# North Central Region Healthcare Coalition

## 2018-2019 Joint Risk Assessment

March 2019

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## INTRODUCTION

### PURPOSE

The 2018-2019 North Central Region Healthcare Coalition (NCR HCC) Joint Risk Assessment (JRA) has been developed to provide 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. In addition, this document will aid 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.

Further, the NCR HCC JRA will be provided to the Colorado Department of Public Health and Environment's Office of Emergency of Preparedness and Response (CDPHE-OEPR) and will be included in the CDPHE-OEPR State Jurisdictional Risk Analysis Report, as well as 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 related to the healthcare component of the emergency response system.

This document, and the included data, has been developed to support the coalition and its members and is not directive in nature.

### PLANNING ASSUMPTIONS

- While there will likely be significant overlap between the NCR HCC Hazard Vulnerability Analysis (HVA), JRA, and the 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 were 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. The data provided by these members is influenced by their own organizational initiatives and planning efforts.

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[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

- Although this JRA focuses on the impact to healthcare, the HVA and JRA process was inclusive of data from emergency management partners, public health, and other non-traditional health and medical partners.

## ADMINISTRATIVE SUPPORT

The NCR HCC JRA will be reviewed and revised by the NCR HCC Governance Board, HCC Chapter Leads, and HCC members, on an annual basis. Each subsequent annual update will consist of a review of the previous year's JRA and integration of relevant new information, as appropriate. Additionally, the JRA will be 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 2018-2019 NCR HCC JRA, as well as any revisions, will be distributed to all NCR HCC members and stakeholders and will 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. The primary function of the NCR HCC is to coordinate and conduct healthcare emergency preparedness activities through the promotion, development, and enhancement of the region's cross-jurisdictional coordination and collaboration to the health and medical component of incident preparedness, response, and recovery. More specifically, the NCR HCC focuses on 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, broken down by county (Figure 1).
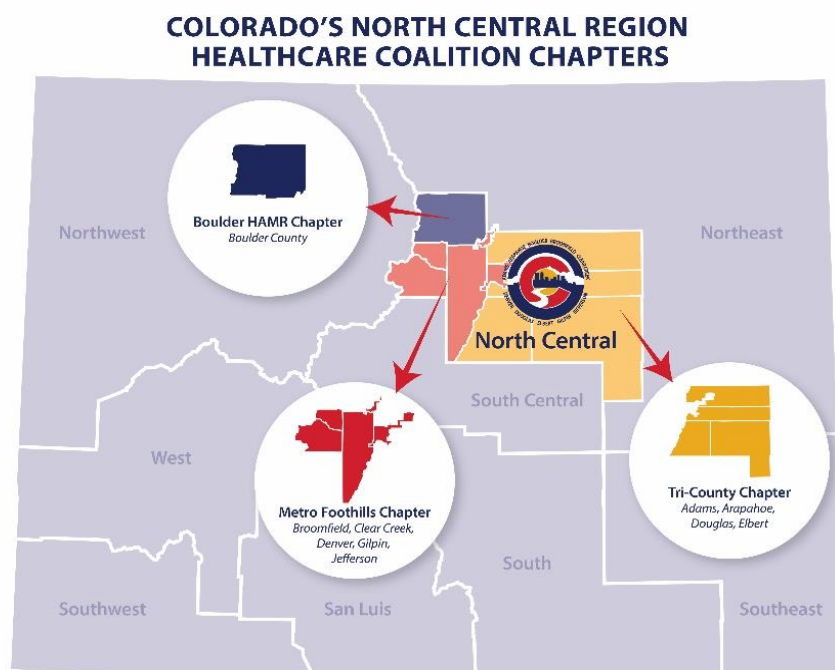
*Figure 1: Colorado's NCR HCC Chapters*

The NCR HCC, and its chapters, are governed by the NCR HCC Governance Board. 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.

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

## NCR HCC Membership (N=294)

Number of Organizations/Disciplines Represented

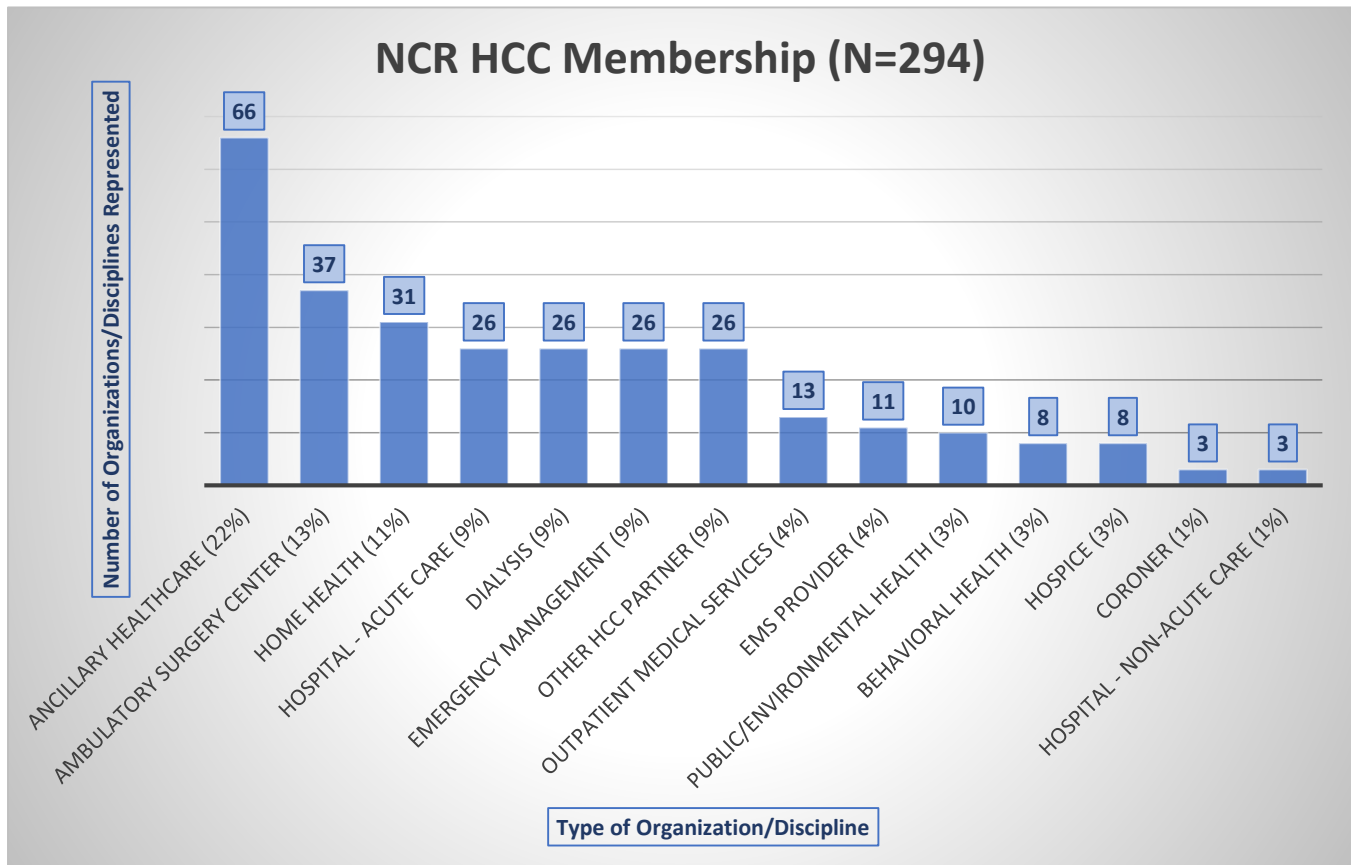| Value | Type of Organization/Discipline |
|---|---|
| 66 | ANCILLARY HEALTHCARE (22%) |
| 37 | AMBULATORY SURGERY CENTER (13%) |
| 31 | HOME HEALTH (11%) |
| 26 | HOSPITAL - ACUTE CARE (9%) |
| 26 | DIALYSIS (9%) |
| 26 | EMERGENCY MANAGEMENT (9%) |
| 26 | OTHER HCC PARTNER (9%) |
| 13 | OUTPATIENT MEDICAL SERVICES (4%) |
| 11 | EMS PROVIDER (4%) |
| 10 | PUBLIC/ENVIRONMENTAL HEALTH (3%) |
| 8 | BEHAVIORAL HEALTH (3%) |
| 8 | HOSPICE (3%) |
| 3 | CORONER (1%) |
| 3 | HOSPITAL - NON-ACUTE CARE (1%) |

*Figure 2: NCR HCC Membership Representation*
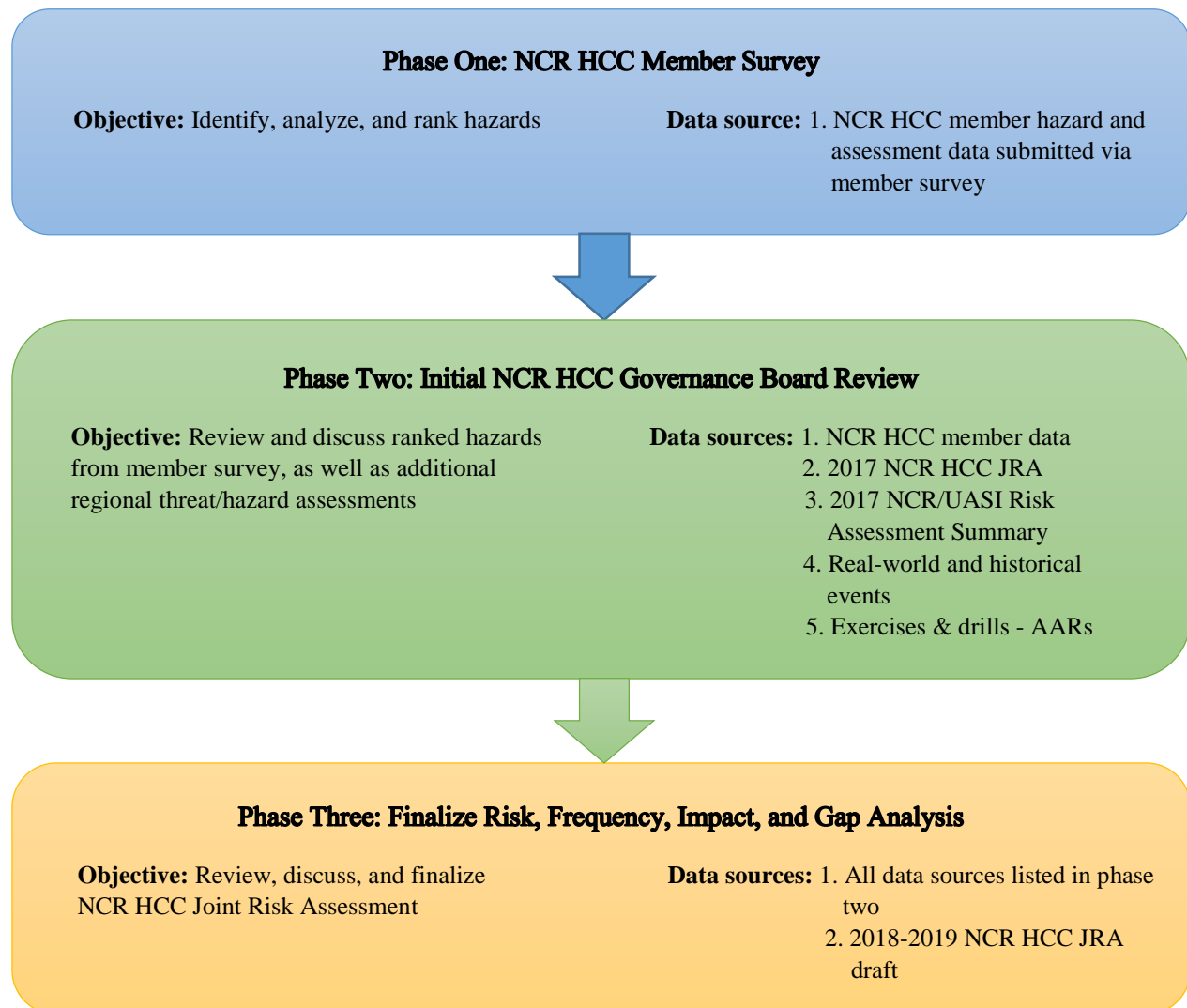
## RESPONSE ROLE OF THE NCR HCC

The composition of the NCR HCC is reflective of those partners that would 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 the Emergency Operations Center (EOC), allowing for direct communication and coordination with other support functions and emergency management. HCC members are integrated into the larger emergency response framework via this structure with the intention being that ESF-8/health and medical branches will complement and support existing agency level plans and procedures, not replace them.

While the NCR HCC does not have an independent response role, the coalition is in the process of further developing and defining operationalization within the region. The current areas of focus related to this effort are information sharing and resource identification. These two elements are integral components of any response, and provide an opportunity for the HCC to capitalize on the preparedness activities and relationship building that occurs on a daily basis.

## DEVELOPMENT

### PROCESS OVERVIEW

The development of the 2018-2019 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.

**Phase One: NCR HCC Member Survey**

**Objective:** Identify, analyze, and rank hazards

**Data source:** 1. NCR HCC member hazard and assessment data submitted via member survey

**Phase Two: Initial NCR HCC Governance Board Review**

**Objective:** Review and discuss ranked hazards from member survey, as well as additional regional threat/hazard assessments

**Data sources:** 1. NCR HCC member data
2. 2017 NCR HCC JRA
3. 2017 NCR/UASI Risk Assessment Summary
4. Real-world and historical events
5. Exercises & drills - AARs

**Phase Three: Finalize Risk, Frequency, Impact, and Gap Analysis**

**Objective:** Review, discuss, and finalize NCR HCC Joint Risk Assessment

**Data sources:** 1. All data sources listed in phase two
2. 2018-2019 NCR HCC JRA draft

*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. HCC members were asked to complete a survey as well as submit their hazard and risk assessments. A total of forty-two (42) agencies completed the survey and/or submitted documentation (Figure 4). Only those assessments completed within the last two years were included. Once received, the data was compiled into a single spreadsheet and synthesized to identify the top shared risks at the organizational level.
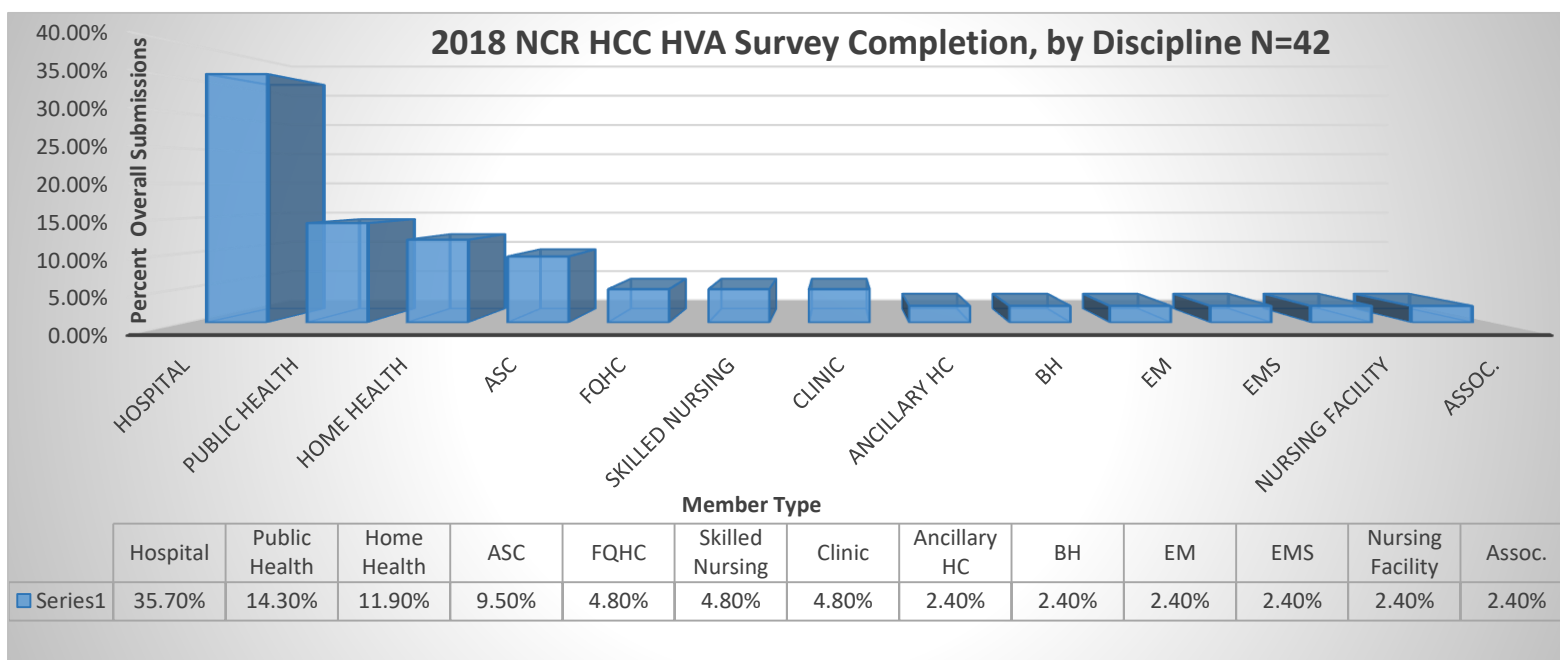
This quantitative data was then reviewed by the NCR HCC Governance Board as part of a facilitated discussion (see Phase Two above for data sources included in this discussion). The outcome of this discussion was a preliminary list of the top threats/hazards pertaining to the health and medical system 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.

**2018 NCR HCC HVA Survey Completion, by Discipline N=42**

| | Hospital | Public Health | Home Health | ASC | FQHC | Skilled Nursing | Clinic | Ancillary HC | BH | EM | EMS | Nursing Facility | Assoc. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Series1 | 35.70% | 14.30% | 11.90% | 9.50% | 4.80% | 4.80% | 4.80% | 2.40% | 2.40% | 2.40% | 2.40% | 2.40% | 2.40% |

*Figure 4: 2018 NCR HCC HVA member participation via HVA survey and submission*

## NCR GEOGRAPHY AND POPULATION CHARACTERISTICS

### GEOGRAPHY

The ten-county North Central Region encompasses just under 7,000 square miles[3] of both urban, rural, and mountainous geography. The total population of the region is just over 3.2 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 410 people per square mile[2]. 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 704,621 residents[3].

The NCR includes the counties of: Adams, Arapahoe, Boulder, Broomfield, Clear Creek, Denver, Douglas, Elbert, Gilpin, and Jefferson.

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

| County | Population [2017][3] | Land Area (sq. miles) [2010][2] | Population per Sq. Mile [2010][2] |
|---|---|---|---|
| **Adams County** | 503,167 | 1,167.65 | 378.2 |
| **Arapahoe County** | 643,052 | 798.10 | 716.7 |
| **Boulder County** | 322,514 | 726.29 | 405.6 |
| **Broomfield County** | 68,341 | 33.030 | 1691.9 |
| **Clear Creek County** | 9,574 | 395.23 | 23.0 |
| **Denver County** | 704,621 | 153.00 | 3,922.6 |
| **Douglas County** | 355,299 | 840.25 | 339.7 |
| **Elbert County** | 25,642 | 1850.85 | 12.5 |
| **Gilpin County** | 6,013 | 149.90 | 36.3 |
| **Jefferson County** | 574,613 | 764.21 | 699.5 |
| **NCR Total** | **3,212,836** | **6,878.51** | **410.3** |

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[3] United States Census Bureau – U.S. Census Bureau Geography Division: Quick Facts. 2010 data.
[4] United States Census Bureau: Quick Facts. July 1, 2017 data.

## POPULATION CHARACTERISTICS

The 3.2 million individuals that make up the North Central Region are diverse both in 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 North Central Region includes approximately 909,071 children under the age of 18, which is 28.3% of the total population (Table 2). With the knowledge that children make up over one-quarter of the community within the region, the NCR has partnered with the state health department to begin work on a 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 better 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 14.5% (462,734) 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. 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 of time. 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) [2017][5] | Children Under 5 [2017][3] | | Children Under 18 [2017][3] | | Older Adults 65 Years and Over [2017][3] | | Older Adults 85 Years and Over [2013-2017][6] | | Non-White (all persons except white, non-Hispanic) [2017][3] | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | # | % | # | % | # | % | # | % | # | % |
| **Adams County** | 13.14 | 36,228 | 7.2% | 135,352 | 26.9% | 50,820 | 10.1% | 4,879 | 1.0% | 251,080 | 49.9% |
| **Arapahoe County** | 11.78 | 40,512 | 6.3% | 153,046 | 23.8% | 81,668 | 12.7% | 8,773 | 1.4% | 254,006 | 39.5% |
| **Boulder County** | 8.15 | 14,836 | 4.6% | 62,568 | 19.4% | 44,184 | 13.7% | 4,752 | 1.5% | 71,276 | 22.1% |
| **Broomfield County** | N/A | 3,759 | 5.5% | 16,128 | 23.6% | 9,021 | 13.2% | 9,642 | 1.5% | 15,787 | 23.1% |
| **Clear Creek County** | N/A | 373 | 3.9% | 1,503 | 15.7% | 1,848 | 19.3% | 37 | 0.4% | 1,091 | 11.4% |
| **Denver County** | 13.62 | 42,982 | 6.1% | 140,220 | 19.9% | 81,736 | 11.6% | 10,855 | 1.6% | 321,307 | 45.6% |
| **Douglas County** | 10.04 | 19,783 | 5.9% | 89,190 | 26.6% | 40,504 | 11.4% | 2,888 | 0.9% | 61,822 | 17.4% |
| **Elbert County** | N/A | 1,154 | 4.5% | 5,462 | 21.3% | 4,051 | 15.8% | 368 | 1.5% | 6,994 | 36.6% |
| **Gilpin County** | N/A | 210 | 3.5% | 962 | 16.0% | 938 | 15.6% | 104 | 1.8% | 740 | 12.3% |
| **Jefferson County** | 10.13 | 29,880 | 5.2% | 114,923 | 20.0% | 95,513 | 16.1% | 10,153 | 1.8% | 124,691 | 21.7% |
| **NCR Total** | **N/A** | **189,717** | **5.9%** | **719,354** | **22.4%** | **410,283** | **12.8%** | **52,451** | **1.7%** | **1,108,794** | **34.5%** |

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## 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 multiple jurisdictions have incorporated access and functional needs populations into exercises and drills, including the statewide Public Health Emergency Dispensing Exercise (PHED Ex) in June of 2017. 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 as a result of an event(s). The NCR HCC Governance Board has reviewed all of the special populations data included in this JRA and has committed to a regular review of this data to continue to support planning in this area. Additionally, the NCR HCC will be completing focus groups with those partners that provide services to members of the community with Access and Functional Needs (AFN) as well as those that serve the pediatric population within the NCR. The results of these focus groups will be incorporated into future planning, response, and recovery efforts.

One way that CDPHE has encouraged the state HCCs to assess and incorporate the access and functional needs of the community into planning efforts, is through the utilization of 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 5 categories: **C** Communication, **M** Medical/Health, **I** Independence, **S** Safety and Support, and **T** Transportation. The C-MIST framework has been introduced to members of the NCR HCC via the CICO map training, which provides members with the resources and tools to identify those with access and functional needs, as well as the C-MIST framework which supports inclusive planning.

In an effort to better tie in AFN planning initiatives with the C-MIST Framework, the NCR HCC will be reviewing the hazards and threats included in this assessment, and their impact on those with access and functional needs, utilizing the C-MIST model. The outcomes of this review will be included in the final NCR HCC AFN Focus Group report scheduled to be completed in 2019.

**Table 3: North Central Region Disability Characteristics: 2013-2017 United States Census Bureau Data[8]**
(Disability definitions on page 14)

| County | Total Disability Population | | Hearing Difficulty | | Vision Difficulty | | Cognitive Difficulty | | Ambulatory Difficulty | | Independent Living Difficulty | |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|
| | # | % | # | % | # | % | # | % | # | % | # | % |
| **Adams County** | 51,764 | 10.7% | 15,576 | 3.2% | 10,331 | 2.1% | 18,239 | 4.1% | 26,047 | 5.8% | 15,839 | 4.5% |
| **Arapahoe County** | 55,935 | 9.0% | 16,523 | 2.7% | 10,510 | 1.7% | 20,264 | 3.5% | 26,001 | 4.5% | 18,853 | 4.0% |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Boulder County** | 26,094 | 8.3% | 8,580 | 2.7% | 4,376 | 1.4% | 10,489 | 3.5% | 10,999 | 3.7% | 7,994 | 3.2% |
| **Broomfield County** | 5,321 | 8.3% | 1,932 | 3.0% | 863 | 1.3% | 1,923 | 3.2% | 2,213 | 3.7% | 1,473 | 3.0% |
| **Clear Creek County** | 859 | 9.4% | 308 | 3.4% | 144 | 1.6% | 168 | 1.9% | 347 | 4.0% | 175 | 2.3% |
| **Denver County** | 64,433 | 9.6% | 18,172 | 2.7% | 13,929 | 2.1% | 24,735 | 3.9% | 31,163 | 5.0% | 22,709 | 4.3% |
| **Douglas County** | 20,661 | 6.5% | 7,473 | 2.3% | 3,166 | 1.0% | 6,722 | 2.2% | 7,972 | 2.7% | 5,766 | 2.5% |
| **Elbert County** | 2,429 | 9.9% | 913 | 3.7% | 300 | 1.2% | 849 | 3.6% | 1,106 | 4.7% | 795 | 4.2% |
| **Gilpin County** | 485 | 8.4% | 215 | 3.7% | 101 | 1.8% | 283 | 5.1% | 267 | 4.9% | 142 | 3.0% |
| **Jefferson County** | 54,945 | 9.9% | 19,599 | 3.5% | 8,950 | 1.6% | 18,578 | 3.5% | 24,917 | 4.7% | 17,088 | 3.9% |
| **NCR Total** | **282,926** | **9.0%** | **89,291** | **3.1%** | **52,670** | **1.6%** | **102,250** | **3.5%** | **131,032** | **4.4%** | **90,834** | **3.5%** |

| 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 |

**Table 4: North Central Region Language Characteristics[6]**

| County | Language Isolation: Non-English households that speak English less than well | | Most prevalent isolated non-English language | 2nd most prevalent isolated non-English language | 3rd most prevalent isolated non-English language |
|---|---|---|---|---|---|
| | # | % | Language | Language | Language |
| **Adams County** | 51,784 | 11.5% | Spanish | Other Asian and Pacific Island languages | Other Indo-European languages |
| **Arapahoe County** | 51,476 | 8.8% | Spanish | Other and Unspecified languages | Other Indo-European languages |
| **Boulder County** | 14,782 | 4.9% | Spanish | Other Indo-European languages | Other Asian and Pacific Island languages |
| **Broomfield County** | 2,431 | 4.0% | Spanish | Other Asian and Pacific Island languages | Other Indo-European languages |
| **Clear Creek County** | 76 | 0.9% | Spanish | German or other West Germanic languages | Other Indo-European languages |
| **Denver County** | 66,522 | 10.5% | Spanish | Other and unspecified languages | Other Indo-European languages |
| **Douglas County** | 6,799 | 2.3% | Spanish | Other Indo-European languages | Other Asian and Pacific Island languages |
| **Elbert County** | 136 | 0.6% | Spanish | German or other West Germanic languages | French, Haitian, or Cajun |
| **Gilpin County** | 86 | 1.5% | Spanish | Other Indo-European languages | Korean |
| **Jefferson County** | 17,551 | 3.3% | Spanish | Other Indo-European languages | Russian, Polish, or other Slavic languages |

| TOTAL REGION | 211,643 | 4.8% | | | |
|---|---|---|---|---|---|

## SOCIAL VULNERABILITY

Social vulnerability refers to the socioeconomic and demographic factors that affect the resilience of communities[7]. 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)[8]. 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).

In the NCR, Adams County ranked the highest on the SVI scale (0.6332). This is the only county in the region with a rating that is defined as "moderate to high." Denver and Arapahoe Counties are both rated as "low to moderate," and the rest of the seven counties are all rated as "low." The regional average is 0.1761, which falls into the "low" 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.

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[7] 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.

[8] Agency for Toxic Substances and Disease Registry/ Geospatial Research, Analysis, and Services Program. Social Vulnerability Index 2014 Database Washington. Centers for Disease Control and Prevention. https://svi.cdc.gov/map.html. Accessed on 11 March 2019.
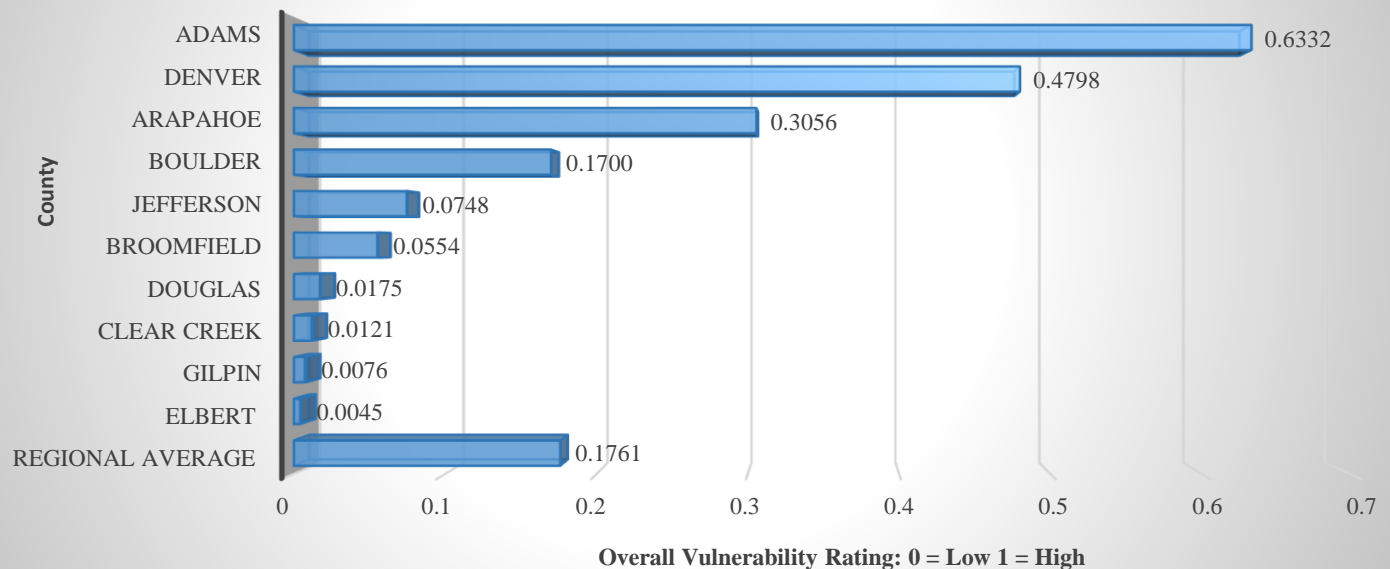
*Figure 4: Overall Social Vulnerability Index ratings, by county, for the 10-county North Central Region*

## THREAT AND HAZARD ANALYSIS

### DISASTER DECLARATIONS

According to FEMA[9], the State of Colorado has experienced 80 natural disasters from 1953 - 2016. The vast majority of these disasters were fire related (71%), followed by flood (16%) and severe storms and snow (both at 4%). Twenty-six (26) of these natural disasters have impacted counties within the North Central Region, resulting in 93 declarations at the county level.

- Fire (wildfire) has received the highest number of declarations across the region with 12 declarations, followed by flood at 8 declarations, and snow at 2 declarations. Coastal storm (Hurricane Katrina evacuations), drought, severe weather, and tornado each had 1 declaration.
- At the county level, Boulder County has the highest number of disaster declarations in the region at 13 declarations. This is followed by Jefferson (11), Adams, Douglas, and Elbert (10), Arapahoe and Denver (9), Clear Creek (7), Gilpin (6), and Broomfield (4).
- In addition to the declarations listed above, there have been four (4) statewide declarations for: flood (2) and fire (2).

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

- During the development of the JRA, the NCR, as well as the eastern part of the state, experienced a winter blizzard described as a "Bomb Cyclone." This type of event is defined by a drop in barometric pressure that exceeds 24 millibars in 24 hours[10].
  - The storm left hundreds of thousands of residents without power, stranded more than 1,000 motorists, shut down Denver International Airport (DIA), and resulted in one fatality.
  - Record setting non-thunderstorm winds clocked in at 80 MPH at DIA and major roadways were shut down.
  - The storm led the Governor to declare an emergency and the National Guard was activated to assist with search, rescue, and life-saving efforts.

## 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/hazards to the NCR's health and medical system:

**Table 5: North Central Region Hazard Identification Assessment**

Frequency and Severity scales on page 19

| Hazard | Frequency | Severity (to people, property, crops, or facilities) |
|---|---|---|
| Communicable Disease/Epidemic | Moderate | High |
| Severe Weather | Very High | Elevated |
| Flood | Moderate | High |
| Utility Failure | Very High | Elevated |
| Information Technology (IT) Failure, including Cyber-Terrorism | Moderate | Elevated |
| Mass Casualty Incident | Moderate | Severe |

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[10] The Denver Post. Denver weather: Storm subsides in metro area after day that saw governor declare emergency. March 13 2019. https://www.denverpost.com/2019/03/13/denver-weather-march-13-bomb-cyclone/.

| 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 Division of Homeland Security and Emergency Management (DHSEM). 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 |
|---|---|---|---|---|
| **Communicable Disease/Epidemic** | Medium (2) | Medium (2) | High (3) | **Guarded (12)** |
| **Severe Weather** | High (3) | Medium (2) | Medium (2) | **Guarded (12)** |
| **Flood** | Medium (2) | High (3) | High (3) | **Elevated (18)** |
| **Information Technology (IT) Failure, including Cyber-Terrorism** | Medium (2) | High (3) | High (3) | **Elevated (18)** |
| **Mass Casualty Incident** | Medium (2) | Medium (3) | Medium (3) | **Elevated (18)** |
| **Utility Failure** | Medium (3) | Medium (3) | Medium (3) | **High (27)** |

| 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: regional After Action Reports, data submitted by NCR HCC members through the HVA survey, NCR HCC chapter meeting topics and discussions, the 2017 NCR HCC JRA, and the NCR HCC 2018-2019 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 and environmental diversity within the region** | The NCR covers large areas of densely populated urban cities, rural plains, and small mountain towns. Additionally, due in part to geography, the NCR has an economically diverse population. These factors impact health and medical resources as well as access to these resources. To be effective, regional planning must take into account this variability and its impact to healthcare delivery. |
| **Geographic isolation** | The NCR, including Colorado's capital city, Denver, is geographically isolated. Denver is the largest city in a 500-mile radius. This isolation impacts the following response areas: <br> • patient movement out-of-state <br> • mobilization of out-of-state resources |

| Volume of ancillary healthcare facilities that are at the beginning stages of emergency preparedness | Over the last year and a half, the NCR has experienced a significant increase in ancillary healthcare providers who are prioritizing the development and implementation of new emergency preparedness programs. This, in part, is due to the 2017 Centers for Medicare and Medicaid Services (CMS) Emergency Preparedness Rule.<br><br>The region has worked extensively to support these organizations, but they often are working with limited funding and limited experience in emergency preparedness and response. 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.<br><br>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. |
|---|---|

## 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 where infrastructure is impacted, there is the potential for cascading effects, which can result in additional stress being put on the health and medical system. This is especially true for individuals in the community who may need additional assistance during an emergency, includes those with access and functional and/or complex medical needs.

## THREAT AND HAZARD DESCRIPTION AND IMPACT

### Communicable Disease/Epidemic Description

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 cause of an outbreak is unknown, even after thorough investigation[11].

A 2014 study titled, Global rise in human infectious disease outbreaks[12] found that the total number of outbreaks and richness of causal diseases have each increased globally since 1980 (figure 3).
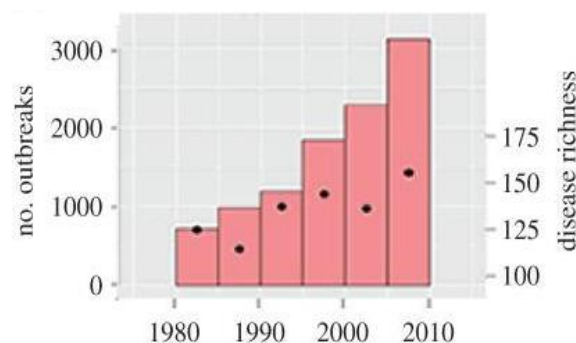


*Figure 3: Global number of human infectious disease outbreaks and richness of causal diseases 1980 – 2010*

When examining the impact that a communicable disease outbreak/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. The cause of emerging infections include[13]:

- 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

According to a 2007 WHO report, infectious diseases are emerging at a rate that has not been seen before. Since the 1970s, about 40 infectious diseases have been discovered. Additionally, it should be noted that there is the potential for disease to emerge as a result of deliberate introduction through bioterrorism.

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

[12] Global rise in human infectious disease outbreaks Katherine F. Smith, Michael Goldberg, Samantha Rosenthal, Lynn Carlson, Jane Chen, Cici Chen, Sohini Ramachandran J R Soc Interface. 2014 Dec 6; 11(101)

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

**Communicable Disease/Epidemic Impact**

A communicable disease outbreak or epidemic 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.

Disease outbreaks and epidemics often require an expansive level of coordination amongst a wide variety of partners. 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).

**Severe Weather**

For the purposes of this assessment, severe weather includes: damaging hail; severe thunderstorms; tornadoes; drought; 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[14].

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[15] lists historical high-impact weather and climate events in Colorado from 1862 – 2017. The data below was pulled from this database, and does not include floods as this is a separate hazard:

- A total of 21 severe or high-impact weather events have impacted the NCR since 1862
- The most frequent event was winter storm (6), followed by: wildfire (4); high-wind, hail, and drought (3); tornado (1); and cold wave (1)
- 18 fatalities have been attributed to these severe weather events

**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,

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[14] 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.

[15] Western Water Assessment (February 2018). "Historical High-Impact Weather and Climate Events in Colorado, Wyoming, and Utah. 1862-2017". Accessed on 13 March 2019.

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.

## Flood

The NCR HCC elected to list flooding separate from severe weather due to the number of destructive floods that have impacted the region throughout history. According to a flood safety document published by FEMA, flooding is a temporary overflow of water onto land that is normally dry. It is the most common natural disaster in the U.S.[16] According to the Western Water Assessment Team database[14], there have been 18 notable floods that have impacted the counties of the NCR since 1864. These floods have resulted in 1,002 fatalities and caused over $10.3 billion dollars in damage (adjusted for inflation).

The most recent flooding event to hit the NCR occurred in September of 2013. This multi-day event, which took nine lives, caused over $4 billion in damage across two dozen Colorado counties and damaged or destroyed an estimated 2,000 homes. Nearly 120 miles of state highways were also damaged or destroyed, cutting off access to entire communities and healthcare facilities[17].

## Flood – Impacts

As evidenced above, floods have the power to wipe out critical infrastructure in a matter of hours. Healthcare facilities are susceptible to flooding in their buildings, damage to utilities (including generators), and access issues due to washed out or impassable roadways. If the impact is significant enough, it may even result in evacuations, which are exponentially more dangerous when attempted during a flood.

Impacts to the roadways can also greatly impact the ability of a facility to provide services. In the 2013 floods, there were stories of nurses and doctors being unable to get to hospitals due to washed out roads. Those same impassable roads prevented patients and ambulances from reaching medical facilities, which meant that no patients were leaving and none were coming in.

Because Colorado has experienced so many floods in its history, the state's ability to mitigate against, prepare for, respond to, and recover from these events has increased. The same can be said for the NCR and the health facilities that operate within its boundaries. However, flooding is still considered one of the top hazards to the healthcare system due to the frequency in which Colorado has experienced destructive flooding, as well as the propensity for flooding to rapidly disrupt or destroy critical infrastructure.

## Information Technology (IT) Failure, including Cyber-Terrorism

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

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[16] Federal Emergency Management Agency. Be prepared for a flood. FEMA V-1005. March 2018. https://www.fema.gov/media-library-data/1522342356506-54bd8d92d0d0d07bca4c1250ebde2b21/Flood_508.pdf. Accessed 14 March 2019.

[17] Denver Post. 2013 flood a 100-year event. September 2018. https://www.denverpost.com/wp-content/uploads/2018/09/CD09FLOODANNIV.png. Accessed 14 March 2019.

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.

Information technology failures can be the result of utility disruptions, system blackouts, and/or cyber-attacks. The outages can occur at the facility level (e.g., damage to a server room) and/or off-site (disruption to service at a remote data center). Failures within IT can 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.

Cyber-terrorism, or cyber-attacks, 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[18]. 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 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[19].

**Information Technology (IT) Failure, including Cyber-Terrorism – Impact**

An IT failure 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.

**Mass Casualty Incidents**

The commonly agreed on definition of a mass casualty incident (MCI) is: an event that overwhelms the local healthcare system, where the number of casualties vastly exceeds the local resources and capabilities in a short period of time. This is based upon available resources, number of injuries, and

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[18] 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.

[19] 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.

severity of injuries. Each MCI event is unique, regardless of whether it is the result of a natural disaster or the result of an intentional human act. MCIs are oftentimes unpredictable and can evolve rapidly with little to no notice. These events can quickly deplete available resources and capabilities for both the MCI response as well as day-to-day activities for both hospitals and EMS providers. Additionally, there could be added complexities to the incident, such as: contamination (chemical, biological, radiological), safety and security of healthcare facility and providers, loss of communication modalities, and limited situational awareness due to the fast-moving nature of these events.

The mass casualty incidents that have impacted the NCR have taken many different forms, including natural hazards as well as human caused events:

- 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 medical system, in its entirety was overwhelmed by the sheer volume of medical needs.

- 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.

**Mass Casualty Incidents – Impact**

Regardless of the causal event(s), the impacts from MCIs are felt quickly, are complex in nature, and have the potential to affect all facets of the healthcare continuum. 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. These first few minutes, or even hours, of an MCI 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 of the event is oftentimes disproportionate.

Beyond the initial needs for triage, transportation, trauma, and surgical capabilities, the secondary or cascading impacts from an 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 MCI events, depending on the location and size of the incident, will require the region to work together closely to manage what impacts they can. This can include: identification, prioritization and allocation of resources; patient distribution; information sharing; and public information. Further, once the initial impact of these events has diminished, activities begin to transition to a focus on recovery. As

seen in the 2012 Aurora Theater shooting, recovery efforts can last years and are oftentimes supported by non-hospital regional HCC partners.

## Utility Failure

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[20].

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 Failure – Impacts

Due to the complex nature of utility systems within most healthcare facilities, the vast majority of minor day-to-day utility failures 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 failure(s) and/or when one facility experiences wide spread 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.

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[20] 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.

## 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 a 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 prioritized the development of a regional health and medical communications framework. This framework is scheduled to be completed by June, 2019. |
| **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 focused on the development of processes and documents to facilitate cross-jurisdictional, cross-disciplinary, and regional information sharing. |
| **No formalized process for regional hospital coordination** | A special project, funded by the Denver Urban Areas Security Initiative (UASI), specifically addresses this gap. The "NCR Hospital Coordination Project" has already held a number of steering committee meetings, a regional workshop, and has a functional exercise scheduled for May 2019. |
| **Limited ability to identify and allocate resources at the regional level** | The NCR HCC, through the development of the HCC Response Plan and operationalization of the healthcare coalition, is in the development phase of formalizing processes for regional resource identification and resource allocation. Allocation decisions primarily occur within ESF-8/Health and Medical Branch with support from the healthcare coalition. |
| **Gaps in processes related to cross-jurisdictional and cross-disciplinary coordination** | This gap continues to be a priority for the region. It has been addressed, in part, via the NCR Public Health Committee, NCR HCC Governance Board workgroup, HCC Response Plan, and NCR Hospital Coordination project. |

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. But, for capability and capacity to be optimized, the planning and collaborative efforts must broaden to the regional level. Acknowledgement of the potential for a regional event to impact the NCR, has driven the HCC 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: communicable disease/epidemic; severe weather; flood; information technology (IT) failure, including cyber-terrorism; mass casualty incident; and utility failure. 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.
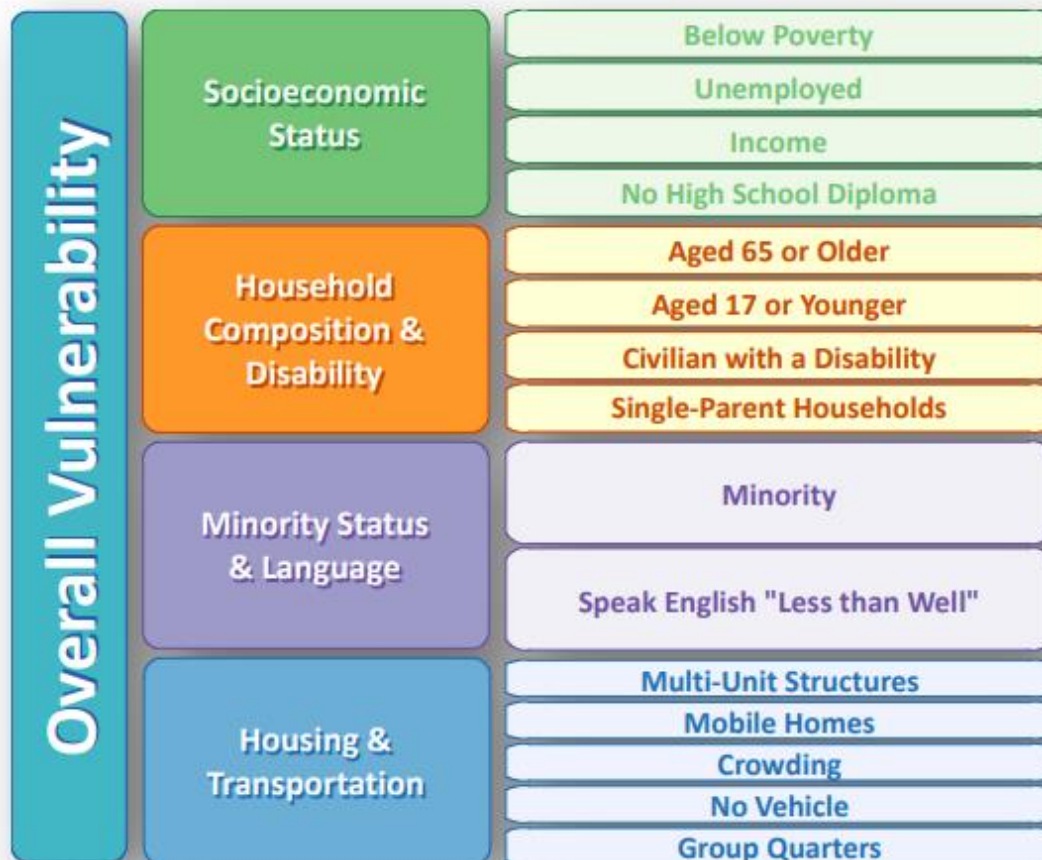
In addition to identifying the top regional threats and hazards, the NCR HCC outlined gaps in the current preparedness, response, and recovery systems and structure. The gaps presented in this assessment include: lack of a regional health and medical communications framework; gaps in regional information sharing during an event; no formalized process for regional hospital coordination; 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 information included in this NCR HCC Joint Risk Assessment will be utilized by the coalition, and its key stakeholders, to develop and prioritize planning, training, and exercise initiatives moving forward. This includes the development of the 2019-2020 NCR HCC Strategic Plan, development of the NCR HCC Response Plan, and the completion of the 2019 NCR HCC Training Needs Assessment and Workshop. 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 work being done within the larger 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:



| Overall Vulnerability | Socioeconomic Status | Below Poverty |
| | | Unemployed |
| | | Income |
| | | No High School Diploma |
| | Household Composition & Disability | Aged 65 or Older |
| | | Aged 17 or Younger |
| | | Civilian with a Disability |
| | | Single-Parent Households |
| | Minority Status & Language | Minority |
| | | Speak English "Less than Well" |
| | Housing & Transportation | Multi-Unit Structures |
| | | Mobile Homes |
| | | Crowding |
| | | No Vehicle |
| | | Group Quarters |

[21]

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## 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 |
| IT | Information Technology |
| JRA | Joint Risk Assessment |
| MCI | Mass Casualty Incident |
| MFHCC | Metro Foothills Healthcare Coalition |

| Acronym | Term |
|---------|------|
| NCR HCC | North Central Region Healthcare Coalition |
| NOAA | National Oceanic and Atmospheric Administration |
| PH | Public Health |
| PHED Ex | Public Health Emergency Dispensing Exercise |
| SVI | Social Vulnerability Index |
| THIRA | Threat and Hazard Identification and Risk Assessment |
| UASI | Urban Areas Security Initiative |
| WHO | World Health Organization |

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