Mackenzie Health's Successful COVID-19 Response

Mackenzie Health

Primary Contact Information:
- Sharon MacSween, Director, Clinical Informatics
- Sharon.macsween@mackenziehealth.ca
- 905-883-1212 ext. 7405

Clinical Project Leads:
- Heather Stewart, Associate Vice President, Acute and Critical Hospital Services
- heather.stewart@mackenziehealth.ca
- 905-883-1212 ext. 7207
- Dr. Katharina Plenk
- Chief and Medical Director, Department of Medicine

IT Project Lead:
- Dr. Victoria Chan, Deputy CMIO and Pulmonologist
- Victoria.chan@mackenziehealth.ca
- 905-883-1212 ext. 7405

EXECUTIVE SUMMARY

Mackenzie Health, an innovative, HIMSS Stage 7 hospital, operating two full-service hospitals including Mackenzie Richmond Hill Hospital and Cortellucci Vaughan Hospital and a network of community-based programs and services we serve a population of more than half a million people across western York Region which is in the Greater Toronto Area in Ontario, Canada. Both hospitals offer a range of core services with specialized programs at each. Between the two hospitals, we see over 200,000 Emergency Visits and 48,999 admissions annually. The organization employs 5200 staff and has 550 physicians credentialed. The hospital is committed to its corporate digital strategy focusing on opportunities to improve clinical patient outcomes through technology**.** Managing bed capacity has been a constant challenge for Canadian hospitals serving highly populated urban centres. Seasonal variations usually push capacity past 115%, especially in the winter months with emergency departments often having upwards of 40 admitted patients unable to be transferred to conventional inpatient beds. At the end of February 2020, prior to the pandemic, there were 437 inpatient beds and 22 critical care beds at the Richmond Hill site of Mackenzie Health. Richmond

Hill is located in York Region just north of the Greater Toronto Area (GTA) in Ontario, Canada. Capacity was already an issue for Mackenzie Health as they were set to open their second site in Vaughan located 10 kms away from its primary location. The plan was to open additional acute care beds (147 beds) to serve the community. The planned opening of the new hospital was 11 months away when the pandemic began. In March 2020 our first COVID-19 patient was admitted to the hospital and was quickly transferred to critical care. From then on, a steady stream of COVID-19 patients filled up the available spaces in the hospital. The Canadian International border was closed, the province shut down restaurants, schools, public areas and severely limited movement, as well as imposing a universal mask mandate to help curb the virus. Managing the increasing patient volumes, on top of existing capacity challenges, was an incredibly challenging situation for the hospital to manage. Additionally, successfully treating the virus was of upmost concern for clinicians at the hospital. As a result of all these pressures, Mackenzie Health's advanced EMR and analytics were constantly put to the test to best assist in the creative planning that was required to survive the pandemic. This case study will show how a HIMSS stage 7 hospital executed a coordinated response to the pandemic through collaboration, clinical excellence and operational efficiency through use of advanced digital health tools and advanced analytics. Due to these positive results, the new hospital site was initially opened as a COVID-19 relief hospital at the request of the Government of Ontario, in February 2021 when COVID-19 cases skyrocketed and there was an imminent danger of a lack of critical care capacity in the province.

Define the Clinical Problem and Pre-Implementation Performance

The Mackenzie Health Richmond Hill location was bursting at the seams. The pressure to provide inpatient beds for the ever-growing population, including Vaughan, a neighboring community, did not have sufficient capacity, let alone when dealing with a pandemic. The densely populated catchment area of the hospital became a COVID-19 hotspot. COVID-19 hit the world in several waves. With each wave there were important lessons learned which informed and guided the response in subsequent waves. It is important to note there was no option to divert patients to other organizations as all hospitals equally were experiencing capacity issues. The main goal was to optimize capacity management and track adherence to current guidelines in order to minimize the COVID-19 mortality rate without raising the mortality of non-COVID-19 patients.

The first wave of patients were mostly travelers, primary contacts with those travelers and long-term care residents. The sickest were mostly elderly and immunocompromised patients that became severely ill or required critical care. There were a few emerging outcomes from this first wave from March 1, 2020 to June 30, 2020. Mortality rate in the first wave was 22.0% and most of the deaths were elderly patients over the age of 80. Patients did not realize they were hypoxic (happy hypoxia phenomenon). There was little information as to how to treat these patients at the start of the pandemic. It was critically important from a hospital standpoint to know where the patients were coming from to get a handle on the location of where the virus was mutating because of the contagious nature. Identifying locations of clusters of infection could help with limiting the spread of COVID-19 and allowed the hospital to identify Vaughan as a hotspot and allowed for opening of Covid Assessment Centre for testing as well as vaccination centers to target the areas where the infection was high. It was vital for the management of patient flow to know which patients tested positive. COVID-19 lab tests for the hospital were outsourced to an external lab and due to the pressure of the incredible, province-wide volume of PCR tests, the turnaround time for results increased. PCR tests did not integrate with the hospital EMR system requiring each test result to be faxed and manually transcribed into the system by laboratory staff. The time to transcribe each lab result was 5 minutes. This time did not include any follow up or tracking down of missing specimens. As testing became more widespread, pressures mounted on resulting PCR labs in the province. Turnaround times increased from 48 hours to over 96 hours as rising cases overwhelmed the resources available. Knowing if a patient was positive or negative had huge impacts for many downstream systems including public health would have to provide surveillance for every patient until their status was confirmed as negative.

Even though we had five regular and three critical care COVID-19 admissions per day at most during the month of April 2020, entire dedicated wards were established to help limit the spread and often up to 25 beds were blocked to support infection control protocols which subsequently put pressure on an already overloaded system.

The concern at the end of the first wave was that epidemiologists and infectious disease specialists were predicting the next wave to be much longer and larger than the first. With critical lessons learned from the first wave, the hospital was challenged to handle an increasing burden of patients in subsequent waves.

Design and Implementation Model Practices and Governance

At Mackenzie Health, treatment guidance for COVID-19 was collaboratively provided by Infectious Disease, Respirology (Pulmonology), Critical Care and the Chief of Medicine. This group continually curated emerging therapies. As the pandemic progressed changes were so constant that adapting to workflow changes and new interventions was very challenging.

The Senior Management team established an Incident Management System (IMS) response committee that met daily to plan resources based on the evolving challenges presented as a result of COVID-19. This group guided the work of the Capacity Optimization Resource (COR) team, which managed patient flow.

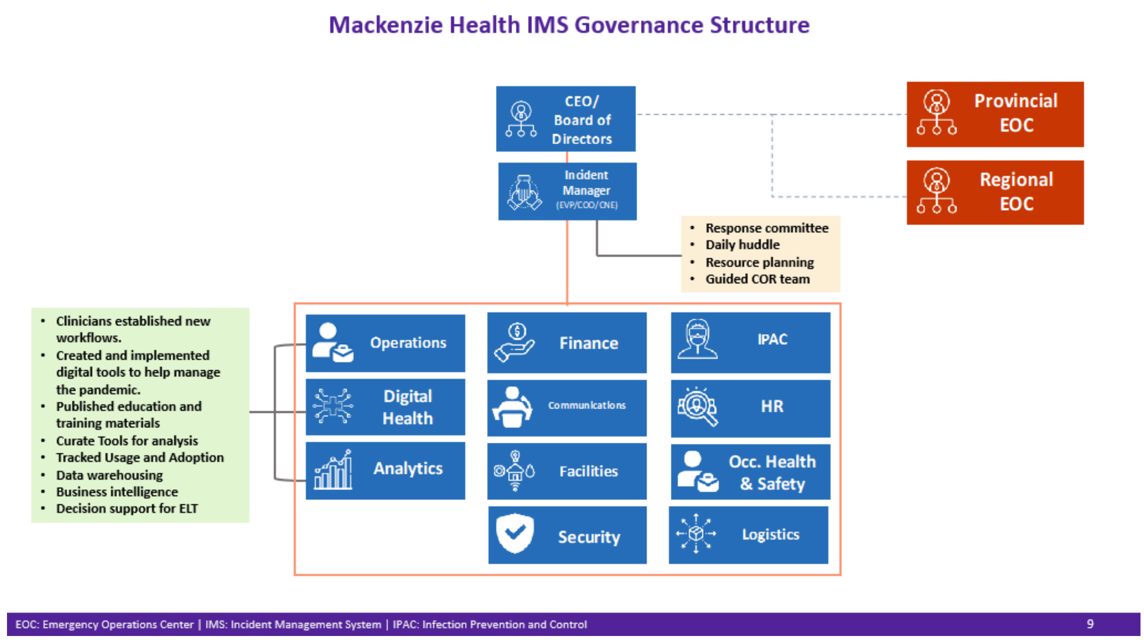


Fig 1

Information, Communication, Automation and Technology (ICAT) champions included the CMIO/CIO (an active intensivist), Deputy CMIO (Director of Analytics and Pulmonologist), Director of Clinical Informatics and Chief Technology Officer (CTO) and were responsible for the selection of technology tools that were used. Operational and clinical leads, working collaboratively with Clinical Informatics, created, tested and moved to production digital tools to help manage the pandemic.

Traditional ICAT governance was not possible during this time and the work was approved and endorsed by the SLT IMS response committee. End users, who were mostly clinicians, established workflows, while analytics tracked usage and progress.

This applied to the COVID-19 Registry, drug shortage rationing management, treatment protocols and predictive models. From a clinical perspective, the CMIO/CIO and Deputy CMIO, under the guidance of the corporate treatment guidance team, served as champions of technology workflows, constantly meeting with the EMR and analytics teams to improve the usage of the tools and the measurements. A standard change management process was maintained to ensure tools were vetted prior to going into production to ensure the integrity of the EMR.

From an analytics perspective, development teams met on a regular basis, also curating tools used for analysis. One of the key tools, a COVID-19 registry was developed. Critical up to date information was stored in a data warehouse. In this way, real time dashboards showing the flow of COVID-19 patients, their ventilator and oxygen needs, positivity rates and Emergency to Inpatient to ICU to discharge status could be used to inform the corporate IMS in real-time. Historical data trends were tracked on business intelligence software (Tableau). Historical and real time dashboards were integrated together to inform the Senior Team, the Corporate IMS, operations and clinicians at the hospital. These dashboards were utilized daily by the leadership at Mackenzie Health to make informed decisions on capacity.

As the EMR was evolving at a rapid rate including changing interventions and protocols to respond to the pandemic, a variety of training tools were developed and published to educate all end users of the EMR. This included real time instruction, tip sheets, and videos. Changes were built within the workflows of the EMR to help the clinician adapt to the new changes. Physician leadership was tasked with disseminating the needed information and utilized the EMR team to imbed the needed information in areas that were accessible such as the Learning Home Dashboard and within the EMR toolbars themselves.   When staff were redeployed from areas such as Surgery that were no longer working, they were trained in the areas of critical care, emergency and other hard-hit departments to help relieve stress on staffing issues as a result of the Covid-19 infection and burnout.

Clinical Transformation enabled through Information and Technology

CAPACITY MANAGEMENT

A COVID-19 registry, which formed the basis of all analytics during the pandemic, was created within the first few weeks of the onset of COVID-19 using the case definition provided by our infection prevention and control department. Some examples of information captured in the registry include demographics, test positivity or negativity, date of COVID-19 positive start and end, ventilator usage, vaccination status, patient movement throughout the hospital, discharge disposition, etc. A provincial directive postponed all elective surgeries to create capacity. In many hospitals serving COVID-19 hot spots, this was still not adequate to accommodate the surge. Real time dashboards pulled in structured data from the EMR. This information was critical to COR (the internal capacity management department) with real-time statistics vital to patient flow.

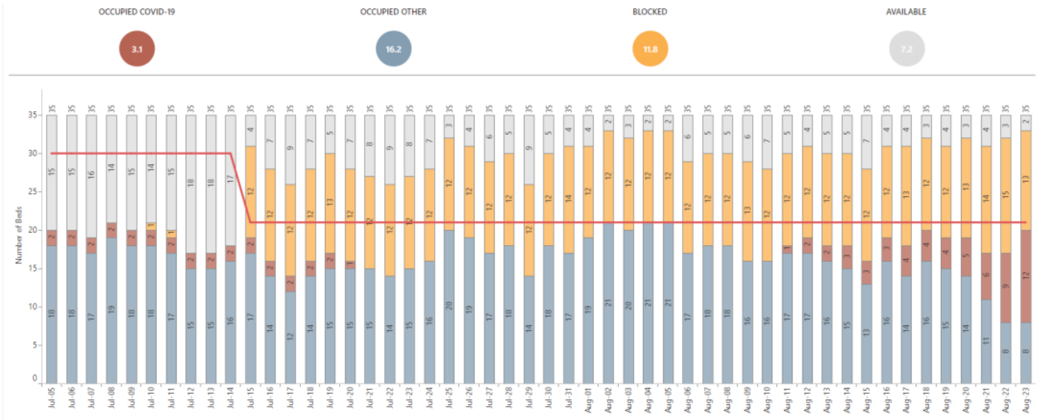


Figure 2 – example of dashboard used to track patient flow, blocked beds, COVID-19 occupancy

LAB INTERFACE

A digital lab interface was created between Dynacare, an external lab, and the hospital's EMR to seamlessly transfer COVID-19 PCR test results. This freed up valuable hospital resources (based on a typical day, 1000 PCR daily test volume would equate to 83.3 hours of effort to transcribe manually) as well as decreasing the turnaround time from 96 hours to 24 hours in the early days of the pandemic. With a positive test result, the infection status of the patient was changed electronically to COVID-19 positive (start date was collected in the registry) and the patient was automatically put into isolation. This aided COR to cohort COVID-19 patients into a dedicated isolation ward which decreased the risk of spread to other patients and staff and aided in starting treatment protocols early.

ANALYSIS BY GEOLOCATION

A geographic analysis heat map was created to visually show the hot spots for COVID-19 in the hospital's catchment area even before it was evident to the region's public health unit due to our real-time availability of test results. Test positivity rates were tracked along with age and demographics. These tools, using characteristics of the first wave, were able to predict a surge in ED visits, ward admissions and/or ICU admissions, giving early warning when to open COVID-19 units, extra critical care beds or COVID-19 Assessment Centres. Data showed a surge in test positivity rates and volumes of greater than 5% resulting in inpatient surges anywhere between 2 and 4 weeks and then followed by ICU surges 2 weeks after that. In the summer and fall of 2021, the hospital proactively prepared for an inpatient surge 2 weeks ahead of time. An excellent example of this at work was tracking widespread gatherings during the World Cup and showing the correlation to the surge that occurred two weeks after the event.

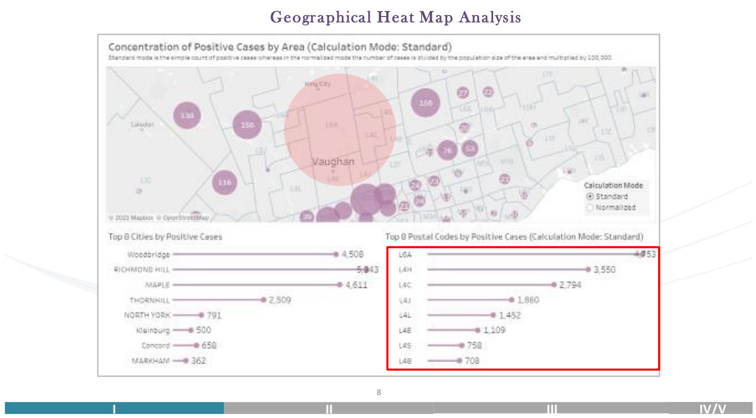


Fig 3

REAL TIME COVID-19 DASHBOARDS

One goal of capacity management was to predict, manage and optimize the scarce resources (ventilators, ICU beds, ward beds) using analytic tools. Dashboards were created to demonstrate the use of high flow oxygen devices and ventilator usage which served as an early warning for the need for critical care beds. The information was pulled from flowsheet data within the EMR and existing device integration to give accurate counts in real time.

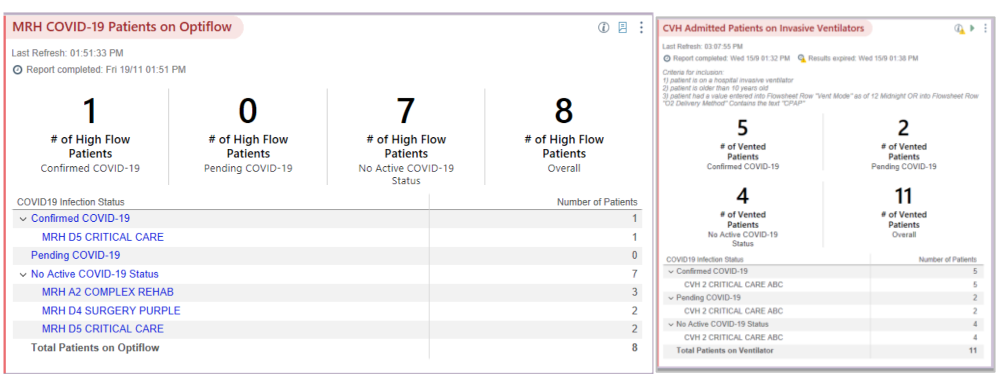


Fig 4

TRACKING MORTALITY LENGTH OF STAY OF COVID-19 AND NON COVID-19 PATIENTS

It was important to Mackenzie Health Senior Leadership that the mortality of non-COVID-19 patients were unaffected by the diversion of resources to the pandemic. Mortality rates not only for COVID-19 patients but for other high volume medicine cases were tracked including patients with congestive heart failure, stroke and chronic obstructive lung disease. Length of stay for these population of patients was tracked internally and externally for COVID-19 and non-COVID-19 patients. Mortality at Mackenzie Health due to COVID-19 was compared using coded data to five peer hospitals. Data was pulled from a provincial database and risk-adjusted for factors such as age, sex, length of stay in days, admission category, transfer, comorbidity using Charlson Comorbidity Index (al, 1987). Raw mortality rate was defined as the numerator which are the number of patients coded as death from COVID-19 over denominator which is the number of active cases for that time period. The data was pulled in a standardized manger from IntelliHealth, a provincial coded database for all acute hospitals in Ontario (ref)

To ensure morale was maintained certain metrics such as mortality data was available only for the Senior Leadership team. Each metric that was developed had an intended audience. Those metrics would be made available real-time to the staff that required them. The EMR was flexible and allowed for real-time reporting as appropriate.

VACCINATION STATUS MONITORING

In Wave 1 of the pandemic, we learned older patients, especially those over age 80, had higher admission rates and thus monitoring the test positivity rates in each age group helped predict an inpatient surge. We monitored our own population independently of our local public health unit to gauge when to open additional dedicated COVID-19 wards. As vaccines became available provincially, they were first offered to first responders and the oldest and most vulnerable population that being in long term care homes. Those that were vaccinated first suddenly decreased as the inpatient population but as the lower successive age groups waited for their vaccines, that same younger middle-aged populations became infected and started filling inpatient and ICU beds.

The government of Ontario managed vaccines for the province and the information was not integrated in any of the hospital EMRs. As a result, vaccination status was not readily available. As this information was important to Mackenzie Health, Pharmacy staff would enter the patient's vaccine status as part of the medication reconciliation. This information was then published on a header in the EMR allowing clinicians to use this information in predicting severity or mortality. There was no AI algorithm associated with this, but physicians used clinical judgement and available data on vaccine status together with symptoms on presentation. Our local data showed earlier then Public Health data that full vaccination (2 doses of the COVID-19 vaccine) protected against ICU admissions and deaths. This gave valuable information to predict outcomes for the clinicians, as to which patients would be at higher risk for high flow oxygen or ICU admission. Numerator for this information was the number of patients with a particular vaccine status and the denominator was the deaths in each age group.

STANDARDIZED TREATMENT AND PUBLISHED GUIDELINES

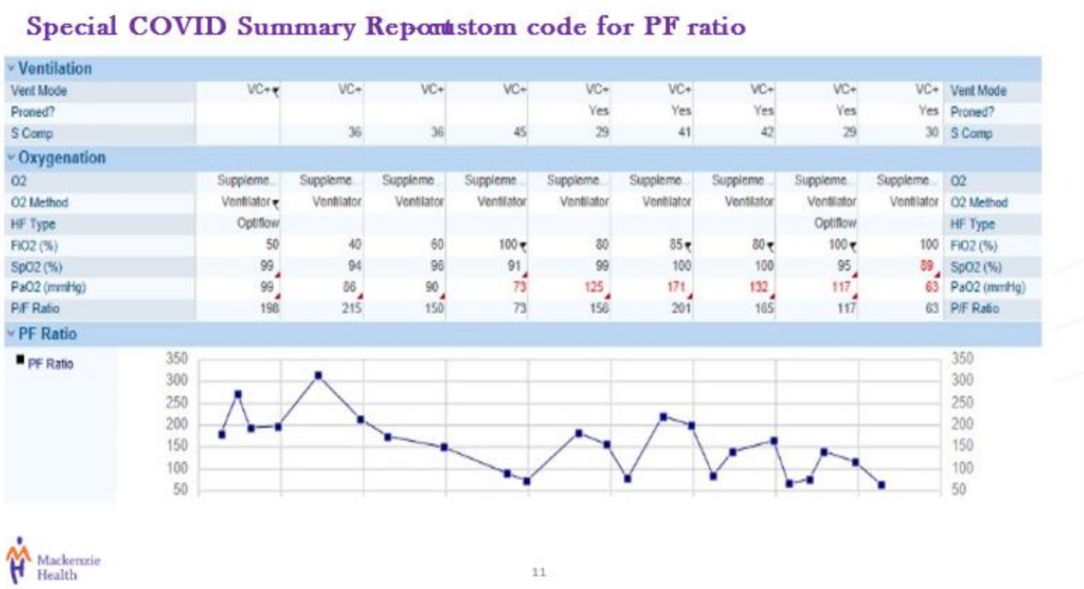
Standardizing treatment for COVID-19 was a clinical goal of the hospital using the best available guidelines to ensure compliance and standard of practice. By the late spring of 2020 hospitals in England began using Dexamethasone to reduce the mortality rate of patients requiring oxygen and this preliminary information was made available online. The Recovery trial which was published in preliminary form on July 17, 2020 in NEJM (1. ***N Engl J Med 2021; 384:693-704)***. It was not in the final paper what threshold was used and suggested following "local guidelines". Through web sleuthing it was discovered that the threshold for starting oxygen was between 92 to 96% in the United Kingdom. It was decided internally that a new threshold might improve mortality as it did in England. We chose to treat at 94%. Proning patients improved shunt and perfusion in the lower lobes. Dexamethasone, oxygen and proning were three initial strategies that were published in a COVID-19 guideline, a living document placed in an easily accessible location of the EMR for all clinicians to review. It was updated almost every week as treatments evolved. As new therapies became available, such as Remdesivir, Tocilizumab, Sotrovimab etc., these were incorporated into the latest guideline and published.

TREATMENT ADHERENCE TRACKING

Adherence to the guidelines were tracked as the number and percentage of COVID-19 positive inpatients (defined by infection status), all ages who were treated with oxygen and Dexamethasone over the total COVID-19 inpatients as the denominator measured over time to determine rate of adherence. This was also done for Remdesivir, Tocilizumab, Sotrovimab. Compliance charts over time were shown to the clinicians on a weekly to monthly basis. Time to treatment modalities were also measured to ensure timeliness of implementing these measures (2. COVID-19 guideline – internal publication)

SPECIALTY SUMMARY VIEWS

A custom streamlined COVID-19 Summary Report, created by the CMIO/CIO, was placed on the main navigator page of the EMR and was made available to all clinicians treating COVID-19 inpatients. The report became a standard Vital Statistics reference page for all clinicians displaying vital signs, inflammatory markers, drugs used or not used and proning positioning. The PF (PaO_2/FiO_2) ratio chart was built from custom code internally. Clinicians could easily see the effect on the PF ratio graph from proning on intubated patients. The target was to increase PF ratio above 300 from prone positioning, an old strategy from ARDS management, that increases perfusion and shunt ratios to the lower lobes of both lungs, an important aspect of supported care of ventilated patients.



Ventilation										
Vent Mode	VC+	VC+	VC+	VC+	VC+	VC+	VC+	VC+	VC+	Vent Mode
Proned?					Yes	Yes	Yes	Yes	Yes	Proned?
S Comp		36	36	45	29	41	42	29	30	S Comp
Oxygenation										
O2	Suppleme...	Suppleme...	Suppleme...	Suppleme...	Suppleme...	Suppleme...	Suppleme...	Suppleme...	Suppleme...	O2
O2 Method	Ventilator	Ventilator	Ventilator	Ventilator	Ventilator	Ventilator	Ventilator	Ventilator	Ventilator	O2 Method
HF Type	Optiflow							Optiflow		HF Type
FiO2 (%)	50	40	60	100	80	85	80	100	100	FiO2 (%)
SpO2 (%)	99	94	96	91	99	100	100	95	89	SpO2 (%)
PaO2 (mmHg)	99	86	90	73	125	171	132	117	63	PaO2 (mmHg)
P/F Ratio	198	215	150	73	156	201	165	117	63	P/F Ratio

Fig 5

COVID-19 PATHWAY AND ORDER PANELS

A COVID-19 clinical pathway was developed incorporating all the latest guidelines in the EMR. This electronic pathway guided therapy for clinicians during the first critical days of admission. From a nursing perspective, patients were encouraged to prone for most of the day. Treatment options like Tocilizumab, Remdesivir, Dexamethasone or other biologic agents were incorporated in the order sets. Rationing of important drugs that were in short supply such as Tocilizumab warranted creating criteria so that the most critical patients got the drug ahead of milder patients. Drug ordering was based on deterioration and inflammatory markers and these criteria were built into an order panel to encourage guideline adherence.

Improving Adherence to the Standard of Care

The first medical guideline implemented came out of the recovery trial in the UK published on the internet by the New England Journal of Medicine in July 2020. Mackenzie Health clinicians treated patients with oxygen with a threshold for treatment mostly at 89%. Through querying the flowsheet data, we were able to study when the clinicians started oxygen. A new EMR order was put into place instructing nurses to apply oxygen to keep saturation above 94 %. Oxygen stats were stratified according to the threshold to which oxygen was started. Patients who started on oxygen were to be treated with Dexamethasone at the same time. A report measuring the number of patients in which Dexamethasone and oxygen were given over the total number of COVID-19 patients was published on a regular basis through a real-time dashboard. Similarly, Remdesivir and Tocilizumab were tracked. Fig 6 Remdesivir was anti-viral where timing to the onset of symptoms was important and Tocilizumab was an expensive immune modulator that was given to deteriorating patients based on scarcity and maybe late treatment t did not always reverse the downward trajectory of the patient. In the left part of this graph below, oxygen was given but Dexamethasone, which had been shown to decrease mortality in the Recovery trial, was not given until the summer of 2020 and usage was not widespread until after this time period. Treatment adherence improved from 22% prior to implementation of tools to 89% post implementation. Graphs of this nature were shown regularly to the clinicians at departmental meetings. Graphs show threshold starts for oxygen were tracked and an EMR order panel was created to keep oxygen saturation above 94% (instead of 89%).

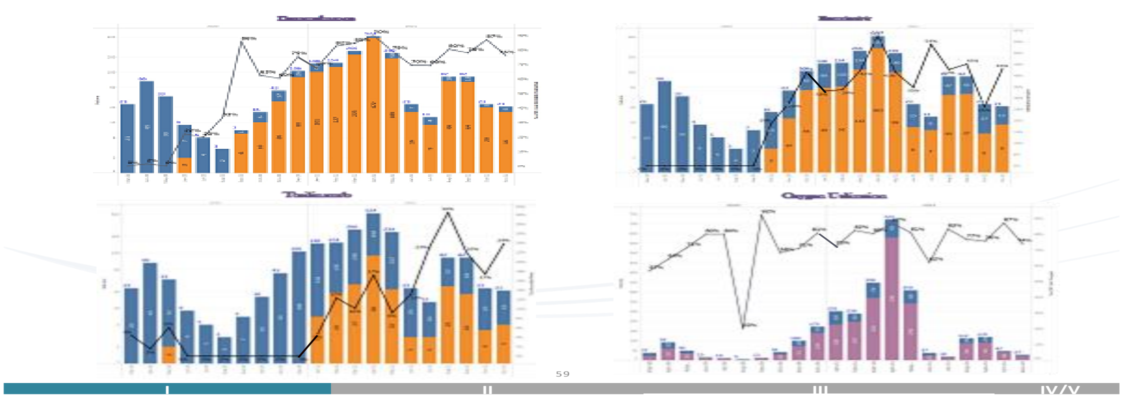


Fig 6

Improving Patient Outcomes

PROVINCIAL COMPARISON PERFORMANCE STUDY

GEMINI – the Ontario branch being GeMQIN (Ontario General Medicine Quality Improvement Network), a quality improvement project endorsed by Ontario Health, was created to compare general medicine patients in participating hospitals. Of the 24 hospitals who submitted their data from July 2020 to June 2021, Mackenzie Health had 7908 patients for this analysis out of 127,438 patients in all 24 hospitals, which represents 6.2% of all the patients. Comorbidity was the same at Mackenzie Health vs all hospitals was roughly at 30% which is a high comorbidity rate.

Compared to 24 other reference hospitals, Mackenzie Health treated double the number of, or to put it in perspective, the most COVID-19 patients in the province (15.2% vs 8.2%). Concentrating on COVID-19 patients can lead to higher mortality rates for cardiac and other respiratory conditions as chaotic responses to the pandemic can lead to unintended deaths from other causes. However, despite treating the most COVID-19 cases – 1861 patients (275 in critical care) in the province between July 1, 2020 and June 30, 2021, we had the third lowest risk adjusted mortality rate of 6% of the top ten health conditions. We monitored our mortality rates for the top health conditions including congestive heart failure, pneumonia, COPD and our mortality rates for other conditions remained low throughout the pandemic.

The chart shows risk adjusted mortality benchmarked across 24 hospitals in the province. Mackenzie Health had the third lowest mortality rate. As well, conditions such as CHF, stroke and septicaemia, were lower than expected and hovered around the 25th percentile for all three conditions. Mortality for pneumonia was higher but it was likely compounded by COVID-19 which was mostly a respiratory infection.

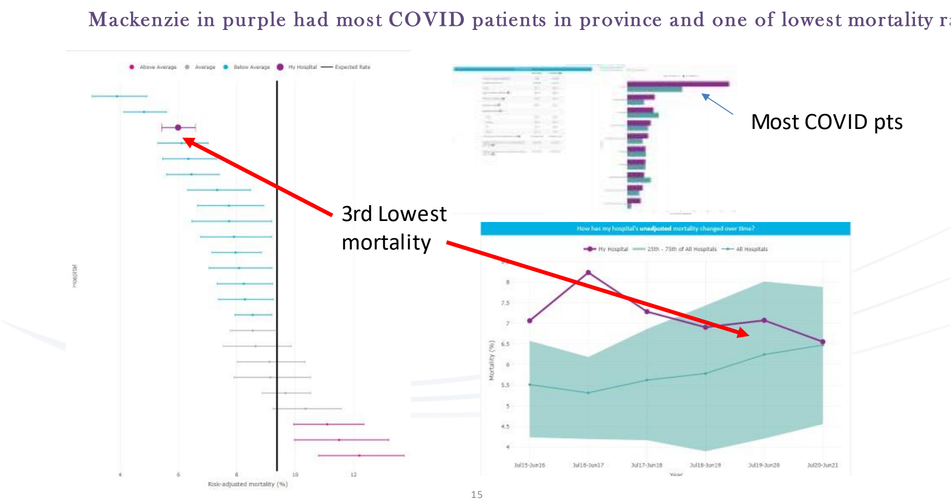


Fig 7

LENGTH OF STAY

This chart shows risk adjusted acute length of stay is substantially lower than other hospitals in study.

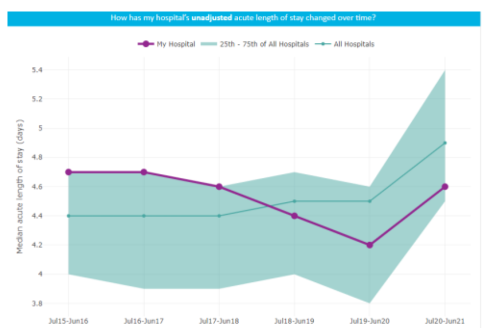


Fig 8

INTERNAL LENGTH OF STAY DATA

The average length of stay in the first year for COVID-19 was 8.4 days from March 1, 2020 to December 31, 2020. The average length of stay of critically ill patients was 22.7 days (based on 40 patients) and of ward patients 5.7 days (based on 125 patients). The average length of stay of patients following this period was on average 4.3 days from January 1, 2021 to December 31, 2021 and 5.3 days from January 1, 2022 to December 31, 2022. As can be seen on the box plot graph, displaying each encounter with median length of stay for each quarter, there were many outliers outside of the designated minimum and maximum quartiles meaning that length of stay had large variability from case to case, even during the milder period of Omicron in 2022.

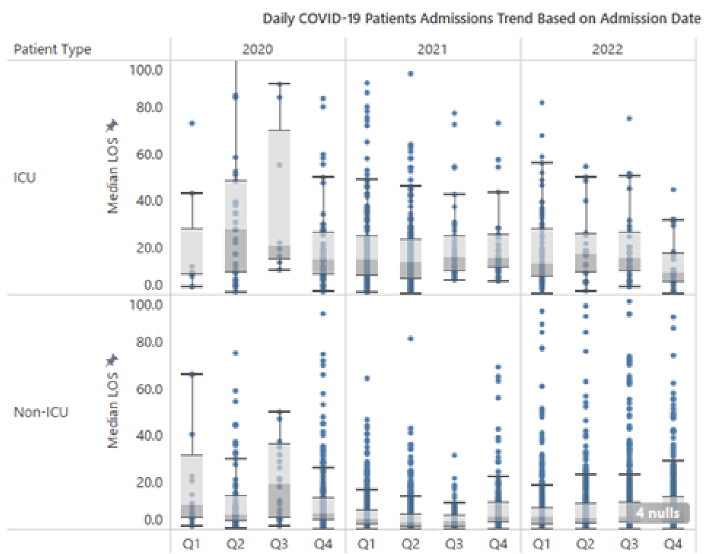


Fig 9

The chart below shows the adjusted length of stay compared to peer hospitals and the rest of the province. ELOS which is the average expected length of stay for patients with the same Case Mix Group (CMG), age category, comorbidity level and intervention factors. The statistic is expressed as a ratio of actual LOS to expected LOS: ALOS:ELOS. Mackenzie's ratio of ALOS:ELOS is 0.70 (0.60-0.86 95th CI), which was lower than the other two groups – peers vs rest of province

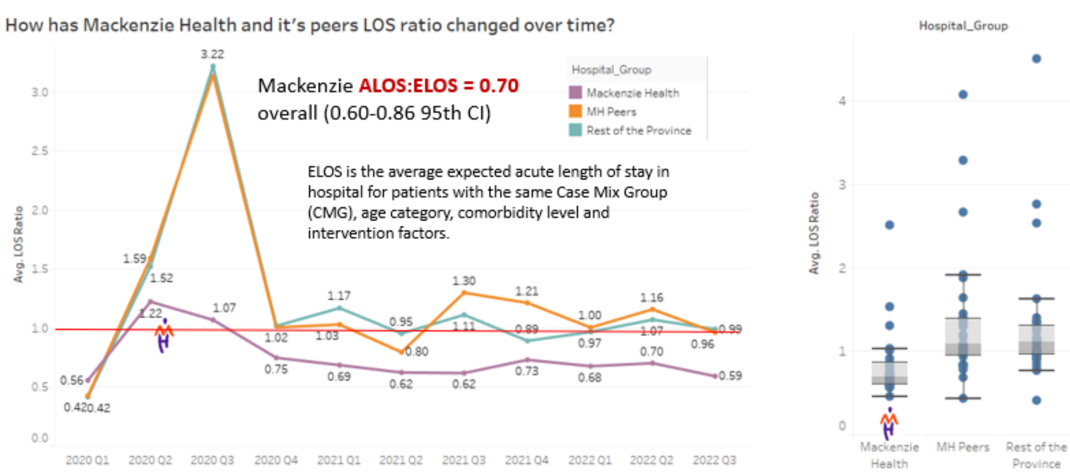


Fig 10

MORTALITY ANALYSIS BY AGE GROUP

COVID-19 continues to be deadly for the older age group, especially for patients over 80. The rise in cases and deaths in this age group even during a supposed milder variant of Omicron in January and February 2022 could be the result of early completion of their initial vaccine series and waning of their immunity. It was around this time that public health urged patients in the older group to get their vaccines updated as we could be seeing the immune evasion of the Omicron variant.

Vaccination Status Effect on Mortality in Different Age Groups

Vaccine status was tracked through the medication reconciliation process at admission. This provided valuable information for the clinician knowing that fully vaccinated patients even months later were protected from serious disease such as becoming critically ill (in blue). The following chart shows that unvaccinated and partially vaccinated individuals in the older age groups, especially during Q1 Q2 2021 and Q1 2022, had a higher mortality. In the first two quarters of 2021, most of the patients who died in critical care were between the ages of 60 to 79. This was the age group that received their vaccines later in that year. This graph is sorted for those patients who were under vaccinated defined by public health as – no vaccination, one dose or without booster or greater than 6 months since last dose.

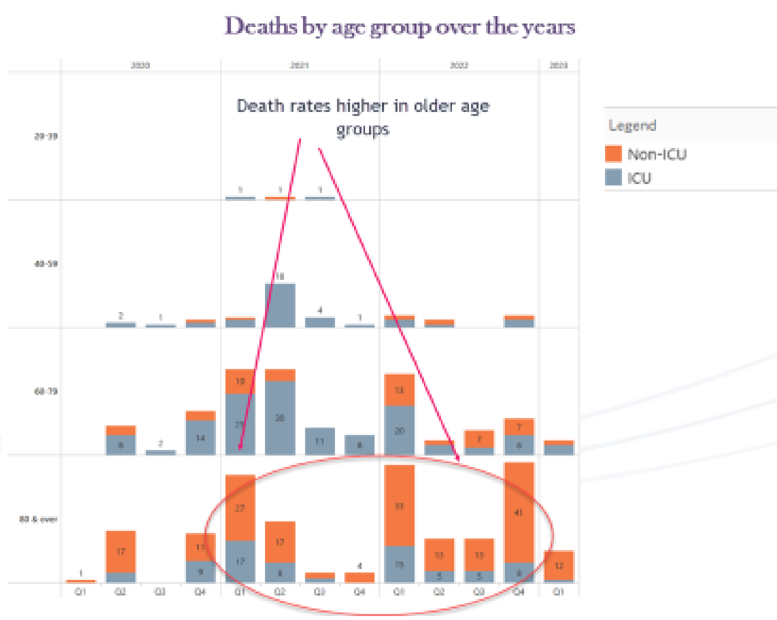


Fig 11

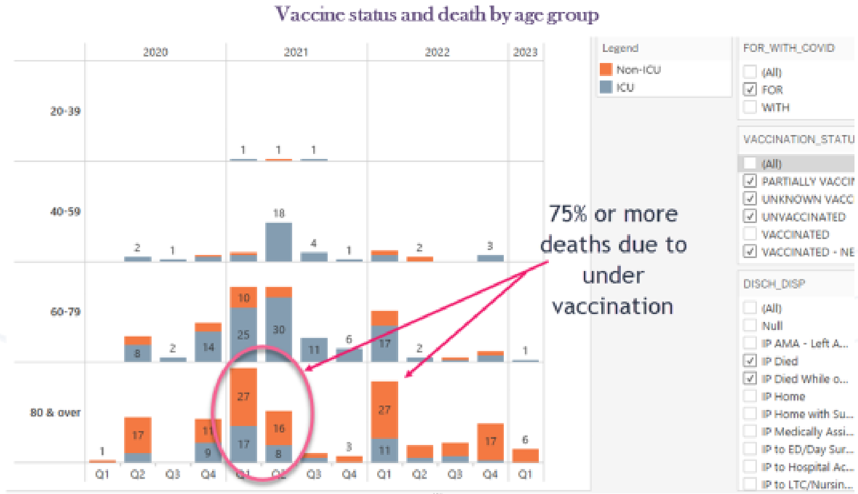


Fig 12

MORTALITY ANALYSIS

The hospital monitored our own mortality rate defined as COVID-19 case by inpatient status with discharge status as deceased. Case attribution of COVID-19 as cause of death was verified by IPAC clinicians and later programmed into an algorithm in the registry and through coding guidelines. In Wave 1 (March 2020 to June 2020) without any specific treatment except supportive on most patients, crude unadjusted mortality was 25/119 patients 22% versus Wave 2 from September 2020 to February 2021 with treatment strategies in place, when volumes were 5 times higher, crude mortality was 55/393 patients 14%. In battling the worst Wave 3, the crude mortality rate was 104/1494 or 7%, the lowest in the province and in our peer group hospitals. Wave 2 and Wave 3 were the deadliest waves elsewhere in the world where the Delta variant dominated. In the ensuing months, the trend was higher mortality in the winter months as predicted by infectious disease experts. Data was sourced from IntelliHealth, a coded central provincial database to benchmark Mackenzie Health against all hospitals in Ontario. The graph below shows that Mackenzie Health had the lowest rate of deaths from Wave 1 through Wave 5 compared to the five peer hospitals or the rest of the province. A “peer hospital” is a hospital serving a similar population in the greater Toronto area whose catchment area were hotspots for COVID-19. Our neighbouring five peer hospitals were all located in hotspots in Ontario which accounted for 22% of all COVID-19 patients in the province.

MORTALITY RATE COMPARED TO MORTALITY RATE OF PEER HOSPITALS

Data was pulled from IntelliHealth, which shows that Mackenzie Health had the lowest mortality compared to five peer hospitals in the same region as Mackenzie Health throughout the pandemic. From the provincial database, 63, 014 cases were coded as COVID-19 with 9138 COVID-19 deaths. The graph below shows peer hospitals, the province and Mackenzie Health. Mackenzie Health had the most COVID-19 patients in the province and the lowest mortality rate. There were several spikes in mortality throughout the pandemic. At the beginning of the pandemic only supportive care was given as there were no standard protocols to help treat. The elderly were the hardest hit age group which dominated the mortality rate for the first three months. As standard protocols began to emerge, and we were able to track patients better, the mortality stabilized with the help of programs such as remote monitoring and effective use of EMR tools and the lab interface. There were periodic spikes in mortality which were attributed to outside factors such as variant mutations, vaccine rollout and changes to provincial mandates of public gathering.

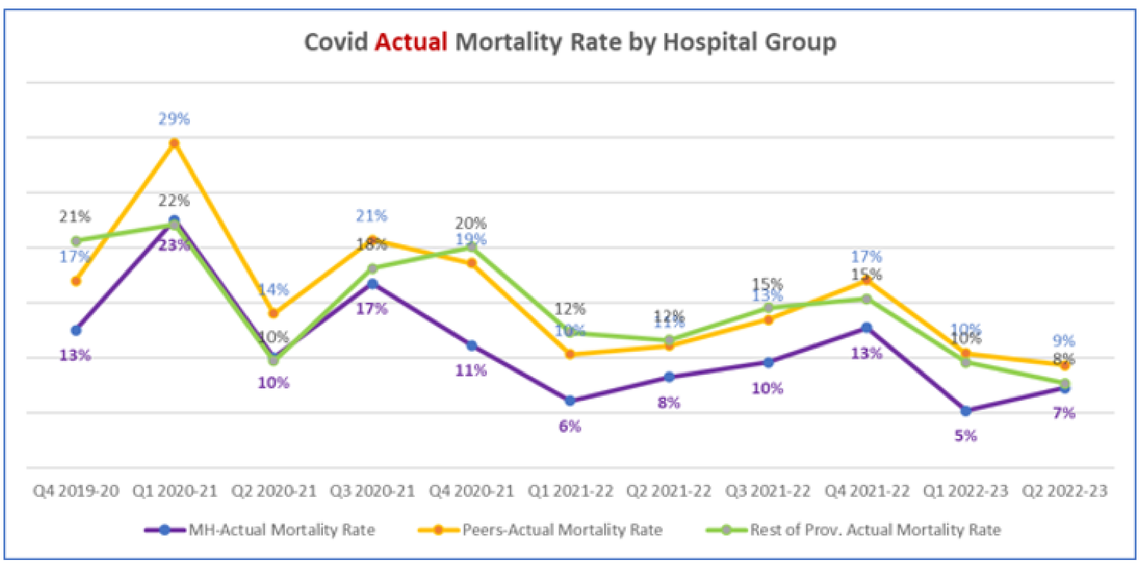


Fig 13

The graph below shows the reduction in risk-adjusted mortality across the province "Province Overall" means all hospitals included in whole province. "Rest of Province" is defined as all hospitals in province excluding Mackenzie Health and peer hospitals. The Peer hospitals were defined earlier. Risk adjusted factors include age in years, sex, length of stay in days, admission category, transfer, comorbidity data, Charlson Index. The overall risk adjusted mortality was 5.6% across 11 quarters from March 1, 2020 to September 30, 2022. This represents a reduction of 47% compared to the rest of the province and our peer hospitals. The second quarter of 2020 coincides with the implementation of dedicated COVID-19 order panels, order sets, best practice advisories, pathway, updated guidelines, and increased treatment adherence of therapies.

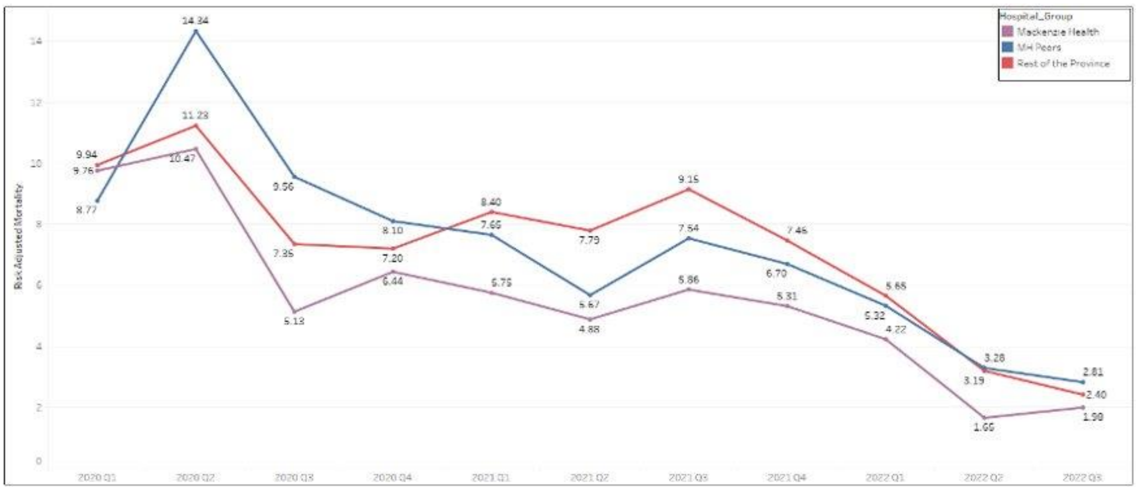


Fig 14

Accountability and Driving Resilient Care Redesign

Relying on coded data or historical data submissions to a central registry and waiting for government bodies to then synthesize and digest the data or relying on external guidelines can prove costly and deadly in a fast-moving pandemic. High levels of EMR adoption in a HIMSS STAGE 7 enterprise wide fully integrated EMR during normal circumstances engrains good practices of filing structured data into flowsheets or specialty sections. The access to high quality data at entry allows for real time analytics without the added steps of data cleansing. Mackenzie Health, creating a COVID-19 registry early in the pandemic and revising it as new definitions evolved, helped the hospital stay ahead of the virus. Dashboards pulling real time data showed usage of high flow oxygen devices, ventilators, census and bed usage. The digital interface with the testing lab showed real time positivity rates allowing for efficient bed management and prediction of inpatient and critical care surges. Automating feeds from labs using interfaces and reporting to public health freed up human resources for in-depth analysis and planning. Dynamic adjustments were made in the

EMR to support care practices at every turn of the pandemic and advanced real time analytics were integrated into the operational planning, capacity management while supporting best practices helped save our hospital from collapse. This information on how Mackenzie Health was able to achieve such great results were shared at the Provincial and Regional EOC (Emergency Operational Committee).   Public Health was also engaged. Early on in the Pandemic our use of Tableau was utilized by other hospitals and public health organizations to help them with managing capacity and mortality.

As the designated COVID-19 relief hospital for the province, Mackenzie Health had the greatest number and percentage of COVID-19 patients than any other hospital but still had one of the lowest mortality rates benchmarked against 24 hospitals in the province for the top ten hospital conditions. One important outcome is that the focus of the hospital being shifted to a pandemic is whether the non-COVID-19 patients suffered higher mortality rates. The data shows this was not the case for common conditions like congestive heart failure, stroke and sepsis.

In more specific analysis isolating coded COVID-19 cases from a provincial database, Mackenzie Health maintained the lowest mortality rate over 11 quarters, across five peer hospitals in the region serving a similar population of COVID-19 patients. This held true compared to the rest of the province.

Although we are now in 2023, emerging mortality data at our own institution shows that COVID-19 will continue to be a deadly infectious disease for the elderly population every winter especially in those that remain unvaccinated or under vaccinated. The use of technology and analytics will contribute to the capacity management and treatment of COVID-19 patients in the future as history has shown us that this virus will be with us in the future.

References:

1. Charlson Comorbidities Index: Journal of Physiotherapy 62 (2016) 171