methods

This case examines the province of Newfoundland and Labrador’s response to COVID-19, highlighting its unique challenges, opportunities, and experiences in healthcare supply chain management during this unprecedented pandemic. The University of Windsor’s Research Ethics Board provided

approval for this project. This case was one of seven, as part of a national CIHR Rapid Research program entitled “*Development of an Implementation Framework to Advance Provincial and National Health System Supply Chain Management of COVID-19*.“ A case study approach was used to understand Newfoundland and Labrador’s healthcare supply chain response during the COVID-19 pandemic. Case studies offer a way to explore and investigate real-life phenomenon through analyzing the context of events and the relationships between them.¹⁸ The primary goal of this case study research was to understand the relationships between leadership strategies, key supply chain management strategies and capacity, and health system response across seven Canadian provinces. The primary data source for this empirical study came from semi-structured interviews with nine key informants. This included nine individual interviews and two group interviews, for a total of eleven interviews. Of the nine individual interviews, four were follow-up interviews with key informants. Document analysis and previous research informed the conceptual framework and interview guide. Purposeful sampling was used to identify the participants who represented varied perspectives and expertise, including healthcare leaders ($n = 4$), government ($n = 1$), and healthcare supply chain experts ($n = 4$). Key informants were contacted by e-mail and provided with a participation letter prior to the interview, identifying information about the study and their role and rights as a participant. Interviews were audio recorded using Microsoft Teams and transcribed by a professional transcriptionist. Key informant responses described experiences, perceptions, and perspectives on supply chain capacity, processes, and health system responses and supply management during the first and second wave of the COVID-19 pandemic.

Anonymity was ensured through de-identification of participants and data (e.g., removal of any potential identifiers, such as individual or organization names), such that only the researchers conducting the interview were aware of participant identities. Coding of interviews proceeded as data were collected, whereby researchers were able to identify emerging themes and concepts to enable reflexivity as interview data were collected and analyzed. Data analysis software, N-Vivo (version 12) was used to assist with the organization and analysis of semi-structured interview data. The following section describes the results of the analysis for this case study.

Provincial context of the Newfoundland and Labrador health system

The healthcare system in NL is organized into four Regional Health Authorities (RHAs): Labrador-Grenfell Health, Central Health, Eastern Health, and Western Health. RHA responsibilities encompass acute care in hospitals, long-term care (often through facilities co-located with hospitals), community care, and public health. Healthcare supply chain governance and management in the province is centralized to one of the RHAs (Central Health). This centralized governance and supply chain management structure (or province-wide shared services model for supply

chain management) was established two years prior to the COVID-19 pandemic, whereby the material management departments in each of the four RHAs were consolidated into one department in the Central Health Authority.¹⁹

This new supply chain governance model was progressing as part of a five-year operating plan at the time of the onset of the pandemic. The healthcare supply chain team at Central Health manages the supply chain teams located in all four RHAs and provides lead supply chain services for four RHAs.

Following the H1N1 pandemic in 2009, NL implemented a pandemic preparedness strategy,²⁰ which included the creation of warehousing space and a pandemic stockpile resource that was managed by one of the RHAs. However, in September 2016, NL decided to stop renting the warehouse space that housed its pandemic supply stockpile of personal protective equipment. After deciding that the product could not be consumed at a regular usage rate, the supply was left to expire and was later discarded. Accordingly, prior to the COVID-19 pandemic, and following the closure of the NL pandemic stockpile warehouse, a much smaller volume of healthcare supplies for NL, including PPE, were stored in hospital settings.

COVID-19 in Newfoundland and Labrador

In January of 2020, NL had experienced an unprecedented snow storm, resulting in 12 to 15 foot snowdrifts. A State of Emergency was in effect for several days in order to manage the impact of this unprecedented storm and much of NL's health system response at this time was focused on managing urgent health services for the population. The impact of the massive snowfall made travel nearly impossible and limited access to essential services such as healthcare services. The first documented case of COVID-19 in Canada was just four days

later, on January 26, 2020. Leaders in NL had little time to prepare for, and respond to, the unfolding pandemic. The key milestones of the COVID-19 pandemic in NL during the first two waves of the pandemic are summarized below and in Figure 1 to provide context for the province's capacity to respond:

1. On March 14, 2020, the first case of COVID-19 in NL was announced by the Chief Medical Officer of Health (CMOH).
2. Between March 15 and March 17, there was an outbreak of COVID-19 in NL, linked to a funeral home, which resulted in 167 cases of COVID-19.²¹
3. On March 18, 2020, a provincial state of emergency was declared and gatherings of over 50 people were prohibited.
4. March 30, the first death in the province was announced,²² with 148 cases in the province.
5. On May 4, 2020, a travel ban was put in place in NL, in which non-residents were prohibited from entering the province.
6. However, on July 3, this travel ban was relaxed to permit the free movement of residents among the Atlantic provinces only (Prince Edward Island, New Brunswick, Nova Scotia, and NL), creating what was called the "Atlantic bubble."
7. On November 23, 2020, with rising COVID-19 cases in New Brunswick and Nova Scotia, NL, and Prince Edward Island announced its intention to withdraw from the Atlantic bubble.²³ Throughout the first months of 2021, various announcements were made concerning the restoration of the Atlantic bubble; however, spikes in COVID-19 cases in the region prevented the full restitution of the bubble.

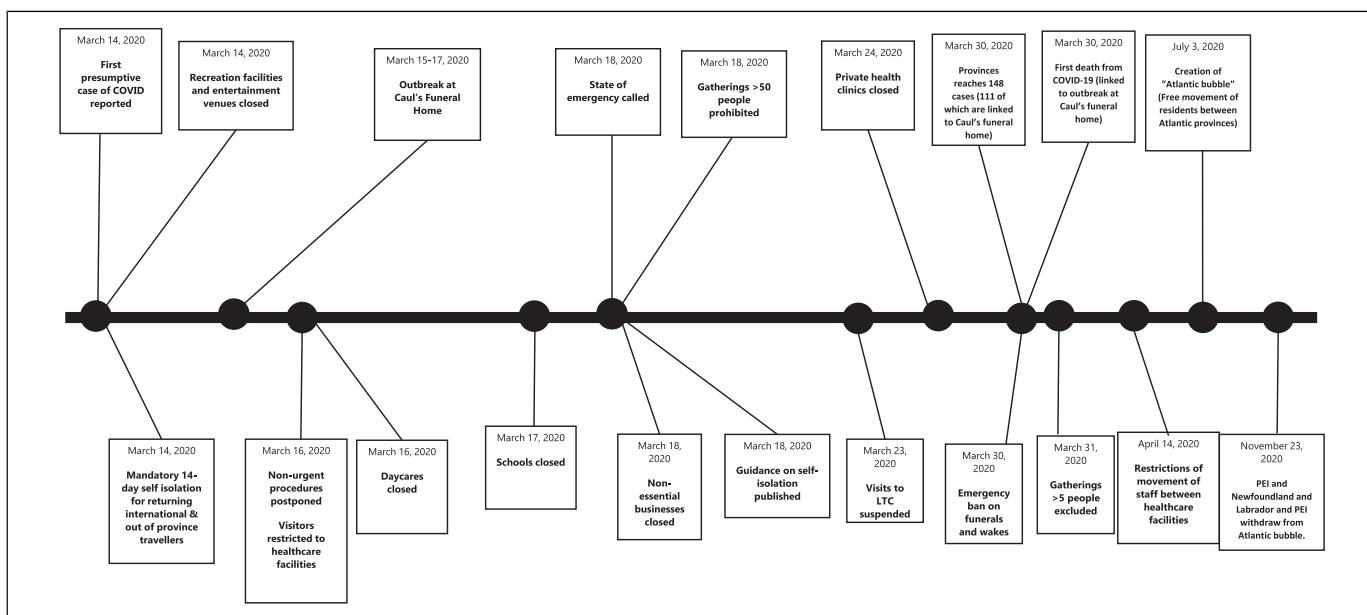


Figure 1. Timeline of key COVID-19 pandemic milestones in NL.

8. As of July 1, 2021, with the successful rollout and uptake of vaccination programs across Canada, all travellers are permitted to enter NL.²⁴
9. To date, NL has had a total of 1,486 cases and only seven deaths.²⁵

The following describe the key findings of the healthcare supply chain case study of the capacity of NL to respond to and manage the COVID-19 pandemic.

Integrated leadership and decision-making strategy

The governance structure for NL's pandemic response was centred on the formation of Emergency Operation Centres (EOCs) in each of the four RHAs with oversight by a provincial EOC, which was led by the CMOH. The provincial EOC made all policy decisions under the leadership of Public Health and the EOCs in each RHA operationalized these decisions to respond to and manage the pandemic across the province. The healthcare supply chain team at Central Health actively engaged with the EOCs in each RHA. NL had already established its supply chain coordination and management processes across the four RHAs, and supply chain processes were centrally managed for all healthcare facilities and care settings, including hospitals, long-term care, and community care. NL had one centralized healthcare supply chain management structure, with a clear delineation of roles and an intentional focus on ensuring every health organization was well served by the centralized supply chain strategy. This was described by a healthcare supply chain leader:

"Moving from decentralized, [from] the 4 materials management [departments] to one supply chain, there were issues, some people always on the fence: will it work or will we get the same service. I think we did build a lot of good will through this whole process that we convinced a lot of people that a centralized supply chain, forget even PPE, but a centralized supply chain can work for the system and not have a bias. Like we service everybody. We balanced out the needs of everybody and it wasn't one RHA over another." (Supply Chain Leader)

As the pandemic unfolded across Canada, NL mobilized its centralized healthcare supply chain strategy to begin to address PPE shortages. The existing shared services health supply chain model proved to be advantageous during this crisis. In the words of another healthcare supply chain leader in NL:

"We would have been two months just figuring that out [a centralized supply chain management strategy] and government would have had to step in, and they would have had to build this." (Supply Chain Leader)

Given the cruciality of PPE for the pandemic response, NL also formed a provincial PPE task force, which included representatives from all of the RHAs, Public Health, Infection Prevention and Control (IPAC), and Occupational Health & Safety (OH&S). This task force was responsible for determining appropriate PPE utilization for the various clinical

teams and health services across the province, a determination which then informed the sourcing, procurement, and distribution of PPE. In addition to this PPE task force, the provincial government in NL designated a deputy minister to provide a specialized focus on supply chain and PPE procurement. This deputy minister both liaised with the Federal government and helped provide financial approval for pandemic purchasing orders. In so doing, NL created a provincial-level strategy for the procurement of PPE, which offered coordination between the provincial government and healthcare supply chain teams, to support responsiveness in the supply chain strategy and pandemic management.

During the pandemic, this province-wide supply chain mandate encompassed all healthcare delivery organizations. Healthcare supply chain teams were responsible for supporting all health organizations, including Emergency Medical Services, personal care, home care, social services, and long-term care. Multiple health leaders in NL stressed the integrated nature of their health system, which encompasses both acute and sub-acute care. In the words of a healthcare supply chain leader:

"We have an integrated system. LTC [long-term care] is fully integrated with our RHAs, so is home support and community care. So, they're all our customers, they're all our family." (Supply Chain Leader)

Accordingly, long-term care (LTC) was prioritized equally with the hospital system relative to supply chain services, as described by one health system leader:

"They [LTC] were supplied the same as our hospitals right from the get-go." (Health System Leader)

Informed by the integrated nature of the health system, NL healthcare leadership took the view that protecting vulnerable populations would help to reduce the demands on the hospital system. A health system leader described this perspective:

"Acute care, we had to be ready for surge, we had to be ready for volumes of patients that might come through Emergency Room as well as be admitted, looking at areas like Medicine, but also significant impact to critical care. And then the other part of the block I'll say within service delivery is LTC. And we saw across the country what happened in LTC. So there had to be protection of that vulnerable population because that other part of it is if they weren't adequately protected, that was going to mean you'd have more people looking to the hospital for support as well. So, everybody had to stay in their box, but supporting each other you know." (Health System Leader)

"We're an integrated health system here in Newfoundland and Labrador, right, so you know, one impact in one area impacts the other area in terms of patient flow. Also, if you look at it from a public health response and community response, if they weren't doing the job that they needed to do then we were going to see spillage I'll say into the other sectors because their job really was you know, protection and control, right." (Health System Leader)

This integration was described by health leaders as a critical and successful component of NL's pandemic response. A centralized,

integrated leadership strategy that served all organizations across the province proved to be a considerable strength for NL's capacity to respond to the pandemic. As transmission of COVID-19 cases in NL were weeks later than cases in Ontario (where Canada's first case was confirmed in January 2020), NL leaders also had the benefit of learning from other provinces.

Supply chain capacity to respond to COVID-19

The global surge in demand for PPE, and the closure of manufacturing in China due to pandemic quarantine, created a very competitive global market for PPE. During the first wave of the pandemic, PPE utilization rates increased by 1,200% in NL. The surge in demand for PPE created a sense of urgency and a high degree of uncertainty regarding the availability of critical supplies.

In late January of 2020, NL healthcare supply chain teams first attempted to source and procure additional PPE supplies in anticipation of the surge in demand by placing orders for PPE with their traditional suppliers. In order to inform pandemic sourcing and procurement strategies, linkages between the NL healthcare supply chain team, clinical leaders, IPAC and OH&S teams were established to inform decisions on sourcing PPE products. Critical products—PPE essential for health system pandemic response—were first identified by these clinical and IPAC teams. Healthcare supply chain teams would then reach out to their contracted vendors to assess if they could meet the demand for these products. However, only small quantities of PPE were received, and orders were delayed well beyond what was expected. Traditional suppliers placed NL on allocation, whereby the quantities of PPE delivered were limited to historic, contracted (pre-pandemic) volumes. In some cases, traditional suppliers were unable to provide even these historic volumes of product, leaving NL facing severe shortages of PPE. A health system leader described this situation:

"Traditional suppliers [...] were of some value, but little. They couldn't help, they had nothing, their answer was you're on allocation, that's it." (Health System Leader)

To overcome product shortages, NL leaders engaged with federal agencies to source products from the federal stockpile. However, only 5-10% of NL's supply needs were able to be met by Federal allocation from the emergency stockpile. Moreover, the supplies that were received from the federal stockpile were often not deemed of sufficient quality, described by a health system leader in NL:

"Even what the federal government was sending up from the national stockpile, a lot of the stuff that they were sending was poor quality, expired, you know, so we were constantly dealing with that while we were in the middle of an outbreak." (Health System Leader)

One government leader in NL suggested that there was also a misalignment between Federal procurement efforts and provincial needs:

"We still run into challenges about knowing or understanding appropriate labelling of what's coming and we still have the

situation that the feds don't necessarily understand what it is we need, and I'll use one small recent example. And it's around gloves. A number of jurisdictions, us included, generally procure universally acceptable gloves, 12" nitro that you can use for chemo, that's generally what we would procure. So, the feds had gone out with an RFP now for 9" nitro gloves ... but we still find that we're not all aligned on what's being procured and does it meet with a standard from Infection Control and Occupational Health & Safety standpoint that provincial jurisdictions are going to accept the product." (Government Leader)

Traditional vendors were unable to supply these critical PPE products, and products available from the federal stockpile were insufficient to overcome the critical challenges in supply shortages. Accordingly, NL healthcare supply chain teams pursued two primary strategies to address the challenges of healthcare supply chain destabilization and the risk of critical product shortages: (i) collaboration with local business leaders to source PPE and (ii) the employment of conservation strategies that relied on allocation frameworks to determine the usage of and ration PPE.

- (1) *Collaboration with the local business community to source and manufacture critical supplies:* A key component of the NL strategy was the collaboration between health leaders and local business leaders to support both the sourcing of PPE supplies through their unique supply channels and the cultivation of a local manufacturing capacity for PPE. A group of 75 private-sector and community volunteers, termed "TaskforceNL," came together and independently went about engaging industrial supply chain networks from sectors such as mining, gas and oil, and retail, to source and procure PPE. Within two weeks, TaskforceNL was able to source and donate over 1.5 million PPE items to the NL healthcare system.²⁶ According to a health system leader in NL, almost all of the local industrial PPE in the province was donated to the healthcare system:

"They got everything from all industry here in the province, anything that was local that people had like the oil refinery, and all the mines in Labrador, we got every piece of PPE they had, they gave it to us. And then they started, because they were supply chain experts, and PPE crosses all industries, not just health right, so they were using their industrial suppliers and they passed those leads on to us and they helped us secure a tremendous amount of PPE." (Health System Leader)

TaskforceNL facilitated connectivity between NL health supply chain teams and industrial suppliers in the local business community, TaskforceNL also established their own sourcing and procurement team, which was focused on alternate sources of products associated with other business sectors. Once TaskforceNL exhausted their PPE sourcing efforts, they turned their efforts toward the creation of domestic manufacturing capacity in NL, which resulted in the local manufacturing of surgical masks, face shields, and medical gowns. The majority of this domestic manufacturing capacity emerged from the re-tooling or re-purposing of existing manufacturing companies.

Business leaders engaged with union leadership to ensure that the domestically-produced products would be acceptable for utilization by frontline healthcare workers. The establishment of a network of local or community partnerships and the creation of a domestic manufacturing capacity were both crucial components of NL's diversified sourcing and procurement strategy. The development of a domestic manufacturing capacity for gowns and face masks helped NL overcome some of the supply shortages and stabilize the supply of critical products:

"Once we spread out everything local and that got us through April [of 2020], we realized we hit the wall on sourcing. And so, the taskforce now, because they were using volunteers and working all night long [and] because of the time difference in other markets, [realized] that we wouldn't have enough [supplies]. So, what they decide to do [is think], "well, maybe we'll start manufacturing PPE here locally." And so, they got all the industrial suppliers in the province and started making face shields. And we got Health Canada approval, so we're using those currently. They decided to make Level 3 gowns. A garments bag manufacturer here, they started making Level 3 gowns and got Health Canada approval. We're using those currently. And they started making surgical masks and we're using those now for all the patients that are entering our buildings. So that really helped." (Health System Leader)

- (2) *PPE conservation strategies:* the NL health system experienced significant shortages in N95 masks, particularly in the early waves of the pandemic. In order to safeguard the limited supply of PPE, NL implemented a series of conservation measures, including the rationing, allocation, and reprocessing of N95s. Each RHA established a system for rationing products, creating guidelines to indicate situations when products such as N95 masks should be used in patient care settings. Through this allocation system, supply chain teams were able to closely monitor and control product orders. NL supply chain leaders also re-distributed products from one organization to another based on prioritization of need, a process described in the following words by a senior health supply chain leader:

"If we got stuck at a certain facility, we often tapped into another facility that probably had a surplus and probably weren't needing it at this particular time. So, we were robbing Peter to pay Paul in some cases too." (Supply Chain Leader)

The use of allocation procedures generated significant concern among healthcare unions in NL, who advocated for the ability of clinicians to make decisions on the use of PPE, guided by precautionary principles. A major source of contention between the provincial teams managing the allocation of PPE and the healthcare unions was the allocation of N95 masks. Both union and health leaders described a tremendous amount of anxiety among the healthcare workforce regarding their personal safety, which was linked to limited access to N95 respirators. The implementation of these allocation and rationing strategies resulted in some work refusals, particularly in the community

health sector. Staff providing patient care in community settings refused to do COVID-19 testing (using nasal swabs) unless they had access to N95 respirators. In the opinion of one clinician leader, these refusals brought to light a disparity in the PPE allocation or rationing framework: notably, N95s were reserved for aerosol generating procedures, which take place primarily in acute care settings. This allocation principle—limiting N95s to aerosol generating procedures—resulted in community health nurses having little or no access to N95 masks, further fuelling fear and uncertainty regarding their personal safety and the safety of the workplace, described in the following by a clinician leader

"In community [care] the access to N95s if the risk assessment told them that they needed an N95, they were not available so either their manager would refuse to let them have access to it or they weren't supplied because the employer's position was, you're not doing an aerosol generating procedure and you rarely do them in community, so we don't need to even have them available there if you needed them. So that was a double standard." (Clinician Leader)

A senior health system leader in NL later reflected on the use of allocation approaches and the ways in which they constrained the ability of frontline healthcare workers to exercise professional judgement in making decisions on appropriate PPE for care delivery and eroded trust between healthcare workers and health leadership. They described this as a major lesson learned from the pandemic:

"If I was doing it [leading the pandemic response] again, I would certainly allow an employee self-assessment to be the trigger, the risk assessment, whatever the outcome of that is." (Health System Leader)

They further suggested that the erosion of trust between health leaders and frontline healthcare workers would be long-lasting:

"I think we'll live with that long past the pandemic. It will take a while for those, because those feelings [of a loss of trust in the health system leadership] are there, especially from nursing, and that's practical nursing and registered nursing, those feelings are there. I do think all jurisdictions will take years to overcome some of the feelings from this." (Health System Leader)

This same leader stressed that the preservation and incorporation of healthcare worker expertise into their decision-making processes was a critical lesson learned from the pandemic:

"It was foolishness! Because how can you tell a professional I'm giving you two [masks] and you, like it just don't make sense and I think of all things, I mean we would never do that normally , if we wanted to understand something we would ask professionals because that's what we're paying them for. We wouldn't tell them how to do this or how to protect themselves. That's a learning." (Health System Leader)

As part of the broader conservation strategy, NL health leaders also considered the sterilization and reprocessing of N95 respirators. However, this strategy—although never implemented—elicited tremendous concern from the health workforce and healthcare unions. Despite engagement of

clinicians and IPAC expertise in the PPE task force to inform supply allocation decisions, this level of clinician engagement was not sufficient enough to mitigate the profound impact that allocation and conservation approaches had on the anxiety and uncertainty experienced by the health workforce.

Data visibility and digital Infrastructure

One of the early challenges faced by NL healthcare supply chain teams was a lack of digital supply chain infrastructure and interoperability across the information technologies in each of the four RHAs. The integrated supply chain strategy was centralized to one RHA; however, digital infrastructure was not yet integrated across the four RHAs to offer a digital infrastructure able to track PPE utilization across the province. As the demand for PPE rapidly surged, health system and supply chain leadership had no ability to track utilization rates (or “burn rates”) of PPE. To remedy this lack of visibility, healthcare supply chain leadership turned to the Newfoundland Centre for Health Information, an organization with the mandate to support the RHAs in the delivery of information technology and eHealth services for the NL healthcare system.²⁷

The Centre collaborated with the RHAs to integrate supply chain data from each of the four independent RHA Meditech systems, and then created programs to analyze supply utilization using dashboard tools to enable tracking of PPE product utilization in each region of the province. Each of the four RHAs possessed a Meditech system that indicated the inventory for their supplies at a central inventory level, but that did not capture product utilization at the point-of-care. Although health system and supply chain leaders did have some visibility to supply utilization based on changes to supply inventory levels, they had little to no visibility into utilization at the point-of-care on clinical units and little to no line of sight to product inventory available in patient care areas. The PPE dashboard provided a provincial overview, and profiled PPE inventories for each of the RHAs. This PPE dashboard provided data for current PPE inventory levels and utilization rates for each RHA, which informed decisions on the volume of supplies needed, the volume of products sourced and procured, and the location of PPE inventories across the province.

A government leader in NL described the limitations of NL health information systems:

“I would say here one of our constraints is the supply chain systems that we have or do not have at our disposal, so everything that we are measuring is from central inventory rather than directly what's on any particular floor or wing or unit. And so, understanding that flow is a challenge, is a major challenge for us and the system you know, we're using a Meditech system which just is not as sophisticated as we'd all like.” (Government Leader)

Conclusions and implications for health leaders

Findings emerging from this case study of the NL health system demonstrated a number of strengths that served as strategic

assets to enable effective response to the COVID-19 pandemic in NL. The first significant strength was the integrated leadership structure, which was well established prior to the onset of the pandemic. The NL leadership approach to managing the pandemic was highly inclusive, whereby all health organizations were prioritized equally for resource distribution. All health organizations were included and supported in the province’s pandemic response and there was equity in their approach—no health organizations were prioritized over others as was evident in other provinces such as Ontario (e.g., the prioritization of acute care over LTC).

The second strength that contributed to the NL response was the highly integrated provincial level of coordination and collaboration in pandemic response efforts, and more specifically, in the management of healthcare supply. Province-level coordination of supply chain efforts coupled with a well-established supply chain management strategy was a key strength for NL. Pandemic response decisions were led provincially by the CMOH, who had significant support by both the Minister of Health and the Premier. A third strength in NL was a rapid and highly effective collaboration with the business community, which was able to rapidly source donations of critical products from across the province and quickly opened new sources of product via unique industry supply channels. The business sector in NL brought impressive strength to PPE sourcing, which made it possible for NL leaders to take the time needed to find new sources of product globally and stabilize inventories for the province as later phases of the pandemic unfolded. NL leader collaboration included engagement with federal agencies for support in overcoming critical supply challenges; however, despite all efforts towards procuring products, federal agencies were unable to offer the needed support in overcoming supply shortages.

Similar to other provinces, NL experienced a number of challenges managing the pandemic. Supply shortages of critical products had a significant impact on the confidence of the health workforce. The utilization of allocation and rationing processes had a profound impact on the healthcare workforce, which is viewed as a key lesson learned for this province. Despite engagement of Infection Prevention and Control experts, collaboration with workforce groups such as unions was limited and the restriction of critical supplies to largely site-specific procedures (aerosol generating medical procedures) resulted in workforce challenges such as work refusals, particularly for community organizations that had no access to N95s.

Leadership insights and lessons learned

This case study has revealed the cruciality of healthcare supply chain functioning to support and enable care delivery in health systems. The NL experience has made clear how quickly healthcare supply chain destabilization can disrupt care delivery in health organizations: lacking a pandemic stockpile and relying on lengthy healthcare supply chains resulted in a profound shortage of critical PPE product supply across the

province. The impact of the allocation of essential supplies by the traditional suppliers reverberated throughout the NL health system: health leadership, fearing an overwhelming surge in COVID-19 cases and a concomitant and sustained surge in demand for critical products, sequestered and allocated the available supplies of PPE. The use of an allocation strategy to conserve supplies impacted the well-being of frontline healthcare workers, who were not afforded the autonomy to exercise their professional judgement through a point-of-care risk assessment. This resulted in both anxiety and an erosion of frontline healthcare worker trust in health leadership. In short, a critical implication of this research is the indispensable and strategic role of health supply chain infrastructure and management in supporting and enabling safe and effective care delivery to patients. Drawing on the LEADS in a Caring Environment framework (LEADS)²⁸ the NL case study makes clear three key leadership strategies:

Collaborative leadership. NL leaders engaged for the most part in a very collaborative and highly integrated leadership approach, in which collaboration with the local business community became a critical component of their supply chain stabilization efforts and the integration of health organizations encouraged the equitable distribution of supplies. Healthcare supply chain teams were integrated into the broader provincial health system pandemic response and government leadership (e.g., the appointed deputy minister of PPE) was deeply attentive to supply chain issues throughout the early waves of the pandemic. However, a key leadership lesson learned was that a fully realized collaborative strategy may have achieved greater success had collaboration been extended to, and engaged with, the healthcare workforce to collaborate on the joint stewardship of PPE resources. In such a joint stewardship model, the professional autonomy of healthcare workers could have been supported by engaging nurses' unions in the co-design of strategies to conserve PPE, while honouring the ability of frontline healthcare workers to exercise a point-of-care risk assessment. A more horizontal joint stewardship model for critical resources could have allowed for health leadership to collaborate with, and be informed by, frontline staff.

Developing coalitions. A crucial aspect of NL's healthcare supply chain pandemic management response was its ability to engage coalitions beyond their traditional network of relationships. A coalition between health leaders and a taskforce of business leaders in NL (TaskforceNL) was highly effective and able to source PPE supplies at a time when they were desperately needed to support the safety of frontline workers. As the coalition evolved, domestic manufacturing of PPE products was an additional source of PPE inventory to support the NL health system. The creation of a domestic manufacturing capacity in NL was another successful outcome of this coalition with the business community, which allowed for the mobilization of domestic suppliers to supply the NL health system with supplies such as surgical masks, face shields, and medical gowns, which contributed to healthcare supply chain stabilization.

System transformation. Supply chain infrastructure is the bedrock upon which healthcare management takes place. Post-pandemic system transformation and recovery will require the recognition that the healthcare supply chain is a critical and strategic asset for health systems. By ensuring that quality products are effectively distributed to healthcare workers, resilient health supply chain processes make it possible for health systems to deliver quality care that is timely and meets the demand for care across the population.

NL's health leadership response, which stressed collaboration and the formation of multi-sectoral coalitions, allowed for innovation and system transformation: the creation of a sustainable, domestic source of critical supplies, which worked to stabilize and shorten the healthcare supply chain. These efforts would have been impossible without building coalitions supported by a collaborative leadership approach that was willing to transform the healthcare supply chain status quo. Where NL health leaders did not enact a collaborative leadership approach, they risked compromising the trust between healthcare workers and leadership. The consolidation of these implications makes clear that the healthcare supply chain (including healthcare supply chain data, infrastructure, and processes) and healthcare supply chain management must be viewed as critical assets for health leaders. The key implications of the NL case study for health leaders include the following: coalitions and collaborative leadership models help to foster supply chain resilience and support health system transformation; the clinical integration of the healthcare supply chain, including the establishment of linkages between healthcare supply chain teams, health leaders, and frontline healthcare workers is essential; the joint stewardship of resources is crucial; and the integration of healthcare supply chain management is an essential component and enabler of supply chain resilience and highly effective health system performance.

In conclusion, the NL case highlights the value and impact of the following:

- coordinated and centralized healthcare supply processes that served all health organizations equitably;
- the importance of dedicated and specialized healthcare supply chain teams, which were well organized across the four RHAs;
- the ability to bring supply chain expertise to provincial decision-making tables; and
- the value of diversified sourcing, which included domestic manufacturing capacity.

These features of the NL healthcare supply chain response can serve as waymarks on the road to healthcare supply chain resilience in Canada.

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