North Central Region Healthcare Coalition

2021-2022 Joint Risk Assessment

TABLE OF CONTENTS

INTRODUCTION

PURPOSE

The 2021-2022 North Central Region Healthcare Coalition (NCR HCC) Joint Risk Assessment (JRA) provides the NCR HCC, and its associated Governance Board, chapters, and key stakeholders, with the information needed to identify and plan for risks that have the potential to significantly impact the health and medical system within the region. Additionally, this document directly supports the NCR HCC in strategic planning and the prioritization of activities, while helping to direct efforts aimed at addressing the gaps identified within the regional preparedness and response continuum.

The annual NCR HCC JRA is provided to the Colorado Department of Public Health and Environment's Office of Emergency of Preparedness and Response (CDPHE-OEPR) and is incorporated into the CDPHE-OEPR State Jurisdictional Risk Analysis Report. It is also submitted to the Colorado Threat and Hazard Identification and Risk Assessment (THIRA) Review Board in support of the preparation of the annual Colorado State Preparedness Report.

SCOPE

The scope of the NCR HCC JRA is limited to Colorado's ten-county North Central Region. The healthcare coalition, and its associated plans and reports, serve to enhance the emergency mitigation, preparedness, response, and recovery activities of the health and medical system.

This assessment supports the coalition and its members and is not directive in nature.

PLANNING ASSUMPTIONS

- While there will likely be significant overlap between the NCR HCC JRA and the Hazard Vulnerability Analysis (HVA) for individual healthcare organizations, these must be separate and distinct processes.[1]
- A specific vulnerability may not exist across all NCR HCC member organizations; however, coalition members will generally face many of the same hazards.
- The regional JRA does not supersede or replace risk assessments developed at the organizational, local, or state level.
- The assessment of threats and hazards across the NCR was conducted utilizing a combination of quantitative as well as qualitative data. Components of this analysis are subjective in nature.
- The NCR HCC HVA member data that was utilized, in part, to determine the threats and hazards outlined in this document, was not a comprehensive assessment of all members. Although all members of the HCC were invited to complete the survey and submit their HVA, those who participated were self-selected based on interest and capacity. The data provided by these members is influenced by their own organizational initiatives and planning efforts.
- Although this JRA focuses on the impact to healthcare, the HVA and JRA process was inclusive of data from emergency management, public health, and other non-traditional health and medical partners.

[1] U.S. Department of Health and Human Services. MSCC: The Healthcare Coalition in Emergency Response and Recovery. Chapter 5, Section 5.4: Hazards Vulnerability Analysis. May 2009. Accessed 13 March 2019. https://www.phe.gov/Preparedness/planning/mscc/healthcarecoalition/chapter5/Pages/hazards.aspx

ADMINISTRATIVE SUPPORT

The NCR HCC JRA is reviewed and revised by the NCR HCC Governance Board, HCC Chapter Leads, and HCC members, on an annual basis. Each subsequent annual update consists of a review of the previous year's JRA and integration of relevant new information, as appropriate. Additionally, the JRA is updated and revised following real events, planned training exercises, and/or the development of After Action Reports/Improvement Plans that impact the information contained in this assessment. The 2021-2022 NCR HCC JRA, as well as any revisions, will be distributed to all NCR HCC members and stakeholders and will be posted to the NCR HCC website.

NORTH CENTRAL REGION HEALTHCARE COALITION

OVERVIEW

Health and medical emergency preparedness planning and coordination in the North Central All-Hazards Region (NCR) is facilitated, in part, through the NCR HCC. Colorado's NCR HCC exists to promote, develop and enhance the region's cross-jurisdictional and cross-disciplinary coordination to the health and medical component of incident preparedness, response and recovery. This is achieved through communication, planning, training, and collaboration, with coalition partners.

Due to its size, the North Central Region Healthcare Coalition is broken up into three chapters: Boulder Health and Medical Response Partnership (HAMR) Chapter, Metro Foothills Healthcare Coalition (MFHCC) Chapter, and Tri-County Healthcare Coalition Chapter. Each chapter covers a portion of the region, as shown in Figure 1.

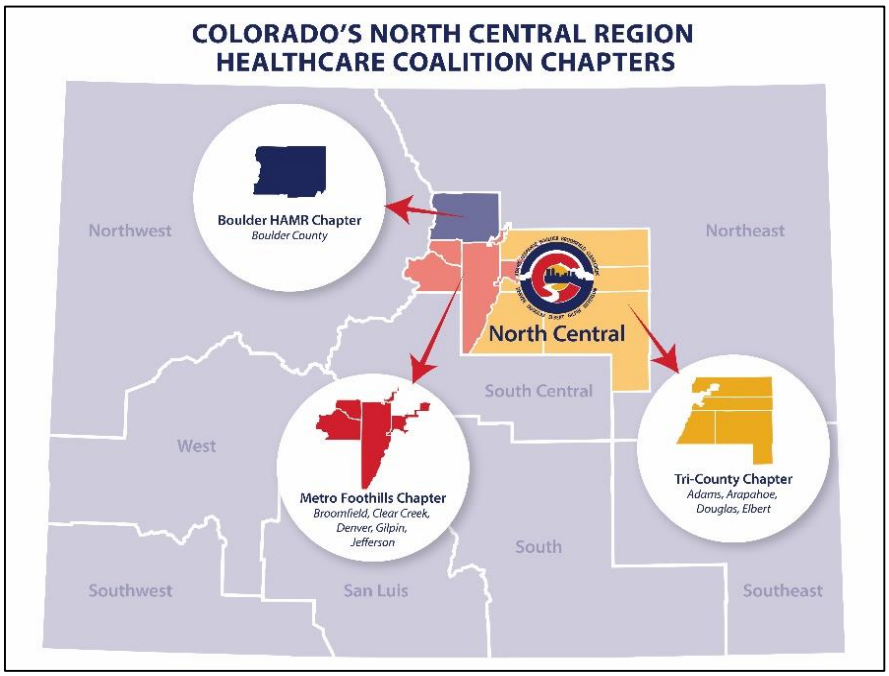

Figure 1: Colorado's NCR HCC Chapters

The NCR HCC Governance Board governs the NCR HCC, and its chapters. This Governance Board functions as an advisory group and is tasked with providing guidance and strategic direction to the region and its associated chapters. The Governance Board includes representation from hospitals, emergency management, public

health, emergency medical services, and various community partners (e.g., clinics, behavioral health, etc.) across all three chapters.

NCR HCC MEMBERSHIP

An HCC member is defined as "an entity within the HCC's defined boundaries that actively contributes to HCC strategic planning, identification of gaps and mitigation strategies, operational planning and response, information sharing, and resource coordination and management." [2] Diversity within an HCC promotes an integrated community response and serves to strengthen the healthcare system as a whole.

Per the Assistant Secretary for Preparedness and Response (ASPR), an HCC must include the following four core members:

- Emergency Management (EM)
- Emergency Medical Services (EMS)
- Hospitals
- Public Health (PH)

Although ASPR designates the above disciplines as core members, the health and medical system is much more diverse and the NCR HCC strives to include all partners within the healthcare continuum. This includes, but is not limited to, representation from: behavioral health, outpatient medical services, ancillary healthcare, volunteer groups, and support organizations.

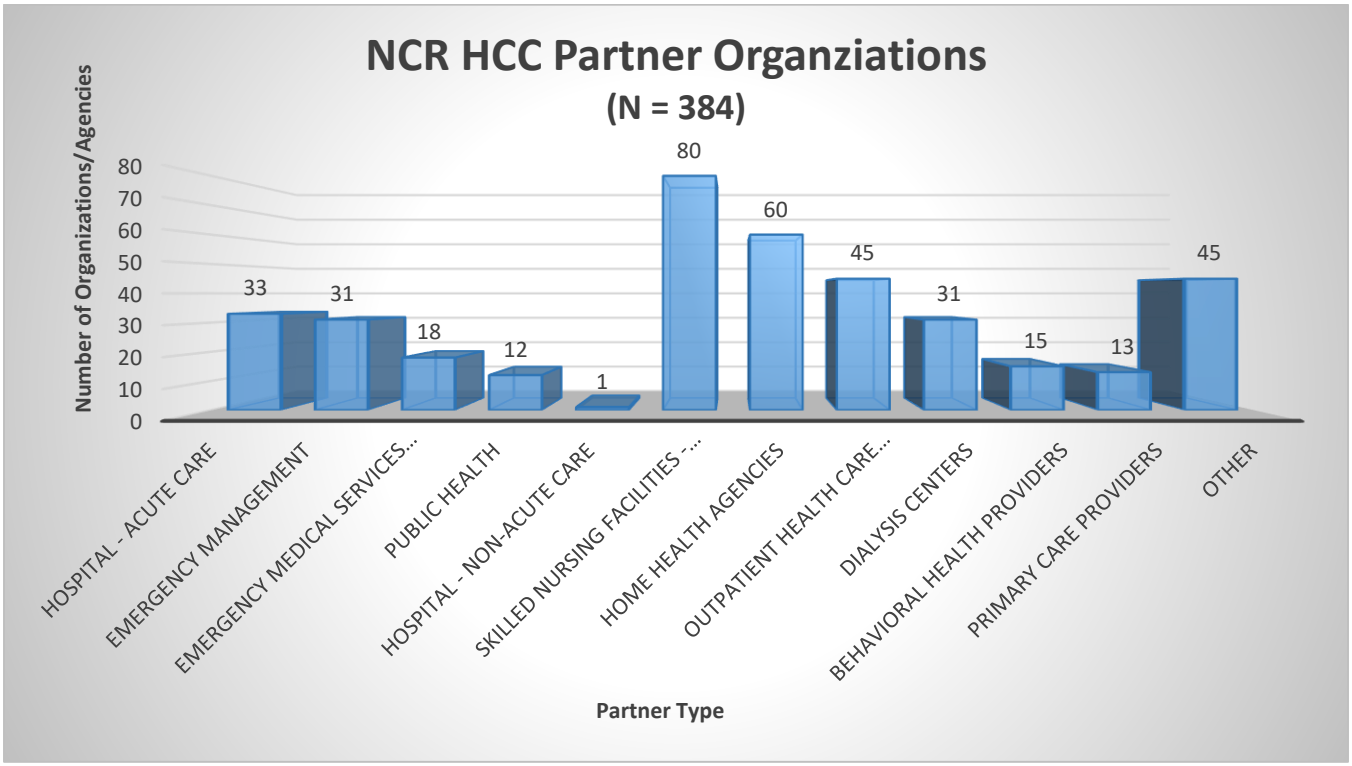

Figure 2: NCR HCC Membership Representation – December 2021

[2] Assistant Secretary for Preparedness and Response: 2017-2022 Healthcare Preparedness and Response Capabilities. November 2016.

RESPONSE ROLE OF THE NCR HCC

The composition of the NCR HCC is reflective of those partners that have the potential to be involved in the health and medical component of a response, including those key partners who function within Emergency Support Function (ESF) 8 / health and medical branch. For this reason, the coalition, and its associated chapters, default to ESF-8, or comparable health and medical branches, as the designated mechanism(s) for the coordination of Federal, State, and local resources related to health and medical needs during an incident(s). These systems primarily operate out of Emergency Operations Centers (EOC) and/or Department Operations Centers (DOC), allowing for direct communication and coordination with other support functions and emergency management. HCC members are integrated into the larger emergency response framework via these structures with the intention being that ESF-8/health and medical branches will complement and support existing agency level plans and procedures, not replace them.

The NCR HCC Response Plan exists to support the health and medical system utilizing collaborative and integrative processes during events that exceed jurisdictional and/or system level capabilities and/or capacity. The primary role of the NCR HCC, during a response, is to facilitate information sharing, support situational awareness, and assist with resource identification.

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DEVELOPMENT

PROCESS OVERVIEW

The development of the 2021-2022 NCR HCC JRA was a collaboration between NCR HCC members and the NCR HCC Governance Board. The development process occurred in multiple phases, with each one building from the previous.

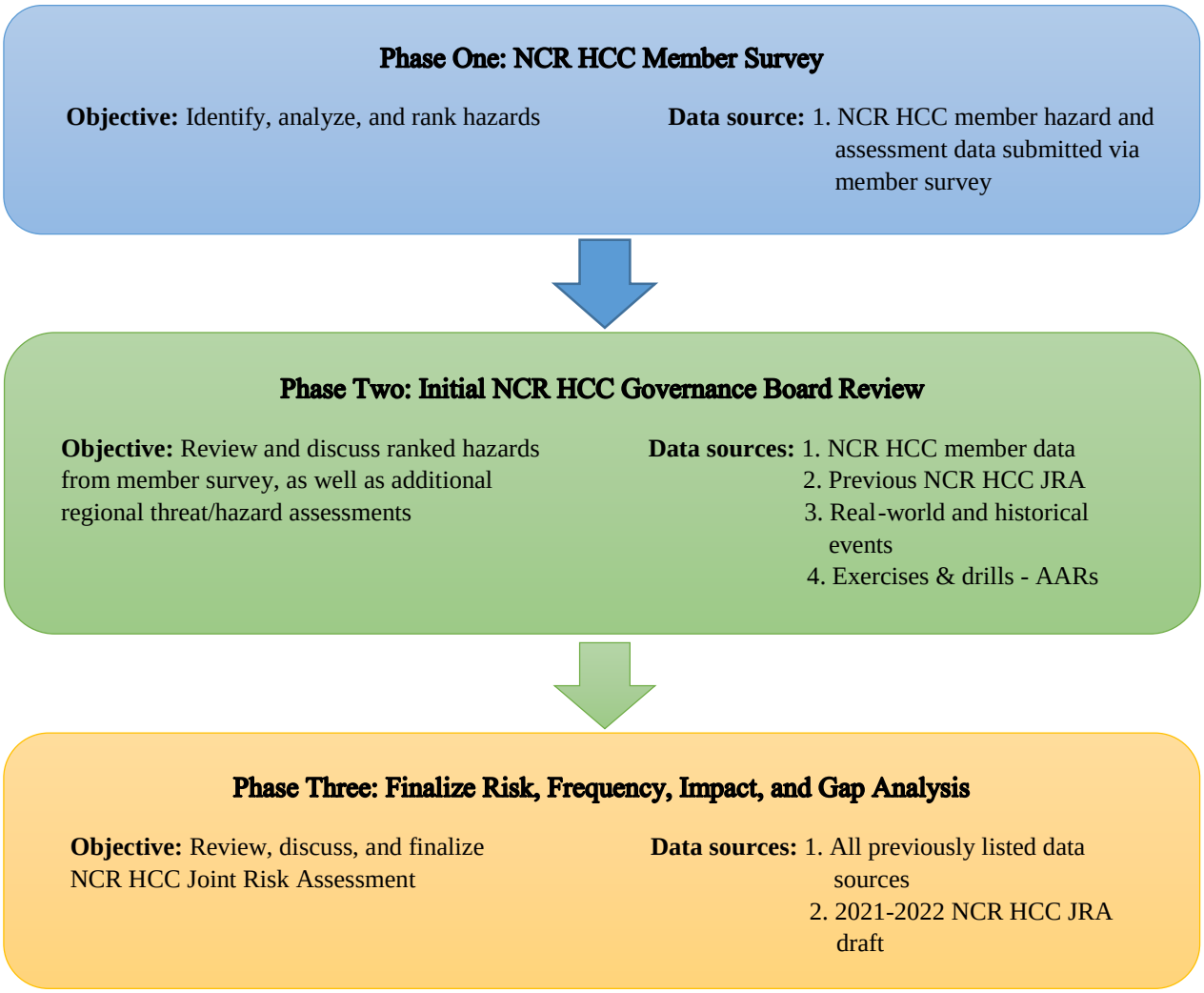


Figure 3: NCR HCC Joint Risk Assessment Development Process

In an effort to ensure that the JRA is representative of the NCR, hazard and threat assessment data was collected from members representing all three NCR HCC chapters, as well as from other state, regional, and local partners during Phase One. HCC members were asked to complete the survey as well as submit their hazard and risk assessments. A total of 131 agencies completed the survey and/or submitted documentation (Figure 4). Completion of the survey suffered as many organizations prioritized pandemic response efforts. Once received, the data was compiled into a single spreadsheet and synthesized to identify the top risks identified at the organizational level.

The NCR HCC Governance Board, as part of a facilitated discussion, then reviewed this data (see Phase Two above for data sources included in this discussion). The outcome of this discussion was a preliminary list of the top threats/hazards pertaining to the health and medical system within the NCR.

Phase Three of the process consisted of a review and finalization of the threats and hazards identified in Phase Two (Table 5: Hazard Identification Assessment) as well as the completion of the following tables included in this assessment:

- Table 6: Risk Identification
- Table 7: Vulnerability Assessment
- Table 8: Summary of Prioritized Gaps

Additionally, this final discussion included a review of the Geography and Population Characteristics, Discussion, and Gaps sections to ensure consensus across the disciplines and chapters.

The final step in this process was a review and subsequent approval by the NCR HCC Governance Board and dissemination of the data to NCR HCC members.

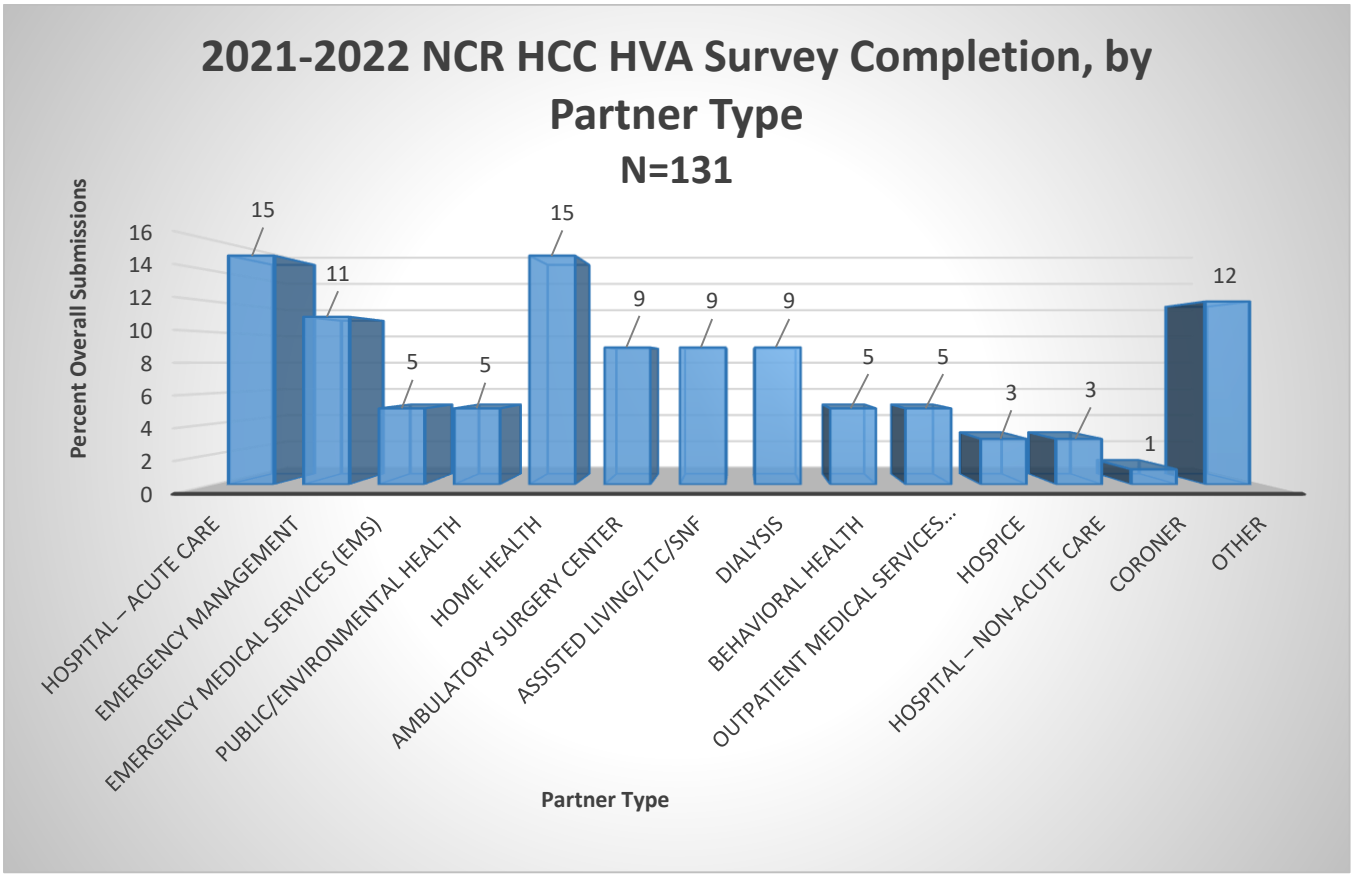


Figure 4: 2021-2022 NCR HCC HVA member participation via HVA survey and submission

NCR GEOGRAPHY AND POPULATION CHARACTERISTICS

GEOGRAPHY

The ten-county North Central Region includes the counties of Adams, Arapahoe, Boulder, Broomfield, Clear Creek, Denver, Douglas, Elbert, Gilpin, and Jefferson. The region encompasses just under 7,000 square miles[3] of both urban, rural, and mountainous geography with a total population just under 3.3 million people[4]. Although the region does include a number of rural areas, it is largely a densely populated metropolitan area with an average of 476 people per square mile. The region is also home to the City and County of Denver – the capital of the State of Colorado and the most populous city in the state with 715,522 residents[4].

Table 1: North Central Region Geography and Population: United States Census Bureau Data

County	Population [2020][4]	Land Area (sq. miles) [2010][3]	Population per Sq. Mile
Adams County	519,572	1,167.65	445.0
Arapahoe County	655,070	798.10	820.8
Boulder County	330,758	726.29	455.4
Broomfield County	74,112	33.03	2,243.8
Clear Creek County	9,397	395.23	23.8
Denver County	715,522	153.00	4,676.6
Douglas County	357,978	840.25	426.0
Elbert County	26,062	1,850.85	14.1
Gilpin County	5,808	149.90	38.7
Jefferson County	582,910	764.21	762.8
NCR Total	**3,277,189**	**6,878.51**	**476.4**

[3] United States Census Bureau – U.S. Census Bureau Geography Division: Quick Facts. 2010 data.
[4] United States Census Bureau: Quick Facts. April 1, 2020 data.

POPULATION CHARACTERISTICS

Over 3.2 million individuals that make up the North Central Region. They are diverse in both age and race. Understanding the composition of each county, as well as the region as a whole, is an important element of emergency preparedness, response, and recovery.

Pediatric Population

The NCR HCC, in partnership with its Clinical Advisor, created a Pediatric Surge Annex to the NCR HCC Response Plan. The current pandemic response has prevented the coalition from testing this annex, this is expected to take place in FY 2022-2023.

The NCR includes approximately 713,440 children under the age of 18, which is 21.8% of the total population (Table 2). There are several pertinent risk factors for a pediatric surge. Injuries are the leading cause of death among Coloradans ages 1-24. The leading causes of injury or violence-related deaths include suicide, motor vehicle crashes (MVCs), poisoning, and homicide/maltreatment. The most common mechanisms for serious traumatic injury seen at Children's Hospital Colorado are child abuse, MVCs, falls, and firearm injuries.

Colorado has the lowest vaccination rate in the nation for measles, mumps and rubella at 87.4%, well below the 95% threshold needed for community immunity.[5] Any mass casualty incident will likely include children, and children are sometimes targeted specifically. During the day these populations can be concentrated in schools and early childhood centers, potentially increasing the impact of disease spread or an act of violence.

Seventy-five percent of Colorado's Pediatric Intensive Care Unit (PICU) beds are contained within the NCR, as well as 58% of the pediatric medical/surgical beds. The State's only Level I pediatric trauma center and both Level IV Neonatal Intensive Care Units (NICUs) are also located in the NCR. Given the small number of pediatric beds, it would take far fewer children to overwhelm the medical system within Colorado.

The NCR continues to collaborate with the state health department on the Colorado Pediatric Disaster Coalition. This coalition, championed by CDPHE-OEPR, includes diverse representation from all areas of the healthcare system and emergency management. The focus is on strengthening the capabilities and increasing the capacity of the health and medical system to effectively prepare for and respond to the unique needs of pediatrics who are involved in disasters. The NCR HCC has broad representation on this coalition, and will continue to support the work being done in this area.

Further, the NCR HCC has a long-standing relationship with Children's Hospital of Colorado (CHCO). This hospital is consistently ranked as one of the top facilities for pediatric specialties, general medical and surgical care. CHCO also has a strong presence in the community through their wellness events and child advocacy programs. Having CHCO as an active member of the NCR HCC allows the coalition to effectively incorporate pediatric needs on a day-to-day basis as well as in times of crisis.

Older Adults 65 Years and Over

Older adults (≥65) comprise 12.7% (405,119) of the total population in the NCR. This demographic, as they continue to age, present unique challenges to the field of emergency management. Older adults may have mobility problems, chronic health conditions, and/or be isolated with little to no support. They may be experiencing challenges that come with advanced age, such as hearing or vision problems or cognitive impairment, which may make it difficult to access, understand, and respond to emergency instructions.

[5] Seither R, Loretan C, Driver K, Mellerson JL, Knighton CL, Black CL. Vaccination Coverage with Selected Vaccines and Exemption Rates Among Children in Kindergarten — United States, 2018–19 School Year. MMWR Morb Mortal Wkly Rep 2019;68:905–912. DOI: http://dx.doi.org/10.15585/mmwr.mm6841e1external icon.

Additionally, individuals who are receiving assistance from support services (e.g., home healthcare, meal delivery services, or in-home caregivers, etc.) may be cut off from these services for an extended period. These factors must be considered during all phases of emergency management, as they make this segment of the community increasingly susceptible to the disruptions that result from a disaster.

The NCR HCC maintains a robust and active group of ancillary healthcare providers, many of whom serve older adults within the region. The unique needs of this population are addressed through trainings, drills/exercises, and discussions that occur within the NCR Ancillary Healthcare Committee. The outcomes of these activities are then shared with the entire coalition in an effort to promote planning that is inclusive of the entire demographic spectrum of the community.

Table 2: North Central Region Age & Race Demographics: United States Census Bureau Data

County	**Birth Rate** (Births per 1000 Persons) [2020][6]	**Children Under 5** [2015-2019][6]		**Children Under 18** [2015-2019][6]		**Older Adults 65 Years and Over** [2015-2019][6]		**Older Adults 85 Years and Over** [2015-2019][7]		**Non-White** (all persons except white, non-Hispanic) [2015-2019][6]	
		#	%	#	%	#	%	#	%	#	%
Adams County	11.61	36,419	7.2%	135,860	27%	51,105	10.1%	5,271	1.0%	251,938	50%
Arapahoe County	11.11	40,412	6.3%	153,589	23.8%	82,111	12.7%	9,466	1.5%	256,004	39.7%
Boulder County	7.52	14,795	4.6%	62,446	19.4%	44,094	13.7%	5,039	1.6%	72,336	22.4%
Broomfield County	N/A	3,698	5.4%	15,741	23.2%	9,026	13.3%	906	1.3%	15,770	23.2%
Clear Creek County	N/A	375	3.9%	1,505	15.9%	1,846	19.4%	84	0.9%	1,073	11.3%
Denver County	12.50	42,830	6.1%	139,687	19.8%	81,488	11.5%	10,587	1.5%	323,348	45.8%
Douglas County	9.63	19,880	5.9%	89,235	26.6%	38,417	11.4%	3,452	1%	59,725	17.8%
Elbert County	N/A	1,141	4.4%	5,572	21.7%	3,984	15.5%	323	1.3%	2,953	11.5%
Gilpin County	N/A	144	2.4%	818	13.6%	1,079	17.9%	88	1.5%	885	14.7%
Jefferson County	9.43	29,880	5.2%	115,079	20%	91,969	16%	10,667	1.9%	125,753	21.9%
NCR Total	**N/A**	**189,574**	**5.9%**	**719,532**	**22.5%**	**405,119**	**12.7%**	**45,883**	**1.4%**	**1,109,785**	**34.7%**

[6] United States Department of Health and Human Services (US DHHS), Centers for Disease Control and Prevention (CDC), National Center for Health Statistics (NCHS), Division of Vital Statistics, Natality public-use data 2007-2020, on CDC WONDER Online Database, November 2021. Accessed at http://wonder.cdc.gov/natality-current.html on Nov 23, 2021 12:20 PM

[7] U.S. Census Bureau, 2015-2019 American Community Survey 5-Year Estimates.

ACCESS AND FUNCTIONAL NEEDS

Historically, the region has shown a strong commitment to addressing the needs of special populations through planning, training, and exercises. HCC chapters regularly host trainings on CDPHE's Community Inclusion in Colorado (CICO) maps and incorporates access and functional needs considerations into exercises and drill. Additionally, the NCR supports an active and robust Access and Functional needs committee and regularly engages with the Division of Homeland Security and Emergency Management's Access and Functional Needs Coordinator.

During the COVID-19 response, the NCR HCC consulted with an Assistive Technology Program of Colorado Outreach Coordinator on various AFN-related response considerations and supported the inclusion of this subject matter expert into the development of alternate care sites.

HCC members are strongly encouraged to maintain awareness around special populations that may fall under their care and/or who may end up requiring their services because of an event(s). In addition, the NCR HCC has adopted, and trained its members on, the C-MIST framework. This approach is based on a "functional needs framework" which focuses on addressing the functional and access needs of an individual or group, not the specific vulnerability or condition. These needs are organized into five categories: **C** Communication, **M** Medical/Health, **I** Independence, **S** Safety and Support, and **T** Transportation.

Table 3: North Central Region Language Characteristics[6]

County	Language Isolation: Non-English households that speak English less than well		Most prevalent isolated non-English language
	#	%	Language
Adams County	51,784	11.5%	Spanish
Arapahoe County	51,476	8.8%	Spanish
Boulder County	14,782	4.9%	Spanish
Broomfield County	2,431	4.0%	Spanish
Clear Creek County	76	0.9%	Spanish
Denver County	66,522	10.5%	Spanish
Douglas County	6,799	2.3%	Spanish
Elbert County	136	0.6%	Spanish
Gilpin County	86	1.5%	Spanish
Jefferson County	17,551	3.3%	Spanish
TOTAL REGION	**211,643**	**4.8%**	

Table 4: North Central Region Disability Characteristics: 2015-2019 United States Census Bureau Data[6]

County	Total Disability Population		Hearing Difficulty		Vision Difficulty		Cognitive Difficulty		Ambulatory Difficulty		Independent Living Difficulty	
	#	%	#	%	#	%	#	%	#	%	#	%
Adams County	52,006	10.4%	14,784	3.0%	9,627	1.9%	19,124	4.1%	24,886	5.4%	15,410	4.2%
Arapahoe County	57,415	9.0%	17,145	2.7%	10,649	1.7%	21,073	3.5%	26,879	4.5%	20,660	4.3%
Boulder County	26,043	8.1%	9,029	2.8%	4,350	1.4%	9,996	3.3%	10,527	3.4%	7,858	3.0%
Broomfield County	5,479	8.1%	1,955	2.9%	1,014	1.5%	1,957	3.1%	2,237	3.5%	1,364	2.6%
Clear Creek County	928	9.9%	339	3.6%	170	1.8%	138	1.5%	362	4.0%	258	3.3%
Denver County	67,073	9.6%	18,827	2.7%	13,724	2.0%	25,797	3.9%	30,617	4.7%	22,769	4.1%
Douglas County	22,459	6.7%	7,990	2.4%	3,406	1.0%	7,556	2.4%	8,161	2.6%	6,098	2.5%
Elbert County	2,288	8.9%	824	3.2%	376	1.5%	684	2.8%	1,047	4.3%	719	3.6%
Gilpin County	572	9.6%	279	4.7%	36	0.6%	228	3.9%	270	4.6%	193	3.8%
Jefferson County	57, 029	10%	20,603	3.6%	10,093	1.8%	19,210	3.6%	25,250	4.7%	18,002	4.0%
NCR Total	**291, 292**	**9.2%**	**91,775**	**2.9%**	**53,445**	**1.7%**	**105,763**	**3.3%**	**130,236**	**4.1%**	**93,331**	**2.9%**

Disability	Definition
Hearing Difficulty	Deaf or serious difficulty hearing
Vision Difficulty	Blind or serious difficulty seeing even when wearing glasses
Cognitive Difficulty	Serious difficulty concentrating, remembering, or making decisions due to a physical, mental, or emotional condition
Ambulatory Difficulty	Serious difficulty walking or climbing stairs
Independent Living Difficulty	Difficulty doing errands alone due to a physical, mental, or emotional condition

SOCIAL VULNERABILITY

Social vulnerability refers to the socioeconomic and demographic factors that affect the resilience of communities[8]. Evidence, as well as historical events, have shown that those who with higher social vulnerability are more likely to be adversely affected during a disaster. These members of the community, when impacted by disaster, are less likely to recover and are more likely to die.

There are a number of variables that can influence vulnerability to hazards, including age, income, the strength of social networks, and neighborhood characteristics. Further, many of these vulnerability variables occur in combination. Evidence shows that the poor are more vulnerable at all stages of a disaster: before, during, and after. This is also the case for individuals with access and functional needs, racial and ethnic minorities, children, and elders.

Due to the high likelihood that members of a vulnerable community will experience reduced resiliency, identifying these communities should be incorporated into the mitigation and planning activities at the local, state, and federal level in an effort to provide those residents with increased assistance over the course of a disaster.

To help identify at-risk and vulnerable populations, the Center for Disease Control (CDC) created the Social Vulnerability Index (SVI)[9]. The information within the SVI can support emergency management systems identify areas with higher social vulnerability and levels of access and functional needs. With this information, those in emergency management can develop preparedness, response, and recovery processes that support the needs of the community.

The CDC's SVI uses 15 social factors from the U.S. census to develop themes as well as an overall ranking at the county level (please refer to Appendix A for a list of all 15 factors). SVI scores range from 0 (lowest vulnerability) to 1 (highest vulnerability).

The scores for counties within the NCR may be found on the following page (Figure 5). Adams County ranked the highest on the SVI scale (0.7937). This is the only county in the region with a rating that is defined as "high." Denver County is rated as "moderate to high", Arapahoe and Boulder Counties are rated as "low to moderate" and the remaining six counties are rated as "low." The average SVI score for the region is .27461, putting the region as a whole in the "low to moderate" category.

Social Vulnerability data, including data from the SVI, can shed light on those areas within a community that are at risk of experiencing higher levels of mortality, limited resources, and decreased resiliency during a catastrophic event. Being able to identify socially vulnerable areas within the region supports the overall goal of increasing health and resilience through diversified planning, the development of processes and plans that are tailored to the specific needs of the community, and building stronger networks while increasing engagement within population groups that are often at-risk and underserved.

[8] Flanagan, Barry E.; Gregory, Edward W.; Hallisey, Elaine J.; Heitgerd, Janet L.; and Lewis, Brian (2011) "A Social Vulnerability Index for Disaster Management," Journal of Homeland Security and Emergency Management: Vol. 8: Iss. 1, Article 3.

[9] Centers for Disease Control and Prevention/ Agency for Toxic Substances and Disease Registry/ Geospatial Research, Analysis, and Services Program. CDC Social Vulnerability Index 2018 Database Colorado. https://www.atsdr.cdc.gov/placeandhealth/svi/data_documentation_download.html. Accessed on 12.4.20.

SVI data have also shown to be an asset during response and recovery operations as it has the ability to identify those highly vulnerable areas and support targeted response operations and recovery planning. Further, the SVI can be leveraged to prioritize the allocation of scarce resources to those who are more likely to be adversely affected during a disaster and are less likely to recover.

The recognition of social vulnerability, and subsequent integration of initiatives aimed at mitigating its impacts, continues to be a prominent component of Colorado's COVID-19 response. These efforts are being led by health equity teams at both the state and local levels.

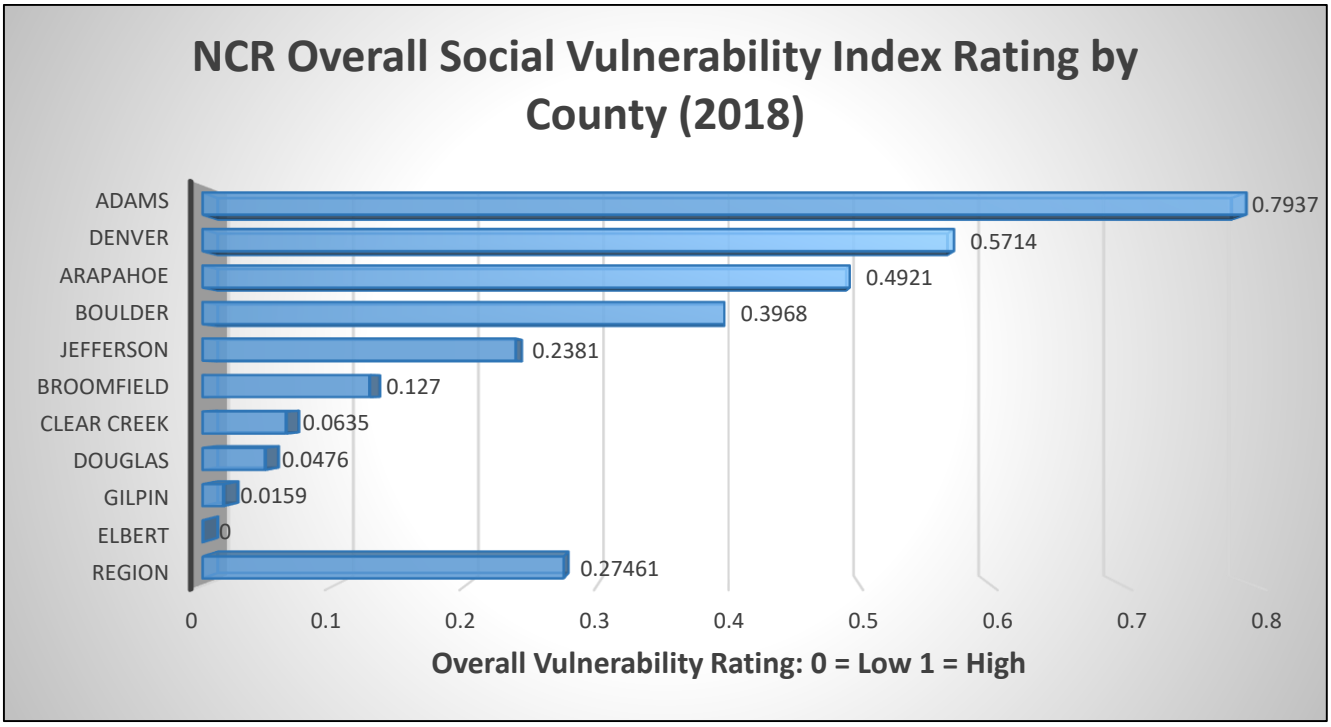


Figure 5: Overall Social Vulnerability Index ratings, by county, for the 10-county North Central Region

THREAT AND HAZARD ANALYSIS

DISASTER DECLARATIONS

According to FEMA[10], the State of Colorado has experienced 96 natural disasters from 1953 - 2020. The vast majority of these disasters were fire related (45%); followed by flood (14%); severe storms and snow (both at 3%); biological at 2%; and dam/levee, coastal storm (Hurricane Katrina), drought, and tornado at 1% each. Historically, the month with the most federal declared disasters in Colorado is June due, primarily due to the high volume of wildfires in the Summer months.

[10] Federal Emergency Management Agency (FEMA). Data Visualization: Disaster Declarations for State and Counties. https://www.fema.gov/data-visualization-disaster-declarations-states-and-counties. Accessed on 11.24.21

North Central Region Disasters

Per FEMA, twenty-four (24) federally declared disasters have occurred in the NCR since 1953, with the top two (2) being fire (42%), flood (25%). See Figure 6 for additional details.

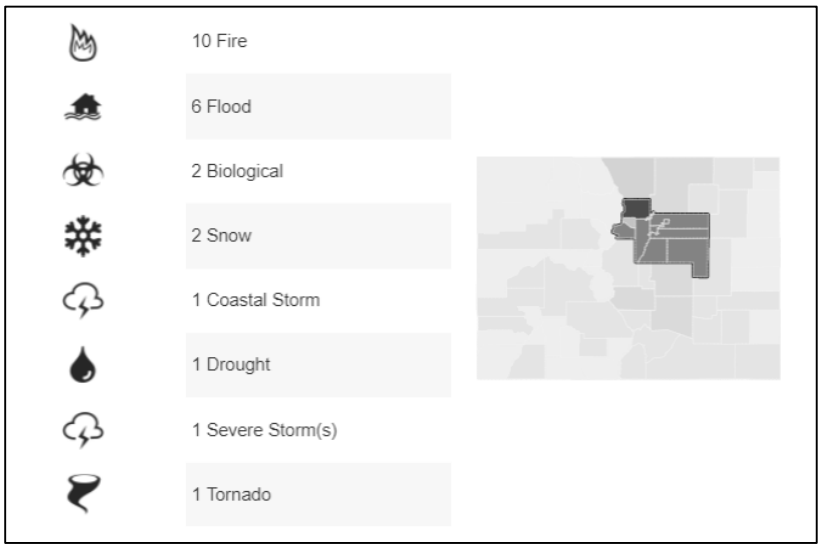


Figure 6: Federally Declared Disasters in the NCR Since 1953

Number of Disaster Declarations by County: North Central Region

- At the county level, Boulder County has the highest number of disaster declarations in the region at 15 declarations. This is followed by Jefferson (13), Adams, Douglas, and Elbert (12), Arapahoe and Denver (11), Clear Creek (9), Gilpin (8), and Broomfield (6).

RECENT EVENTS

SARS-CoV-2 (COVID-19) Pandemic: March 2020 – Present

The world has been managing the outbreak of the SARS-CoV-2 virus, better known as COVID-19, since late 2019. This virus is believed to have originated in Wuhan, the capital city of the Hubei province in China, in December of 2019. Colorado identified its first confirmed cases of COVID-19 on March 5, 2020; although, it is highly likely that the virus had reached Colorado weeks earlier.

To date, Colorado has experienced five (5) distinct periods of significantly increased infection rates. While all five of these waves have resulted in a sharp rise of COVID-19 hospitalizations, only three (3) threatened to fully overwhelm the health and medical infrastructure: Spring 2020, late Fall/early Winter 2020, and late Fall/early Winter 2021. Due to a combination of coordinated efforts at the facility, system, local, regional, and state level, the state's healthcare system was able to respond to the increased demand with only limited utilization of the crisis standards of care for PPE, Emergency Medical Services, and Health Care Staffing.

As of December 10, 2021, Colorado has seen 851,785 confirmed cases; 48,617 hospitalizations; 9,863 fatalities, and 7,016 outbreaks due to COVID-19[11].

- Regional coordination efforts related to the COVID-19 pandemic:
    - Activation of the NCR HCC Response Plan and NCR Hospital Coordination Plan.
    - Implementation of regional coordination calls to support the COVID-19 response. While a number of these calls were discipline-specific (e.g. EMS, ancillary healthcare, emergency management, public health, etc.), the region also facilitated regular opportunities for multi-disciplinary information sharing and coordination.
    - Development of regional information sharing processes focused on hospital and healthcare metrics.
    - Integration into state-level structures and planning/response activities.
    - Sustainment of an extended response that continues to require high volumes of staff, resources, and time.
    - Collective management of the pandemic response while also supporting non-COVID incidents (e.g., wildfires, civil unrest, etc.).

The pandemic is still quite active with Colorado experiencing an influx of cases and hospitalizations while the rest of the nation has largely been experiencing a decline in COVID activity. Much of the success in managing the pandemic throughout 2021 can be attributed to vaccination efforts. As of December 2021 approximately 68% of eligible[12] individuals within the NCR are fully immunized. In addition to the availability of three (3) distinct vaccines, Colorado has implemented the administration of monoclonal antibody therapies in an effort to fight the SARS-CoV-2 infection.

The 2021 late Fall/early Winter medical surge of COVID-19 patients has proven to be the most challenging to the healthcare system across Colorado. This is due to a multitude of factors including, but not limited to: critical staffing shortages, surge of patients who have delayed care, and the sustained volume of backlogged surgeries that were previously delayed due to the pandemic. The cascading impacts of these systemic variables have resulted in sustained bed availability <10%, utilization of federal medical assets, and the activation of the Colorado CSC for Healthcare Staffing.

While 2020 saw a myriad of incidents in the NCR (e.g., civil unrest, wildfires, severe storms, etc.), 2021 proved to be a relatively stable year outside of the ongoing pandemic response.

Marshall Fire: December 30, 2021

On December 30, 2021, the North Central Region experienced the most destructive fire in Colorado's history. The fire primarily impacted the City of Louisville, the City of Superior, and unincorporated areas of Boulder County. There were two fatalities as a result of this event. A total of 1,084 homes were destroyed and 149 homes were damaged.

[11] Colorado Department of Public Health and Environment. *Colorado COVID-19 Data*. https://covid19.colorado.gov/data. Accessed December 10, 2021.

[12] As of this writing (December 2021), only individuals 5 and up are eligible to be vaccinated in the state of Colorado.

This fire prompted the full evacuation of Avista Adventist Hospital in Louisville, a partial evacuation of Good Samaritan Medical Center in Lafayette, and the full evacuation of numerous residential care facilities in the area. Additionally, UCHealth Broomfield Hospital (a community hospital) received six (6) walk-in patients within 15 minutes. Three (3) of these individuals required intubation. Patient transfers to a Level 1 Trauma Center and Burn Center (University of Colorado Hospital) were coordinated within the UCHealth system. There was also a small patient surge when Avista evacuated and Good Samaritan Medical Center temporarily closed their emergency department.

The 2021-2022 NCR HCC JRA had already been approved at the time of this incident. For this reason, the Marshall Fire response was not considered during the development of this assessment and will be extensively covered in the NCR HCC 2022-2023 JRA.

REGIONAL THREATS AND HAZARDS

The review, assessment, and discussion process outlined in the Development section of this document resulted in the following incident types being identified as the top threats and hazards to the NCR's health and medical system:

Table 5: North Central Region Hazard Identification Assessment

Hazard	Frequency	Severity (to people, property, crops, or facilities)
Supply Chain Disruption	Moderate	Guarded
Severe Weather	Very High	Elevated
Utility Disruption (Power, Water, Network, etc.)	Very High	High
Healthcare Facility Evacuation	Low	Severe
Medical Surge	High	Severe
Cyber-Attack	Moderate	High
Critical Healthcare Staff Shortage	High	Severe
Widespread Disease Outbreak	High	Severe

Frequency Scale	
Frequency Ratings	**Definition of Frequency Ratings**
Very High	Likely annual occurrence or more
High	Likely bi-annual occurrence
Moderate	Likely within a 5 year period
Low	Likely within a 10 year period
Very Low	Likely within a 50 year period

Severity Scale
Low
Guarded
Elevated
High
Severe

RISK

To identify risk levels for each threat and hazard, the NCR HCC utilized a scoring system that was provided to all Colorado HCCs by the Colorado Department of Public Health and Environment (CDPHE). The risk calculation takes into account the level of threat, system weakness, and impacts and consequences. These three variables produce a final risk score for each threat or hazard. This risk score is broken up into six levels ranging from low to severe. It is important to note that, although this scale is subjective in nature, a comprehensive review of the data was conducted at all levels: facility, system, local, regional, and state. This data was used to support the risk calculations provided below.

A full breakdown of each scale used in Table 6 is included on page 20.

Table 6: NCR HCC Risk Identification

Hazard	Threats & Hazards Scale 1-4	System Weakness 1-4	Impacts & Consequences 1-4	Risk = T x W x I
Supply Chain Disruption	Medium (2)	Medium (2)	Medium (2)	**Guarded (8)**
Severe Weather	High (3)	Medium (2)	Medium (2)	**Guarded (12)**
Utility Disruption (Power, Water, Network, etc.)	High (3)	Medium (2)	High (3)	**Elevated (18)**
Healthcare Facility Evacuation	Medium (2)	High (3)	High (3)	**Elevated (18)**
Medical Surge	High (3)	Medium (2)	Critical (4)	**High (24)**
Cyber-Attack	High (3)	High (3)	High (3)	**High (27)**
Critical Healthcare Staff Shortage	Critical (4)	High (3)	High (3)	**Severe (36)**
Widespread Disease Outbreak	Critical (4)	High (3)	Critical (4)	**Severe (48)**

Threats and Hazards Scale	
1	**Low**: Little or no credible threat posed by adversaries, natural disaster, or technological failure
2	**Medium**: Potential threat posed by adversaries, natural disaster, or technological failure
3	**High**: Credible threat posed by adversaries, natural disaster, or technological failure
4	**Critical**: Definite threat posed by adversaries, natural disaster, or technological failure

System Weakness Scale	
1	**Low:** Few or no weaknesses with multiple layers of protective measures or countermeasures in place with proven effectiveness
2	**Medium:** Few weaknesses with some protective measures or countermeasures in place with proven effectiveness
3	**High:** Multiple weaknesses with some protective measures or countermeasures in place with proven effectiveness
4	**Critical**: Multiple weaknesses with no protective measures or countermeasures in place with proven effectiveness

Impacts and Consequences Scale	
1	**Low**: Little or no effects on the system or patients/clients
2	**Medium**: Moderate effects leading to injury or economic loss, including possible disruptions to healthcare delivery
3	**High**: Serious effects leading to loss of life, serious injury, or economic loss, including disruptions to healthcare delivery
4	**Critical**: Grave effects leading to significant loss of life, serious injury, or economic loss, including total disruption to healthcare delivery

Risk Scale	
1-7	**Low:** At least two factors Low or one Low with none Critical
8-15	**Guarded:** All factors Medium/High or at least two High or Critical with one Low
16-23	**Elevated:** Two factors Critical or one Critical with no Low or at least two High with none Low
24-35	**High**: At least two factors High or Critical with no low
36-64	**Severe:** All factors minimally High with at least one Critical

VULNERABILITY AND IMPACT

Vulnerability, as it relates to emergency preparedness, can be described as the susceptibility of people, property, industry, resources, and environment to the negative impact(s) of a disaster. There are four main types of vulnerability:

1. Physical Vulnerability
2. Social Vulnerability
3. Economic Vulnerability
4. Environmental Vulnerability

These vulnerabilities, when exposed during an event, have the ability to create cascading impacts that can significantly reduce response and recovery capabilities.

Vulnerability, and the resulting impact(s), can and should be identified at all levels: facility, system, local, regional, state, and federal. For this assessment, the NCR HCC focused on regional vulnerabilities that have the potential to impact the health and medical system. The elements identified below (Table 7) were selected utilizing a variety of data sources available to the NCR HCC, including: real-world events, After Action Reports, data submitted by NCR HCC members through the HVA survey, NCR HCC chapter meeting topics and discussions, 2020-2021 NCR HCC JRA, NCR HCC Response Plan, and the NCR HCC Strategic Plan. Trends pulled from these sources were then discussed and reviewed by the NCR HCC Governance Board, which resulted in the vulnerabilities and impacts described below.

Table 7: NCR HCC Vulnerability Identification Assessment

Vulnerability	Impact on Healthcare Delivery
High level of economic, geographic, and political diversity within the region	The NCR covers large areas of densely populated urban cities, rural plains, and small mountain towns. Due in part to this geography, the NCR is comprised of an economically diverse population, as evidenced in the variability of SVI scores outlined in figure 5. As evidenced throughout the COVID-19 response, the region's political diversity has the potential to directly impact local, regional, and state priorities, plans, and response initiatives. While diversity in perspectives and viewpoints is a valuable asset during normal operations, the politicization of an emergency response can result inconsistencies, incongruent messaging and expectations, ultimately eroding the collaborative approach that is oftentimes necessary during a large-scale event. Various levels and types of diversity are inherent to a region the size of the NCR and, while these differences make for a dynamic region, it also creates vulnerabilities associated to the health and medical system. This includes, but is not limited to: health and medical resources, access to those resources, community response, and resiliency. Understanding these impacts and vulnerabilities are critical to the region's goal of effective planning and operationalization. Efforts much continue to acknowledge the region's diversity and implement actionable steps to mitigate its impact.

Geographic isolation	The NCR, including Colorado's capital, Denver, is geographically isolated as it is the largest city in a 500-mile radius. This isolation impacts the following response areas: • Patient movement out-of-state • Mobilization of out-of-state resources Additionally, a number of hospitals located within the NCR are identified as primary receivers of patients needing higher levels of care, including specialty care such as burn or pediatrics. While this is a key asset for Colorado, and the surrounding states, it can also put the region's health and medical system into a vulnerable position depending on the size, scope, and demand of an incident(s). A large scale event that requires critical and/or specialty care services can quickly escalate to a point where interstate support becomes impractical or at capacity, requiring Federal assets. With this in mind, the region may be directly reliant upon federal assistance and subject to their response times and resource availability. The potential impacts from both of these factors reinforce the need for the NCR, as well as the entire state, to continue to build and strengthen local, regional, and state capacity and capabilities to build a system that can respond to the demands of the local communities as well as the needs of surrounding areas.
Volume and diversity of ancillary healthcare partners	The NCR HCC continues to focus multiple efforts on developing and strengthening the preparedness, response, and recovery capabilities of the region's ancillary healthcare providers. The services provided by ancillary facilities are critical to the overall healthcare infrastructure, and those that have not sought out support on preparedness planning (regardless of if it is with the coalition or not), are oftentimes more vulnerable due to limited resources and incomplete or siloed planning efforts. Should a threat or hazard significantly impact a large number of these facilities, a considerable amount of regional resources would be required to support this sector of the healthcare system. This, in part, is due to lowered capabilities of these facilities to manage quickly evolving and/or large-scale events. The strain on resources results in cascading impacts on the other healthcare sectors as well as on the community as a whole. Like most large urban centers, the volume and diversity of ancillary healthcare providers in the NCR remains a factor when assessing vulnerability. While the coalition has engaged hundreds of ancillary partners over the past three years, this only represents a fraction of the total number of ancillary providers across the region. Additionally, the level of diversity amongst ancillary providers is quite significant, which adds an additional level of complexity to the NCR HCC's efforts to support these members. This diversity is evident in both the member-types as well as level of experience with emergency preparedness. The NCR HCC will continue to support program development, implementation, and evaluation in an effort to increase the emergency preparedness and response capabilities within the ancillary healthcare system. As these capabilities expand, this vulnerability, and its impacts, will decrease.

Deviations from existing plans and structures once in the response phase	As the region transitioned into more formal response structures and processes in the early stages of COVID-19, a trend began to emerge that continues to complicate elements of the region's response. A number of the plans that had been developed and tested, prior to COVID-19, were not being followed in the response environment. While this occurred, to some degree, at all levels, the deviation from existing plans, at the state level, resulted in the most salient consequences for the NCR. COVID-19 has been a challenge for all involved, and a large number of plans have required modification to adapt to the ever-changing environment, and the state's plans have not been immune. The "vulnerability" element is created when communication on changes to structures, expectations, or roles, is not consistent. Additionally, deviations from existing operational structures/hierarchy further complicates communication efficiency, effective information sharing, and standardization. This is an area that the NCR believes can be strengthened, at all levels, through the development of after-action reports and sustainable integrated and coordinated planning, training, and exercising opportunities.
Lack of public health capacity	While this vulnerability became quite clear due to COVID-19, it is something that will likely remain a vulnerability long past this pandemic. The legal foundations for public health action have been compromised due in part to politicization at the federal, state, and local levels. This further limits the public health sector's ability to implement measures necessary to quickly address and limit the impact of public health emergencies. Infectious disease outbreak, epidemic, and pandemic response is heavily dependent upon the capacity and capabilities of the public health system. A system that is not equipped to support an extended and fluid response will begin to crack once the demand reaches a certain level. While COVID-19 has been a historic event, the potential for future public health led responses is likely to continue to increase. Public health capacity and capabilities, including epidemiology, must be robust and resilient enough to support the communities that they serve. Without a strong public health structure, the NCR will continue to vulnerable to the consequences of the highest rated threat listed in this report – communicable disease/epidemic. Local public health agencies, key stakeholders, and constituents, will continue to advocate for support focused on strengthening their capabilities, expansion of staffing, and adequate and stable funding.

DISCUSSION

The threats and hazards identified in this regional JRA all possess the ability to significantly impact the health and wellbeing of individuals and/or facilities located in or near the affected area(s). When health and safety is compromised, oftentimes the medical system and its associated components are immediately affected in some capacity. In addition, as the size and scope of an incident fluctuates, different components of the health and medical system may be impacted in different ways. Due to the densely populated North Central Region, the human impact due to a single event, or a combination of events, has the potential to be significant and rapidly escalate into a multi-jurisdictional and/or region-wide response.

In addition to the human impact, these incidents have the ability to disrupt and/or destroy critical infrastructure. Cyber-attacks, in particular, are becoming increasingly common and can be catastrophic on both an economic as well as an operational front. Natural disasters, such as severe weather and floods, have the capacity to shut down cities and wipe out infrastructure in a matter of hours. With the region's strong reliance on these systems (e.g., electricity, cell phone communication, IT/computer networks, etc.), any significant disruption would greatly impact the health and medical system as well as those individuals within the affected area(s). During a prolonged event, such as COVID-19, where there is a sustained impact to infrastructure and systems, there is the potential for cascading effects, which can result in additional stress being put on the health and medical system. The current healthcare worker shortage is one such cascading effect that has resulted in reduced capacity within the healthcare system. Individuals in the community who may need additional assistance during an emergency, including those with access and functional and/or complex medical needs, may be particularly impacted by the cascading effects of an incident.

THREAT AND HAZARD DESCRIPTIONS AND IMPACTS

Supply Chain Disruption

Generally speaking, the healthcare system in the NCR is able to overcome supply chain disruptions that are limited in scope (e.g., time and type of resource that was scarce, short-term impacts from weather, etc.), by redistributing resources at the system level and using equivalent alternatives. However, the region has also experienced wide spread and/or extended disruptions to equipment and consumable supplies significant enough to impact healthcare service delivery. While the COVID-19 pandemic exposed a wide variety of supply chain vulnerabilities, a number of more localized incidents, both within and outside of the state, have also caused multi-jurisdictional shortages within and beyond the region. Supply chain disruptions can occur at any point along the continuum, including: 1) production (e.g., Hurricane Maria in Puerto Rico – 2017), 2) shipping (e.g., Suez Canal blockage in 2021), 3) and/or local transport/delivery (e.g., 2019 Colorado Bomb Cyclone).

Redundancies in the supply chain oftentimes exist at the facility, system, local, state, and federal level. However, these supplies are limited in quantity and cannot fully support an extended or large-scale incident(s). This includes the Strategic National Stockpile (SNS) which was utilized during the pandemic, but struggled to meet the demand due to persistent storage cuts, quality of equipment/supplies, and gaps in management. Without considerable reform, the Strategic National Stockpile should not be considered a reliable source of equipment or supplies.

In 2022, the Colorado Healthcare Coalitions will complete a statewide supply chain integrity assessment. This assessment will provide insight into the current status of the supply chain.

Supply Chain Disruption – Impacts

In the last two years, disruptions have made it difficult to obtain everything from PPE (e.g., gloves, masks, gowns, etc.) to computer chips that make it possible for advanced medical equipment to function. Shortages of some of these items are particularly concerning during prolonged and largescale events as it has the potential to rapidly and significantly reduce the level of care being delivered and/or result in unnecessary exposures and subsequent illness.

Severe Weather

For the purposes of this assessment, severe weather includes damaging hail, severe thunderstorms, tornadoes, drought, floods, and severe winter weather. According to the World Meteorological Organization, the definition of severe weather: is an extreme meteorological event or phenomenon, which represents a real hazard to human life and property. The definition of severe weather is most often impacts based, and usually defined by "local/regional" thresholds that are related to the inability for the "local/regional" populations to safely conduct normal business, to the point of being life threatening[13].

The Disaster Declarations section of this assessment outline those natural disasters that have resulted in one or more declarations within the ten-county NCR, but there are additional severe weather events that have not resulted in disaster declarations. These events have been captured by the Western Water Assessment Team, which is affiliated with the National Oceanic and Atmospheric Administration (NOAA) and the University of Colorado Boulder. This database[14] lists historical high-impact weather and climate events in Colorado from 1862 – 2021:

- A total of 40 severe or high-impact weather events have impacted the NCR since 1862
- The most frequent event was flooding (18), followed by: winter storm (7), wildfire (4); high-wind, hail, and drought (3); tornado (1); and cold wave (1)
- 231 fatalities have been attributed to these severe weather events (210 attributed to flooding alone)

Severe Weather - Impacts

Severe weather, in its many forms, has the potential to cause significant disruptions within the health and medical system. These weather events often create surges of demand for healthcare while simultaneously threatening the continuity of that care. Building damage and/or loss of utilities (including power) from a high impact weather event(s) can immediately cause a disruption to service delivery, which may result in evacuation (full, vertical, and/or horizontal) as well as injuries to patients, staff, and/or visitors. Further, the effects of severe weather on the community may result in transportation disruptions and reduced staffing. As with many of the threats and hazards reviewed in this assessment, there are cascading or secondary impacts from severe weather which can affect other facilities within the region that were not primarily impacted from the initial event. These secondary disruptions can include medical surge as well as supply and resource shortages.

[13] World Meteorological Organization (October 2004). "Workshop On Severe and ExPOO Events Forecasting". Archived from the original on 2017-01-03. Accessed on 13 March 2019.
[14] Western Water Assessment. "Historical High-Impact Weather and Climate Events in Colorado, Wyoming, and Utah. 1862-2021. Accessed on 27 December 2021.

Utility Disruption

Although they often operate in the background, utility systems play a key role in the ability of an organization to function effectively and provide safe and reliable patient care. Healthcare facility utility systems can include: mechanical (e.g., heating, ventilation and cooling); electrical (i.e., normal power and emergency power); hot and cold water and other plumbing systems; technology systems, including communications and data systems; elevators; fire alarm and suppression systems; fuel systems; access control; duress alarm and security/surveillance systems; air and vacuum systems; and medical gases[15].

There are a number of points in the system where a utility failure can occur: at the utility system source, at a major utility distribution point, and/or at local utility distribution or usage points. Failures at the utility source can be classified as internal (e.g., fire alarm control panel, boiler, etc.) and/or external (e.g., utility lines, water utility to a building, etc.). Disruptions at major utility distribution points can include piping that connects multiple boilers, data switch rooms, and connections that serve multiple pieces of equipment (e.g., medical gas tanks, vacuum pumps, air compressors, etc.). Local utility distribution failures can include items such as electrical closets, isolation room exhaust fan, etc. It is important to recognize that failures at any one, or at multiple points, in the system have the capacity to significantly impact normal operations and the ability for the organization to provide safe patient care.

Disruptions in utilities can be classified and responded to in two different ways: 1) the primary event impacting the facility, which is not tied to an additional threat or hazard or 2) a secondary event or the result of another hazard. Although both of these result in similar impacts to the facility, and elicit similar response activities, those utility failures that are caused by another event are oftentimes complicated by the needs and impacts of that disaster (e.g., a power outage that occurs due to severe weather – the facility must manage the consequences of the severe weather in addition to the power outage).

Utility Disruption - Impacts

Due to the complex nature of utility systems within most healthcare facilities, the vast majority of minor day-to-day utility disruptions can be managed at the facility level and rarely rise to the level of significantly impacting patient care. Additionally, many facilities have built-in redundancies in their utility systems to mitigate the impact of utility disruptions. The ability of a healthcare facility to respond to and mitigate against these smaller incidents results in a stronger and more resilient healthcare system throughout the region. The concern, for the NCR, is when multiple facilities are effected by a significant utility disruption and/or when one facility experiences widespread or debilitating disruptions. The loss of one or more acute care hospitals, due to a major utility failure, would be felt immediately within the region, especially if the disruption results in the need for a facility evacuation. The consequence(s), from both of these scenarios, is reduced capability and/or capacity to provide safe and effective care.

Widespread Disease Outbreak

A disease outbreak, according to the World Health Organization (WHO) is the occurrence of disease cases in excess of normal expectancy. The number of cases varies according to the disease-causing agent, and the size and type of previous and existing exposure to the agent. Disease outbreaks are usually caused by an infection, transmitted through person-to-person contact, animal-to-person contact, or from the environment or other media. Outbreaks may also occur following exposure to chemicals or to radioactive materials. Occasionally the

[15] Health Facilities Management. Planning for hospital utility failures and recovery. July 5, 2017. https://www.hfmmagazine.com/articles/2975-planning-for-hospital-utility-failures-and-recovery. Accessed 13 March 2019.

cause of an outbreak is unknown, even after thorough investigation[16]. Additionally, it should be noted that there is the potential for disease to emerge because of deliberate introduction through bioterrorism.

While SARS-Co-V-2 continues to surge through the world, and stress the healthcare system, it is critical that the threat of both existing and novel remains a priority across all the healthcare and emergency management structures.

According to a 2007 WHO report, infectious diseases are spreading more rapidly than ever before and that new infectious diseases are being discovered at a higher rate than at any time in history[17]. In a 2019 publication by the WHO, they wrote: The world is at acute risk for devastating regional or global disease epidemics or pandemics that not only cause loss of life but upend economies and create social chaos[18].

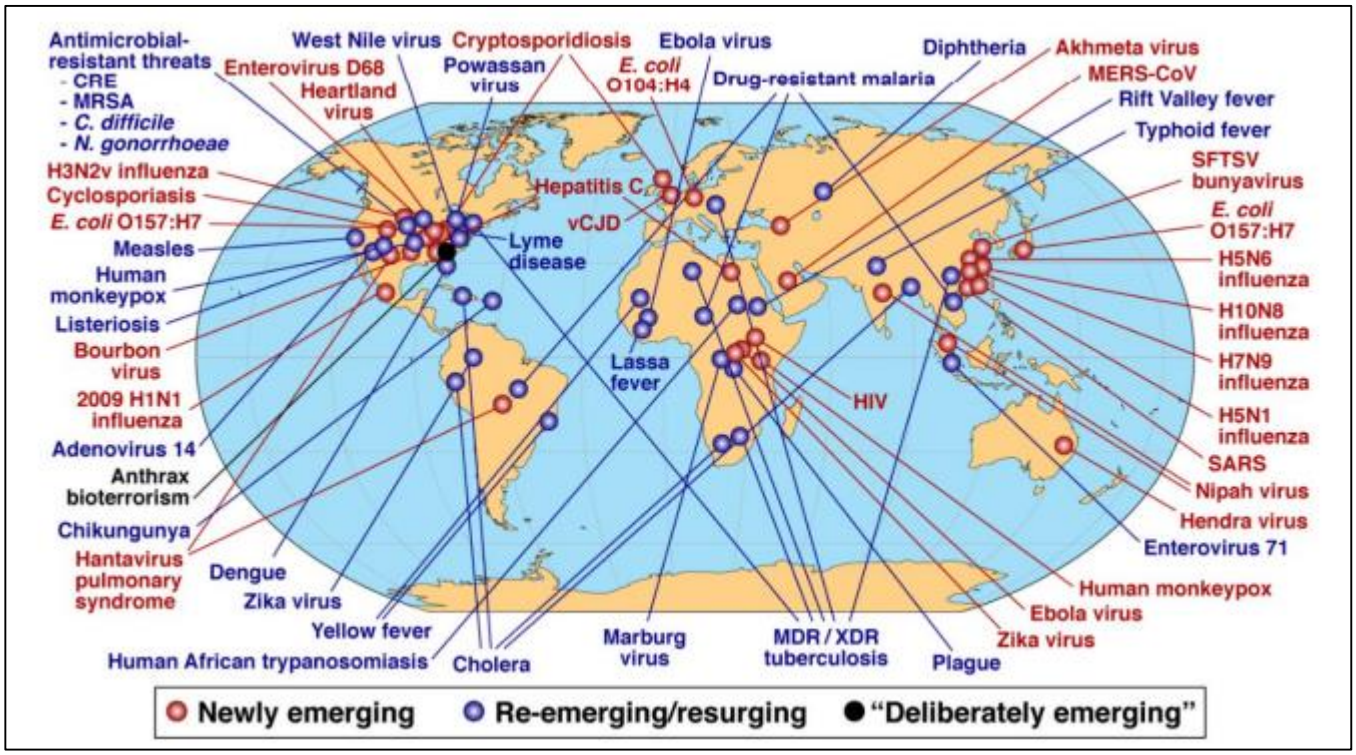


Figure 7: Global examples of emerging and re-emerging diseases[19]

When examining the impact that the current pandemic, or a future communicable disease outbreak or epidemic might have on a community, it is important to note the added complexity of emerging infectious diseases. These diseases are infections that have recently appeared within a population or those whose incidence or geographic range is rapidly increasing or threatens to increase in the near future. Approximately 40 infectious diseases have been discovered since the 1970s, including severe acute respiratory syndrome (SARS), Middle East respiratory

[16] World Health Organization - Environmental Health Emergencies: https://www.who.int/environmental_health_emergencies/disease_outbreaks/en/

[17] Baylor College of Medicine: https://www.bcm.edu/departments/molecular-virology-and-microbiology/emerging-infections-and-biodefense/emerging-infectious-diseases

[18] World Health Organization. A world at risk – annual report on global preparedness for health emergencies. September 2019. https://apps.who.int/gpmb/assets/annual_report/GPMB_Annual_Report_English.pdf

[19] United States National Institutes of Health, National Institute for Allergies and Infectious Diseases. Global examples of emerging and re-emerging diseases. In: United States National Health Security Strategy, 2018–2022. Washington (DC): United States Department of Health and Human Services; 2019 https://www.phe.gov/Preparedness/planning/authority/nhss/Documents/NHSS-Strategy-508.pdf

syndrome (MERS), Ebola, avian flu, swine flu, Zika, and now a novel coronavirus. The cause of emerging infections include[12]:

- Previously undetected or unknown infectious agents
- Known agents that have spread to new geographic locations or new populations
- Previously known agents whose role in specific diseases has previously gone unrecognized
- Re-emergence of agents whose incidence of disease had significantly declined in the past, but whose incidence of disease has reappeared

Disease outbreaks often require an expansive level of coordination amongst a wide variety of partners. The current COVID-19 pandemic, which has now surpassed the two-year mark, exemplifies the complexity of an extended infectious disease response. Over the course of the past 24 months, the response has continued to expand into much more complex and systemic challenge, impacting the daily lives of those across the globe.

Widespread Disease Outbreak Impact

A communicable disease outbreak has far reaching implications for the entire health and medical continuum, not only due to the surge in need, but also due to the impact on staff, the economic impact, and the cascading effects that can threaten the overall health and safety of a community. Further, these incidents can strain the local, state, and even federal response and health and medical systems due to an extended response period and propensity to spread regardless of jurisdictional or state lines.

These events can quickly result in resource and supply shortages, hospital and clinic surges, significant staff shortages, and the implementation of Crisis Standards of Care (Colorado Department of Public Health and Environment Crisis Standards of Care Plan).

Cyber-Attack Description

The world is becoming increasingly reliant on technology to support daily activities, and the healthcare system is no exception. The healthcare industry has become reliant on the digitization of data and the automation of processes to maintain and share patient information and to deliver patient care more effectively and efficiently. However, with these benefits comes a certain level of vulnerability and risk.

Cyber-attacks can cause information technology failures, utility disruptions, system blackouts, and potentially much more. The attacks can occur at the facility level (e.g., damage to a server room, attack on local computer networks, etc.) and/or off-site (e.g., disruption to service at a remote data center, hosting service, etc.). They can also originate at a variety of levels of the IT infrastructure. There are a number of attack modalities but at the time of this writing, ransom ware is one of the most common attack.

Cyber-attacks or cyber-terrorism, within the healthcare industry have been increasing in numbers and in sophistication over the past decade. Health-information technology, which provides critical life-saving functions, consists of connected, networked systems and integrates wireless technologies, which leaves these systems more vulnerable to cyber-attacks[20]. In addition, there are a number of recently identified vulnerabilities that are incorporated in networks across the world. A 2017 IBM study that tracked cybersecurity incidents around the globe, found that attackers who target healthcare providers focused on small to medium entities, as these

[20] U.S. Department of Health and Human Services and Healthcare & Public Health Sector Coordinating Councils. (2018). Health Industry Cybersecurity Practices: Managing Threats and Protecting Patients.

targets require the least time, effort, and money to exploit. In 2016, an estimated $6.2 billion dollars was lost by the U.S. Healthcare System due to data breaches[21].

Cyber-Attack Impact

The potential reach of a cyber-attack is no less than the reach of the systems integrated into digital networks. Many critical infrastructure operations (e.g., water, power, energy, and communications, etc.) are primarily reliant upon some type of digital network to operate. At the facility level, administrative systems, patient monitoring, health record management, and workflow processes are dependent upon computer or network-based systems to reliably function on a day-to-day basis. Due to this level of dependency, cyber-attacks have the potential to have far-reaching impacts, including: patient safety, fiscal, continuity of care, and workflow. These effects can also ripple out to surrounding facilities, depending on the type and scope of the disruption. A cyber incident that disrupts the right system can result in a temporary closure of part or all of a healthcare facility. In 2015, a California hospital emergency department had to shut down after the Electronic Health Record (EHR) and data system failed. These failed systems resulted in issues with properly dispensing medications, verifying physician orders, reviewing labs and other diagnostic procedures, and led to an inability for clinicians to review patient records. Another, similar event, also took down e-mail systems throughout the entire facility.

Cyber-terrorism, including ransomware attacks, can expose sensitive patient information, result in substantial financial costs to address and recover from the attack, and oftentimes require the coordination of diverse resources and support to respond to and minimize the impacts of the cyber-attack. These incidents also affect patient care and safety, and failing to address cyber issues can negatively impact an organization's credibility and trust within the community.

Depending on the scope of the failure, there is potential for the regional healthcare system to be impacted by an IT failure/cyber-terrorism. The failure/attack could involve multiple facilities and systems, creating a widespread outage, or it could be limited to a single facility, which has to alter operations as a result. Both of these plausible scenarios puts stress on the system as a whole and can result in decreased capacity and capability to meet the medical needs of the community.

Throughout the COVID-19 pandemic, the healthcare sector has seen an increase in credible threats associated with cyber-crime. Additionally, there were a number of briefs detailing the potential for cyber-attacks directed at COVID-19 vaccination development and distribution. The recent ransomware attack of Kronos, which provides time keeping and scheduling services to thousands of organizations across the country, directly impacted a number of facilities within the NCR. At the time of this writing, the full impact is not yet known.

HIGH-RISK/HIGH-CONSEQUENCE IMPACTS

The high-risk/high-consequence events described in this section are being highlighted due to the severity of their impacts on the region. While not threats in and of themselves, the NCR continues to prioritize capacity and capability building that directly addresses medical surge and healthcare facility evacuation.

[21] Donovan, Fred. "Healthcare Data Breach Costs Remain Highest Among Industries." Health IT Security. Last modified July 12, 2018. https://healthitsecurity.com/news/healthcare-data-breach-costs-remain-highest-among-industries.

Medical Surge

The term medical surge, for the purposes of this assessment, refers to sudden, unanticipated escalations in health system demand caused by exceptional events (e.g. natural hazard disasters, pandemics, mass casualty incidents (MCI), etc.)[22] and is inclusive of both trauma and non-trauma surge.

At the regional level, a medical surge event can quickly deplete available resources and capabilities for the surge event as well as day-to-day activities for both hospitals and EMS providers. Medical surge can be further complicated due to factors such as contamination (chemical, biological, radiological), safety and security of healthcare facilities and providers, loss of communication modalities, and limited situational awareness if the surge is part of a fast-moving event.

In instances of non-trauma surge (e.g., COVID-19), the region has had to support both a sustained surge in healthcare needs, as well continued resource depletion experienced throughout the state, nation, and globally. This type of surge, as has been seen with recent COVID-19 waves, has the potential to be expansive as the medical consequences impact communities, ancillary healthcare facilities, and healthcare workers.

Medical surge incidents in the NCR have been the result of natural hazards, human caused events, and infectious disease:

- Natural Event - 1993 Pope Visit to Denver: In 1993, during Pope John Paul II's visit to Denver, over 20,000 individuals fell victim to the extreme heat. Those who were ill or injured were moved to makeshift field clinics at the rate of 500 per hour. Reports from this event show that the sheer volume of medical needs overwhelmed the medical system, in its entirety.

- Intentional Human Act - Mass Shootings: The region has also experienced a number of shooting events that have impacted the region's pre-hospital and hospital systems, most notably the 1999 Columbine High School shooting and the 2012 Aurora Theater Shooting. In 2021, the NCR has experienced two (2) significant active shooter events: Boulder King Soopers shooting in March 2021 and the Denver/Lakewood shootings in December 2021.

- Infectious Disease – SARS-CoV-2: 2020 – Present: In March of 2020, FEMA granted an emergency declaration to Colorado as a result of SARS-CoV-2 and Covid-19. Since that date, the NCR has experienced five (5) distinct hospital surges due to the virus. To date, the highest number of hospitalized COVID-19 patients in the region, at one time, has been 1,023. Throughout this pandemic, the healthcare system has faced significant PPE shortages, supply chain disruptions, critical staffing shortages, non-existent bed availability, and the need for a statewide patient transfer center to balance the surge of hospitalizations. As of the writing of this assessment:
    - State-wide: 11,184 total deaths due to COVID-19
        - Approx. 76% of these deaths have been amongst those aged 65+
    - Crisis Standards of Care for Healthcare Staffing and EMS remain activated across the state
    - The NCR's ICU beds are 94% full and medical/surgical beds are 95% full
    - Healthcare worker staffing contracts are in place at the state and system levels in an effort to maintain daily operations
    - An unprecedented number of healthcare workers are being infected by the prominent variant, Omicron

[22] Watson, S. K., Rudge, J. W., & Coker, R. (2013). Health systems' "surge capacity": state of the art and priorities for future research. *The Milbank quarterly*, *91*(1), 78–122. doi:10.1111/milq.12003

Medical Surge – Impact

Regardless of the causal event(s), medical surge is complex in nature and has the potential to affect all facets of the healthcare continuum.

Trauma Surge

The initial impact is a surge in both pre-hospital and hospital care. This surge may or may not come with an initial notification or situational awareness. The first few minutes, or even hours, of a trauma surge are chaotic and require a significant amount of resources. Because of the limited control or awareness in the early stages of an event, the impact is oftentimes disproportionate.

Beyond the initial needs for triage, transportation, trauma, and surgical capabilities, the secondary or cascading impacts from a trauma surge, or MCI, can include:

- Communication breakdowns (e.g., loss of cellular networks)
- Prioritization of care and surge on emergency departments (ED): as evidenced in past events, those that are minimally injured often arrive first to the closest emergency departments. This can result in EDs being maxed out with lower-acuity patients, which limits the care they can provide to those with more traumatic injuries
- Demand surges for supplies and equipment, including blood products
- Electronic medical record (EMR), and other internal patient registration and tracking systems, becoming overloaded
- Convergence of non-injured individuals at the hospitals (e.g., press, family members, volunteers, etc.)

Most trauma surge events, depending on the location and size of the incident, will require the region to work together closely to mitigate and manage what impacts they can. This can include notification, prioritization and allocation of resources; patient distribution; information sharing; and public information. Further, once the initial impact of the event has diminished, activities begin to transition to recovery. As seen in the 2012 Aurora Theater shooting, recovery efforts can last years and are oftentimes supported by non-hospital regional HCC partners.

Non-Trauma Surge

Although events that result in a surge of non-trauma cases oftentimes are slower to evolve and provide an opportunity for the healthcare system to plan and prepare for the surge, the impact is still significant, as evidenced throughout the COVID-19 pandemic.

The region's hospitals, similar to the rest of the nation, routinely operate at or near full capacity. Their ability to rapidly increase services is limited due to bed/space availability and staffing shortages. With many hospitals already operating with reduced staff, the loss of approximately 30% due to an infectious disease event significantly affects continuity of healthcare service delivery.

Extended non-trauma surge events will require the allocation of limited healthcare resources in a manner that does the greatest good for the greatest number of patients. The process for prioritization and allocation of scare resources can be complex, especially when the entire region is impacted and the shortage are widespread.

If a non-trauma surge is related to an infectious disease, there is the potential for the surge to last months or even years. This puts additional stress onto the healthcare infrastructure and workforce and may necessitate the early introduction of behavioral health resources to support staff resiliency.

Healthcare Facility Evacuation

There are numerous events throughout history that have caused the evacuation of at least one healthcare facility due to the primary hazard and/or cascading impacts. These evacuations often make the news because they can be complex, chaotic, and dangerous. A few recent natural disasters that have resulted in healthcare facility evacuations include the flooding during Hurricane Katrina (2005), California's Tubbs (2017) and Kincade fires (2019), Colorado's 2013 floods and, most recently, the Marshall Fire in Boulder County (2021). As the world continues to see the frequency and intensity of natural disasters rise[23], we are likely to see the number of significant healthcare infrastructure impacts, including facility evacuations, tend upward. The impact(s) of these natural disasters, specifically those that result in power outages, are also greater due to the healthcare system's growing reliance on technology and electricity to facilitate patient care. In addition to natural disasters, healthcare facilities may also experience internal events that require patient evacuation (e.g., fire, flood, loss of IT, etc.). In reviewing the NCR HCC member HVAs, it was noted that many of the partners in the NCR have at least one of these hazards listed towards the top of their HVA. This is a critical piece of data that ties into regional planning efforts.

The number of large healthcare facility evacuations in the NCR is relatively low, but the region is highly susceptible to this type of event due to the high number of healthcare organizations and the types of natural hazards that are likely to impact one or more counties within the region. Per the earlier cited FEMA disaster declaration data, wildfire and flood hold the top two spots for declarations in the NCR and, as recent events have demonstrated, both of these hazards carry with them the potential to force facility evacuations.

Due to the recent nature of the Marshall Fire (December 30, 2021), the details of this event will be included in future iterations of the NCR HCC Joint Risk Assessment. However, it is important to note that this fire resulted in the full evacuation of one hospital and the partial evacuation of a secondary hospital. Both efforts were largely successful with no significant adverse impacts to patients or staff.

Healthcare Facility Evacuation - Impact

Although healthcare facility evacuations may be caused by an internal hazard/event, depending on their size and scope, have the potential to affect all elements of the healthcare system due to cascading effects. Prioritization of patients, patient tracking, safe movement of those that are critically ill, coordinating medical and non-medical transport, managing the potential surge into other facilities, and supply management are just a few of the complex challenges that must be managed and supported. To further complicate the event, oftentimes these evacuations are occurring as fires are burning and floodwaters are rising as has been seen in recent national and local disasters.

From the regional perspective, one of the most significant gaps in an evacuation event is transportation. Although the NCR is the most resource rich region in the state, medical transport assets are still limited and a formal process for transportation coordination does not exist. This coordination gap extends to non-medical transport assets as well. Through the integration of ancillary healthcare partners into the coalition, the region has recognized that these organizations have the ability to support a large healthcare facility evacuation by providing transportation and staffing resources. However, without a process for allocation and coordination, these assets cannot be utilized effectively.

The NCR is currently working on developing processes, structures, and platforms to facilitate the implementation of processes that were utilized during the Marshall Fire, specifically, the use of the HCC as a

[23] 2018 Münchener Rückversicherungs-Gesellschaft, NatCatSERVICE – As at December 2019

point of transport coordination and hub for information sharing across the region's hospitals and key stakeholders. The region also continues its work on the idea of an EMS Multiagency Coordinating Group (MAC); however, its operationalization has been slow to develop. Although the probability and regional implications of a healthcare facility evacuation remains elevated, current events and lessons learned, combined with the region's focus on coordinated planning, training, and exercising, have the potential to mitigate the impact to the healthcare system and community.

Critical Healthcare Staff Shortage

The healthcare system, at all levels, has been adapting to the complex issue of healthcare worker shortages for years. As the country moves into the second year of the COVID-19 pandemic, those existing shortages have only been exacerbated. While this continues to be a system problem, recent shortages have been attributed to high patient volumes (both COVID and non-COVID patients), personal risk, staff burnout and attrition, and lucrative opportunities within staffing agencies. Due to the compounding nature of this shortage in trained staff, healthcare capacity has been directly impacted to a point where traditional staffing support and expansion tactics are simply not enough to compensate.

This shortage extends beyond just hospitals as agencies in the public health, post-acute care, and EMS disciplines are also facing critical shortages. Due to the widespread impact, across the healthcare continuum, the region is experiencing reductions in staffed beds, EMS transport capability, lack of post-acute care transfer opportunities, and a slowing and/or loss of critical public health activities.

As mentioned, critical healthcare staffing shortages are both systemic and quite complex. For this reason, solving the problem when it has already reached a critical stage is challenging and has resulted in support from the State of Colorado and Federal agencies such as FEMA and HSS. It is important to note that these are short-term solutions and that any long term approaches to mitigating widespread healthcare staffing shortages will take time and diverse coordination. For this reason, as well as the notion that the impact that COVID-19 has had on staff will persist long after the medical surges, healthcare partners within the region anticipate staffing shortages to be a critical factor in their operational capacity and capabilities for years to come.

Critical Healthcare Staff Shortage – Impact

The impact of critical healthcare staff shortages are considerable. The capacity of the healthcare system and quality of care both suffer. Staffing ratios and scopes of practice may be adjusted to bolster the capacity of the healthcare system for short periods, but quality of care will likely be impacted with prolonged implementation of contingency or crisis standards of care. It is also reasonable to assume that the staff that remain will face increased workloads and demands.

Further, when staffing shortages impact the full healthcare continuum, the cascading effects are experienced at every point of healthcare service delivery (e.g., increased rates of emergency department divert, extended lengths of stay for those appropriate for discharge to a post-acute care facility, the need for strategic and extensive patient transfer systems and protocols, etc.).

GAPS

In addition to the identification of regional hazards and threats, the NCR HCC also identified and prioritized gaps that impact the preparedness, response, and recovery activities within the health and medical system. A summary of the gaps, as well as the identified next steps to address these gaps, is included in Table 8.

Table 8: Summary of Prioritized Gaps

Identified Gaps	Identified Next Steps to Address Gap
Lack of an implemented regional health and medical communications framework	The NCR HCC developed a regional health and medical communications committee in 2018. To-date, this multi-disciplinary committee has created a strategic plan and developed a final draft version of the NCR Regional Health and Medical Communications Framework. This framework includes an operational element, which aims to deconflict and standardize regional communications, where appropriate. The framework will be the focus of a regional workshop in mid-2022, with training, exercise, and implementation projected for late 2022. These activities have been delayed due to COVID-19.
Gaps in regional information sharing during an event	The NCR HCC, through the development of the HCC Response Plan and operationalization of the healthcare coalition, has been able to effectively support the COVID-19 response at the local, regional, and state level. One of the key activities of the NCR HCC has been information sharing. While there has been significant progress made over the last year, a number of notable gaps still remain. The identification of these gaps is one of the primary improvement plan activities listed for the NCR HCC's COVID-19 interim action report (IAR). Specific areas for improvement include, but are not limited to: • Lack of a standardized communication platform/modality across wide variety of partner types • Lack of clarity around what information is informational vs. actionable • Reduction of duplicative information sharing efforts: who is receiving what, are they the appropriate recipients, and are efforts being duplicated

Limited ability to identify and allocate resources at the regional level	The NCR HCC continues to work on increasing the region's ability to identify and allocate resources, an effort that is supported and reinforced through the development and operationalization of the NCR HCC Response Plan and NCR Hospital Coordination Plan. Resource requests and allocation have played a significant role in the COVID-19 response. And, while the vast majority of the region's partners follow the local resource request processes, gaps in knowledge and processes for regional support remain an issue. These gaps in knowledge are in part caused by varying processes at the local level, and resource specific processes implemented at the state level in support of COVID-19 response. A number of partners have been instructed, by external entities, to utilize regional HCCs to support resource identification, if a request is unable to be filled internally or at the local level. As outlined in the NCR HCC Response Plan, regional resource identification is within the scope of the HCC. The disconnect, as evidenced during COVID-19, is that the process for this to occur *and* formalization of how this integrates into existing structures was not built out to the level required to efficiently support the COVID-19 response.
Gaps in processes related to cross-jurisdictional and multi-disciplinary coordination	Addressing gaps associated with cross-jurisdictional and multi-disciplinary coordination will remain a priority for the NCR HCC as long as it is in existence, as this core capability will be in a constant state of evolution. A number of gaps identified over the past three (3) years have significantly improved through the development and then implementation of regional plans. While the region has seen forward progress in this area, the coalition anticipates a number of areas for improvement following the COVID-19 response – this includes the formalization of roles and responsibilities associated with operationalization. The disruption potentially caused by changes within the Tri-County Health Department jurisdictional landscape are of particular concern. The NCR HCC will continue to work closely with TCHD to ensure that processes and protocols remain inclusive regardless of jurisdictional boundaries. The NCR HCC remains committed to training, exercising, evaluating, and de-conflicting these plans and associated activities with the support of local and state partners. continues effective implementation.

The North Central Region's Healthcare Coalition, in partnership with the region's health and medical systems, has been building relationships, developing local emergency response plans and procedures, and working collaboratively for many years. As a result, the region has strong healthcare coalition chapters, dedicated ESF-8 and health and medical branch leads, and well-documented processes around health and medical response and support on a local level. These systems have been tested through exercises and real-world incidents on multiple

occasions, resulting in lessons learned and improvement activities; all of which have strengthened the preparedness, response, and recovery network.

As is often stated in emergency management, “all disasters start local.” This saying reinforces the importance of having a strong foundation at the local level. However, for capability and capacity to be optimized, the planning and collaborative efforts must broaden to the regional level. The impact of the COVID-19 response has further solidified the HCC’s drive to prioritize projects, exercises/drills, and planning initiatives that support regional coordination, communication and situational awareness. The gaps detailed above, as well as the next steps in addressing these gaps, directly align with increase capacity and capabilities at the *regional* level while capitalizing on the successful efforts at the local level.

CONCLUSION

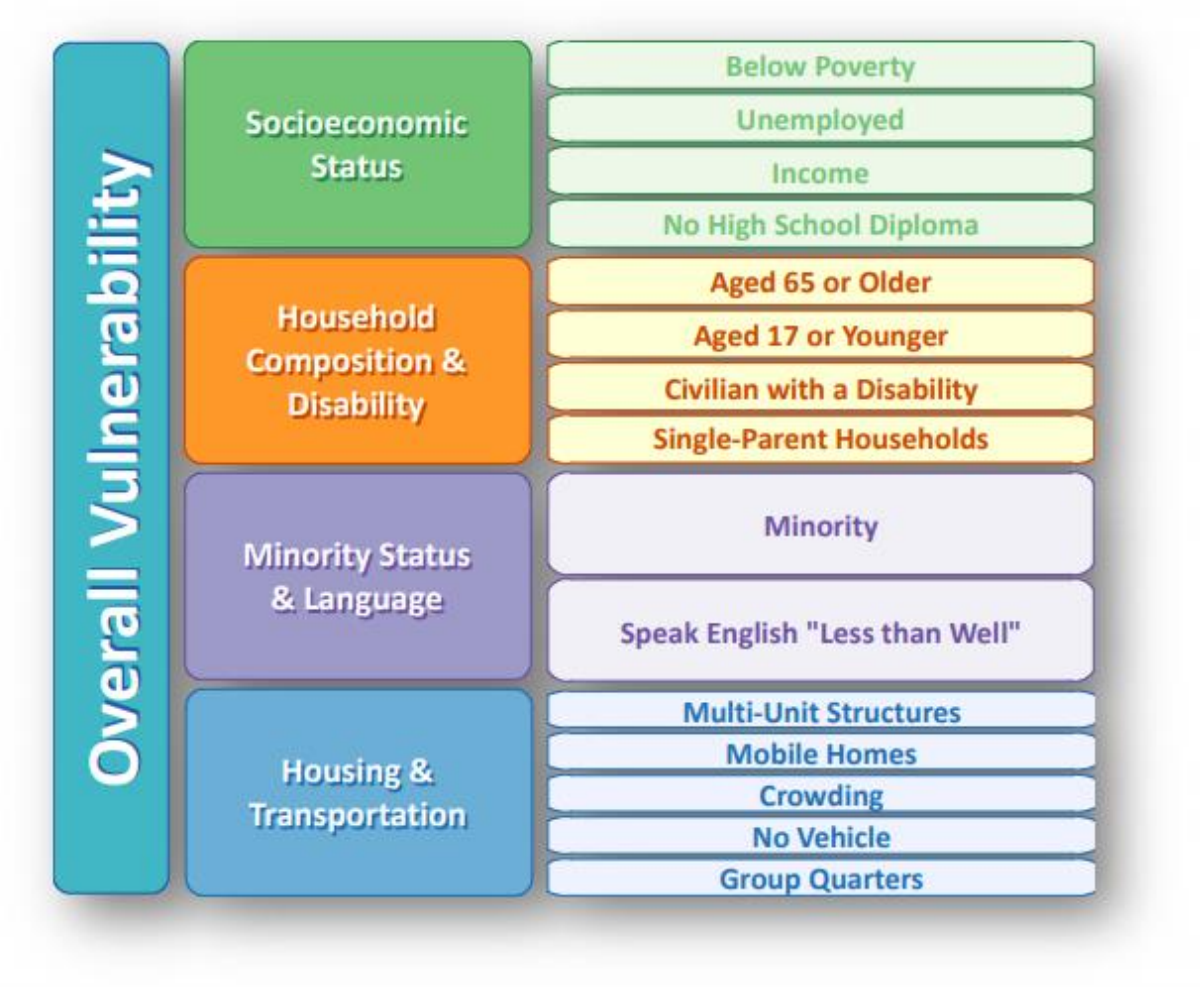
The combination of a detailed analysis of risk assessment data pulled from various sources throughout the region and collaborative discussions amongst regional partners, the North Central Region Healthcare Coalition was able to identify the top threats and hazards to the region’s health and medical system: widespread disease outbreak; critical healthcare staff shortage; cyber-attack; medical surge; healthcare facility evacuation; utility disruption; severe weather; and supply chain disruption. All of these events carry the potential for significant human, infrastructure, and/or economic impact resulting in disruptions in healthcare service delivery. Although the NCR HCC takes an all-hazards approach to planning, it is important to recognize those threats and hazards that carry an increased risk to the region.

In addition to identifying the top regional threats and hazards, the NCR HCC outlined gaps in the current preparedness, response, and recovery systems and structure. The gaps presented in this assessment include: lack of an implemented regional health and medical communications framework; gaps in regional information sharing during an event; limited ability to identify and allocate resources at the regional level; and gaps in processes related to cross-jurisdictional and cross-disciplinary coordination. The coalition is committed to continue working to address these gaps collaboratively with the goal being to increase capabilities on a regional level, which, in turn, will support the planning, and response initiatives aligned with those hazards and threats that present the greatest risk.

The coalition, and its key stakeholders, will utilize the information included in this NCR HCC Joint Risk Assessment to develop and prioritize planning, training, and exercise initiatives moving forward. This includes revisions to the 5-Year NCR HCC Strategic Plan, completion of annual work plans, revisions to existing regional plans, and the development of clinical annexes to support the NCR HCC Response Plan. Additionally, the outcomes of this assessment will support the future funding of HPP projects within the region. As has been done in the past, all of these efforts will be coordinated and aligned with the broader regional and state emergency management systems.

APPENDIX A – SOCIAL VULNERABILITY INDEX VARIABLES

American Community Survey (ACS), 2012-2016 (5-year) data for the following estimates:



[24]

[24] Center for Disease Control. CDC's Social Vulnerability Index (SVI): A tool to identify socially vulnerable communities. https://svi.cdc.gov/Documents/FactSheet/SVIFactSheet.pdf. Accessed 12 March 2019.

APPENDIX B – ACRONYMS

Acronym	Term
AAR	After Action Report
ACS	American Community Survey
AFN	Access and Functional Needs
ASC	Ambulatory Surgery Center
ASPR	Assistant Secretary for Preparedness and Response
BH	Behavioral Health
CDC	Centers for Disease Control
CDPHE	Colorado Department of Public Health and Environment
CDPHE-OEPR	Colorado Department of Public Health and Environment – Office of Emergency Preparedness and Response
CHCO	Children's Hospital of Colorado
CMS	Centers for Medicare and Medicaid Services
DHSEM	Division of Homeland Security and Emergency Management
DIA	Denver International Airport
ED	Emergency Department
EHR	Electronic Health Record
EM	Emergency Management
EMR	Electronic Medical Record
EMS	Emergency Medical Services
EOC	Emergency Operations Center
ESF	Emergency Support Function
FEMA	Federal Emergency Management Agency
FQHC	Federally Qualified Health Center
HAMR	Health and Medical Response
HCC	Healthcare Coalition
HPP	Hospital Preparedness Program
HVA	Hazard Vulnerability Assessment
HVAC	Heating, Ventilation, and Air Conditioning
IT	Information Technology
JRA	Joint Risk Assessment
MAC	Multiagency Coordination

Acronym	Term
MCI	Mass Casualty Incident
MERS	Middle East Respiratory Syndrome
MFHCC	Metro Foothills Healthcare Coalition
MOU	Memorandum of Understanding
NCR HCC	North Central Region Healthcare Coalition
NOAA	National Oceanic and Atmospheric Administration
PH	Public Health
PHED Ex	Public Health Emergency Dispensing Exercise
SARS	Severe Acute Respiratory Syndrome
SitRep	Situation Report
SVI	Social Vulnerability Index
THIRA	Threat and Hazard Identification and Risk Assessment
UASI	Urban Areas Security Initiative
WHO	World Health Organization

APPENDIX C – REFERENCES

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