CROSS-BORDER THREAT SCREENING AND SUPPLY CHAIN DEFENSE
A Department of Homeland Security Center of Excellence

SGL Stochastic Geomechanics Laboratory

R13 - U.S.-Mexico Risk Taskforce to Support the Health Supply Chain Systems for Infrastructure and Workforce Threatened by the COVID19 Pandemic

Monthly Risk-Bulletin September 2020

The objective of the Monthly Risk-Bulletin is to provide an overview a) of lessons learned during the past month in the project, b) of a score-card-type system to communicate the state of risk of supply chains impacted by COVID-19 supporting health infrastructure and the workforce between the U.S. and Mexico, and c) of a communication system to facilitate the restoration of broken supply chains and the formation of new ones to reactivate trade between U.S. and Mexico. The report aims to offer valuable insights to the general public and decision-makers towards informed preventive actions to reduce the current pandemic's potential impact on critical supply chains and better strategize about feasible social, economic, and environmental risk-mitigating actions against COVID19 and converging threats. This bulletin is jointly produced by the project's PIs, the project's contractors, and the U.S. binational task force serving as advisors to the project.

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I. Introduction

The objective of the Monthly Risk-Bulletin is to provide an overview a) of lessons learned during the past month in the project, b) of a score-card-type system to communicate the state of risk of supply chains impacted by COVID-19 supporting health infrastructure and the workforce between the U.S. and Mexico, and c) of a communication system to facilitate the restoration of broken supply chains and the formation of new ones to reactivate trade between U.S. and Mexico. The report aims to offer valuable insights to the general public and decision-makers towards informed preventive actions to reduce the current pandemic's potential impact on critical supply chains and better strategize about feasible social, economic, and environmental risk-mitigating actions against COVID19 and converging threats. This bulletin is jointly produced by the project's PIs, the project's contractors, and the U.S. binational task force serving as advisors to the project. As a reference for the publication of the Risk Bulletin, the three main milestones of the project are:

1. Integrate a triple-helix binational taskforce comprised of representatives from academia, industry, and government from the U.S. and Mexico. Address the public health impacts of the COVID-19 pandemic on the U.S. – Mexico health supply chain systems for health infrastructure and for the health of the workforce, considering current and emerging regional social, economic, and environmental Risks.
2. Develop a data-lake platform concentrating near real-time analytics following a risk systems approach that can provide strategic information about the evolution of COVID19 and related current and emerging threats, the state of vulnerability of the health supply chain systems and the likely impacts a combination of these may cause to society, the economy and the environment.
3. Publish a monthly U.S.-Mexico COVID-19 Risk Bulletin to provide scientific, technological, and strategic cultural support to secure the operation of the U.S.-Mexico health supply chain systems.

The Data-Lake platform will provide access to risk analytics and its sources, including datasets, predictive models, and experts' opinions, needed to produce evidence-based support on the causes and effects posed by COVID-19 on the U.S. health supply chain. While some of these exist already, a technological harmonization will be required to add it into the data-lake, and other analytics will need to be produced. Additionally, the identification and characterization of evidence depicting the dynamics of infrastructure interactions of U.S. domestic and international health supply chains, from procurement, manufacturing, warehousing, to transportation processes, will serve as the basis for the data-lake platform, where available and emerging sources of evidence will be arranged following a common risk framework (see Appendix).

This risk-bulletin report will primarily serve as a liaison to inform the general public of our ongoing efforts and general lessons learned during the discussed timeframe and will introduce the foundational risk framework used to design the Data-Lake System.

II. Project Status & Lessons Learned

Completed Milestone 1: Kick-Off Meeting on 8.26.20

Completed Milestone 2: Data Acquisition and Management Plan

- **Review of Security Protocols and Privileges for everyone involved in the Team**
- The team became aware of the necessary internal security and other needed forms to execute a project with this level of collaboration. R13 is the first project of such a caliber hosted by Texas A&M University for public consumption and participation. *Managing information technology requirements and regulations in place to protect public infrastructure while trying to bring the core team on board wasn't something the team leads expected to take this level of effort and coordination between parties.* Fortunately, the university has been collaborating with everyone as they understand the time sensitiveness and urgency of the project.
- **The utilization of the Texas repository** to publish curated results for archiving *is a major differentiator of this project that has brought up several discussions to homogenate the way we will be storing, processing, and analyzing data from external sources.* A conversation to align the internal processing processes of this project has taken place.
- **The project will be supported by several public and by some commercially available data streams.** Including, but not limited to*, Bloomberg terminal, IBISWorld, S&P's Eikon, Panjiva, accessible through the TAMU Library and the project's own budget*.

Contributing to Milestone 4: Data-Lake System

- All contractors supporting the project have revised well established homogeneous contracts that clearly define their responsibility, roles, and deliverables such that there is limited overlap, and work is done effectively. In addition, the composition of the project leads, and team members have well-defined roles and responsibilities.
- Review of Security Protocols and Privileges for everyone involved in the Team
    - A background check and security protocols are in place for everyone involved in the team according to government and institutional regulations. *The team has learned the value of following protocols and securing access to sensitive information.* Furthermore, graduate students and subcontractors have attended a series of workshops and seminars about internal regulations and managing and protecting their data.
    - The project leads have attended more than a dozen meetings with TAMU IT specialists to follow strict security cybersecurity protocols. Furthermore, a screening of every foreign national involved in the project has been submitted to DHS due to the binational nature of the project.
- Microsoft Project Management System Project Masterplan
    - The project has one individual tasked with managing and updating the project's workplan to aid in the timely execution and monitoring of tasks supporting our milestones. *It has been a dynamic change for graduate students and other academics involved as teamwork and collaboration usually take second place in academia.* However, the core team has started collaborating more closely to deliver the main milestones.
- Communication & Collaboration Environment on MS Teams
    - It is imperative for the team to have an effective collaboration environment to carry their

tasks and work effectively, especially during a global pandemic, with most collaborators working remotely. Thus, it was decided to adopt and use MS Teams as our primary communications platform; this change has allowed closer and more effective information transfer among team members. *Members have been adapting to the new platform, but it hasn't come without resistance to change and unexpected technical issues, but overall, it has provided a very effective tool to communicate across multiple collaborators, partners and contractors.*

Working on Milestone 3: Taskforce

It has been proven difficult for government agencies to define who will be the best representative in the taskforce to attend meetings and provide updates to CBTS, the project leads, and other development team members. Also, those representatives may not be available every week. It has been decided to meet biweekly as the project moves forward.

The taskforce is expected to be composed of key stakeholders' members from the Industry, the Mexican and US State Departments. The preliminary list of confirmed participants is shown in Table 1.

Table 1.- CBTS R-13 U.S. - Mexico Taskforce

Organization	Member
Texas A&M University – College of Engineering	**Dr. Zenon Medina-Cetina** Project PI Associate Professor, Civil Engineering, Petroleum Engineering, Ocean Engineering, Geography
CBTS Director	**Gregory Pompelli, PhD** Project Co-PI Director, CBTS-TAMU
CBTS – Texas A&M University	**Dr. Matt Cochran** Project Co-PI Research Director, CBTS-TAMU
Texas A&M University	**Dr. Maria Jose Perez-Patron** Project Co-PI Adjunct Assistant Professor Department of Epidemiology & Biostatistics Texas A&M School of Public Health
GIS Consulting	**Miriam Olivares** Project Co-PI and Consultant Marx Science and Social Science Library, Yale University THEI Consulting
Mexican National Business Advisory Council (Consejo Coordinador Empresarial, CCE)	**Victor Gutierrez Martinez** CEO, Grupo Plenum Chair of CCE's Innovation Commission
Mexican National COVID-19 Scientific Advisory Board (Grupo CONACYT	**Dr. Oscar Sanchez Siordia** Director, Mexican National Geo-Intelligence Laboratory

COVID-19)	Institutional Member of Grupo CONACYT COVID-19
Mexico Census Bureau	**Dr. Sergio Carrera** Director, Integration, Analysis and Research Mexico Census Bureau
U.S. Census Bureau	**Dr. Bethany DeSalvo** Chief, Small Area Modeling and Development Social, Economic and Housing Statistics Division U.S. Census Bureau
National Institute of Mathematics (CIMAT)	**Dr. Graciela Ma. De los Dolores González Farías** Director, CIMAT Campus Monterrey
U.S. Department of Homeland Security	**Duane C. Caneva, MD, MS** Chief Medical Officer Department of Homeland Security
U.S. Department of Homeland Security	**Tom McGinn DVM** Senior Veterinarian Office of the Chief Medical Officer (OCMO) Countering Weapons of Mass Destruction (CWMD) Department of Homeland Security

Working on Milestone 5: Bulletin

- Initial State-of-the-art Literature Review on the Health System (service delivery, health workforce, medical technologies, insurers, etc.), and Healthcare Supply Chain (manufacturers, purchasers, distributors, providers and end-users).
- Literature Review of Healthcare Supply Chain Definitions
    - Defined the main terminology and definitions employed in the Healthcare Supply Chain Management Practice
- Literature Review of COVID-19 impact to Healthcare Supply Chain
    - Defined the main search criterium and generated a keyword-co-occurrence network
- Working on defining our first risk-bulletin structure, responsible individuals, and delivery format. The first risk-bulletin will be confined in scope since we're just one month after kick-off, and the Data-Lake System is still being configured. However, a virtual delivery system compatible with the future automated report generation capability is being considered.

Identifying important data variables, including the assessment between information related to the current COVID-19 pandemic in the US and Mexico, has taken place. *The team quickly learned that there isn't a consistent federal aggregation system in the US, and states are responsible for defining their own reporting guidelines and schedules.* This led to kickstart the data variables identification process sooner to identify the way reporting agencies to operate in both countries, assessing their main methodologies and assumptions behind each reported case, as well as the level of granularity and periodicity of information reporting. To this end, *it has been proven fundamental to have experts in data aggregation, searching, and categorization, such as experienced librarians working closely with the team*. Furthermore, *several team members' bicultural composition has been incredibly helpful when engaging with Mexican and US authorities. An international research project of this magnitude requires the participation of culturally compatible members*. For instance, *having Spanish speakers has helped us engage with Mexican authorities by facilitating information exchange between parties.*

III. Risk Communication Mechanism - Scorecard

One of the most important objectives of the project is to provide a communication system and platform to facilitate the restoration of broken supply chains impacted by COVID-19 while fostering the creation of new ones to reactivate trade between the U.S. and Mexico.

As mentioned on the project's workplan, this risk-bulletin report will include a report card-type that will be used to define the status of threats, system vulnerabilities and impacts as these relate to each component of the health supply chain systems. It is expected that this bulletin will be jointly produced, to provide scientific, technological, and strategic cultural support to secure the operation of the U.S.-Mexico health supply chain systems.

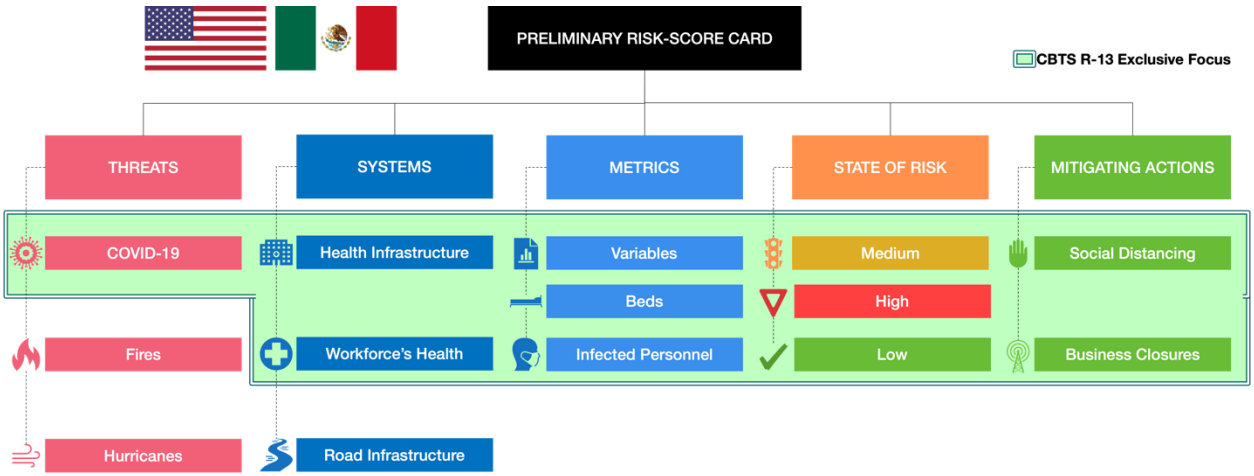


Figure 1.- Simplified proposed scorecard definition to use in for future risk-bulletins

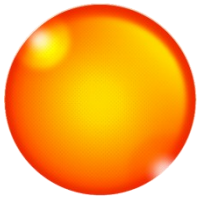
1. Mexico's Epidemiological Report

We present a brief description of an example of a risk communication mechanism that's available, and of interest to our project objectives; the official Mexican "traffic light" risk communication mechanism (https://coronavirus.gob.mx/datos/#SemaFE). Mexico's official dashboard provides daily updates to the general public about the risk per state using a familiar stoplight analogy, the Epidemiological Risk Stoplight to move towards a new normal is a monitoring system to regulate the use of public space according to the risk of contagion of COVID-19.

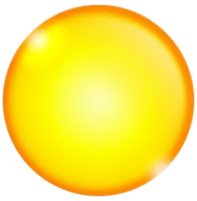
The traffic light is shown per state and is made up of four colors, as shown in Figure 2.

Figure 2.- Mexico's Official Daily COVID-19's Epidemiology Report (from https://coronavirus.gob.mx/datos/#SemaFE)

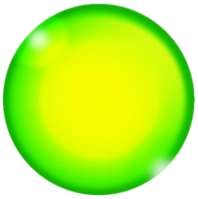
- Only essential economic activities are allowed. People may take a walk inside their homes and private property during the day. Avoid non-essential travel and gatherings.



- Essential economic activities are allowed, non-essential economic activities are allowed to work at a maximum of 30% of personnel capacity of normal operation, always taking into account the maximum care measures for people with a greater risk of presenting a serious picture of COVID-19, open public spaces with a reduced capacity (number of people) will be opened.



- All economic activities are allowed, whilst especial precautions and consideration for people with higher risk of presenting a serious case of COVID-19. Open public spaces will be opened as normal, but closed public spaces can open at a reduced capacity. As in other traffic light colors, these activities must be carried out with basic prevention measures and maximum care for people with a higher risk of presenting a serious picture of COVID-19.



- All activities are allowed, including schools, childcare, etc.

At all levels of epidemiological risk, it is recommended to maintain basic prevention measures:

Hand washing for at least 20 seconds with soap and water, if soap and water are not available, then use 60% alcoholic solutions can be used.

Clean (with soap and water) and disinfect (with a chlorine solution) the surfaces and objects of shared use.

Maintain a healthy distance between people (from 1.5 meters to 2 meters), if you're not able to maintain this distance, for example in public transport, use a mask.

Respiratory etiquette (cover nose and mouth with the inner corner of the elbow or with a tissue)

If you have compatible symptoms and are not part of a vulnerable group or have signs of respiratory illness, please recover at home

A daily monitoring report of all the variables and parameters that allow for the identification and magnitude of the risk is carried out daily and communicated weekly at the status nation-wide COVID19 report conference so that the general public can quickly identify at what level of epidemiological risk their communities are currently at and modify their activities accordingly.

Healthy distance interventions must be strictly followed, depending on the color of the traffic light in which the public is located. Failure to do so will increase the risk of an increased abruptly rate of contagion where the epidemic contagion is currently relatively under control. In such a scenario, local and state authorities will need to impose more restrictive measures that may not be appropriate for a healthy public life and economy.

Mexico invites the general public to be aware of the light traffic epidemiology report in their community or locality and to comply with the federal and local health authorities' indications.

IV. Restoration and Creation of Supply Chains

One of the most important objectives of the project is to provide a communication system and platform to facilitate the restoration of broken supply chains impacted by COVID-19 while fostering the creation of new ones to reactivate trade between the U.S. and Mexico.

We have identified several potential mechanisms of engagement to archive this goal. The following list introduces some of the initial broad methods and ideas to gather more tangible evidential information about the state of risk and impact of COVID-19 on the bilateral trade supply chains. We will be prioritizing and furthering the detailed plan of engagement for each one of them.

1. A public-facing section of the dashboard exclusively dedicated to highlighting essential binational supply chain markets disrupted by the ongoing threat
2. The site will be available in both English and Spanish to ease information access and flow from both countries
3. The risk scorecard will be compatible and aligned with the objectives of this milestone
4. Online-based quick surveys send to industry stakeholders, academics, government officials, and subject matter experts involved in key aspects of the most impacted bilateral trade supply chains
5. A semi-automated matching of needs and supply products related to Healthcare infrastructure and the workforce's health

V. Appendix:

1. Risk Assessment: Bayesian Framework

The 'Risk Assessment Model (RAM)' being developed as part of CBTS-R7 originally developed by Medina-Cetina and Nadim (Medina-Cetina and Nadim 2008)), is based on the use of Bayesian Networks (BN). BNs rely on a) the identification of variables, and b) the definition of the interdependencies between these variables set by cause-effects relations.

BNs allow to reproduce highly complex processes using the Bayesian logic, which is based on probability theory and using the Markov principle. This makes BNs fully transparent and graphically appealing to represent highly complex systems, making use of 'nodes' representing the variables and 'arrows' representing the cause-effect dependencies between them.

R-7 will develop a conceptual RAM using BN. This will be qualitative in nature because it will be developed based on experts' opinion and will serve as a foundational reference for R13. The main effort on the model development will be placed on the identification of the variables (a) and interdependencies (b) which together will represent the complexity of how a set of threats (including COVID19) can affect a set of supply chains, which can present losses/gains depending on the combined effect of the threats' intensity (hazard), the state of robustness of the supply chains (vulnerability), and the impacts these will exhibit upon the effect of the threats on them (consequences). That is, this approach will represent a state of risk, where risk = hazard x vulnerability x consequences.

The resulting model will not be 'unique' to capture a state of risk. Since like any mathematical model (i.e, physically based or empirically based), this will strongly rely on the experts 'behind' its development. That is, if the same challenge is set to two different teams of experts to develop a model to assess the state of risk of a given problem, these may produce different mathematical models. The more similarity between models (i.e. same identification of variables, same understanding between their interdependencies), like in any sampling of the response of the same 'universe' of responses, would mean a qualitative validation.
To address the issue of 'uniqueness' or validation of the RAM, R7 has set two groups of experts to facilitate the model development: research partners of CBTS projects working in COVID19 research, and a CBTS independent mini-taskforce. Both will follow the same methodology for model development based on BN. The process of model development for each group will be documented to show any similarity on the identification of variables and interdependencies. This assessment will be the instrument to use as a metric of uniqueness or validation of the model. A complementary literature review to identify previous research on the variables defined as part of RAM, will provide complementary elements to support the validations process.

It is worth mentioning that R-7 will also include the statistical characterization of the variables identified in the RAM. This will be based on the exploration of evidence availability (e.g. databases, model predictions, experts' beliefs). It is anticipated that there will be overlaps in availability of evidence, but also gaps or absence of evidence.

As part of the R13 project objectives the application of the risk-assessment model to inform the stakeholders about the state of risk for the most important threat currently being faced globally, COVID-19, to this end. A decision to follow the proposed risk framework has been made. Figure 2 shows the proposed risk assessment framework definition where:

Hazard = The probability that a particular *Threat* (*T)* with a given intensity **P(T)** is exceeded within a given period of time.
Vulnerability = The probability of reaching a *Consequence (C)* or damage in the element or system of interest, conditioned on a given Threat intensity **P(C|T)**.
Consequences = The expected Consequence value u(C) of the element or system of interest exposed to a given *Threat* intensity.

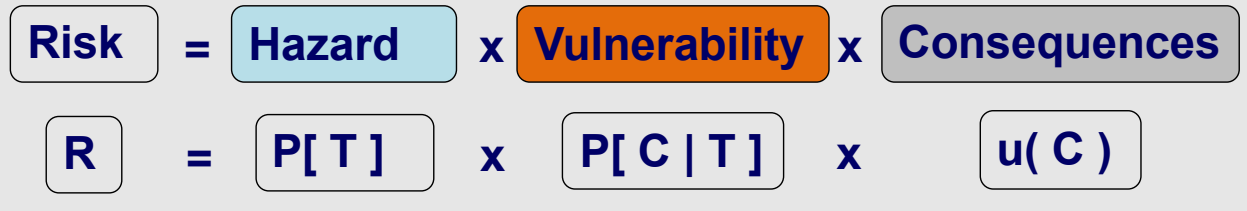


Figure 3.- Proposed Risk Assessment Framework

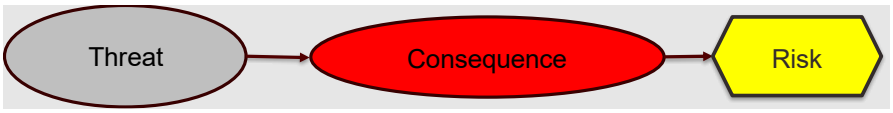


Figure 4.- Bayesian network representation of the risk assessment framework

2. Risk Assessment and Management Framework

The commonly used definition of risk R for predetermined state of information is given by:

We can further expand the equation into the following form to represent Risk Assessment and Management:

$$R = [H * V * C] + [Cost(AC + PC) - AC - PC]$$

Where,

R = State of Risk
H = Hazard
V = Vulnerability
C = Consequence
AC = Active Countermeasures
PC = Passive Countermeasures

In order to reduce the state of risk, mitigation actions such as active countermeasures (AC) and passive countermeasures can be applied. An AC has an impact on hazard reduction, and a PC has an impact on the vulnerability and/or consequence reduction. The implementation of either one of these generates costs. Therefore, the trade-off between the savings induced by the hazard or vulnerability and/or consequences reduction and the costs associated with their implementation is what defines the risk measure.

The approach discussed has been used in several disciplines because of the possibility of including a more refined social assessment on the consequences (C) and vulnerability P[CjT], without modifying the concept of hazard P[T] traditionally associated with physical sciences and engineering, reconciling apparent differences on risk assessment with a recent social idea that 'vulnerabilities, not hazards, cause disasters' Therefore, the risk becomes a direct measure of disasters, which is not a new concept, however, within an inference methodology supported by mathematical models that accept different information levels and yield a robust framework to host other disciplines' contributions. (Medina-Cetina and Nadim 2008)

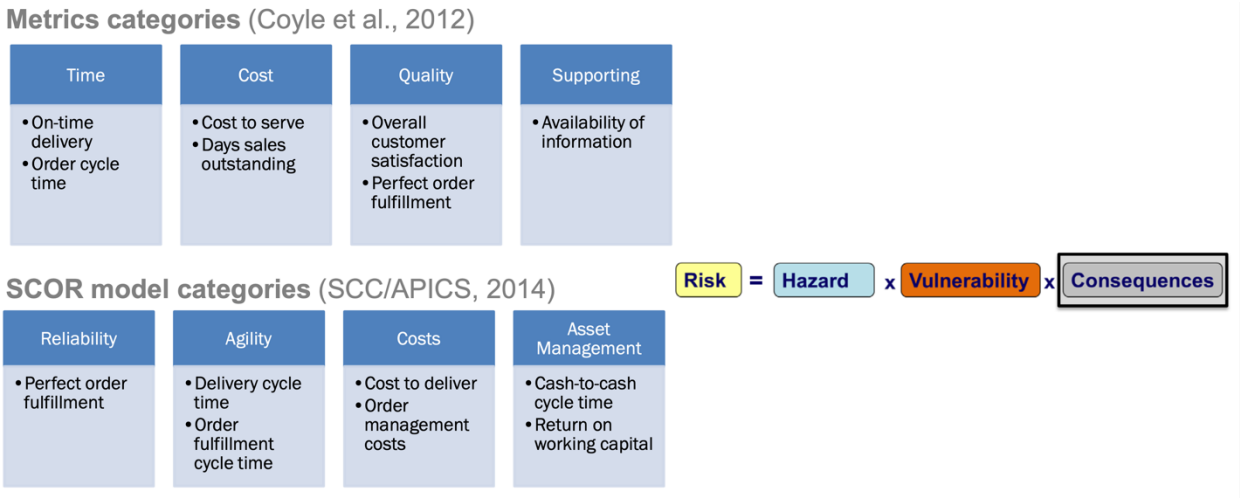


Figure 5.- Risk-Assessment model definition (Medina-Cetina 2020)

3. COVID-19 impact to Global Healthcare Supply Chain keyword co-occurrence networks.

An important element to understand the literature was to assess the relationships that exist in the current academic literature, one effective method is to visually represent some of these relationships, the following figures present results from the initial literature review, a co-occurrence network shows the collective interconnection of terms based on their paired presence within an academic publication. Figure 6, shows the keyword interconnection between healthcare, supply chain, and COVID-19 from 39 results. It is interesting to observe clear research focus on modern manufacturing techniques such as additive manufacturing and personal protective equipment, clearly reflecting the undersupply faced during the second quarter of the year. Figure 7 focuses on the global workforce relationship with COVID-19, the top ten keywords of the network reflect the impact that an outbreak has had on the global supply chain and the need to prevent and protect the workforce's health from potential impacts by being assessing the implied

risk and being better prepared for disruptions caused by the epidemic.

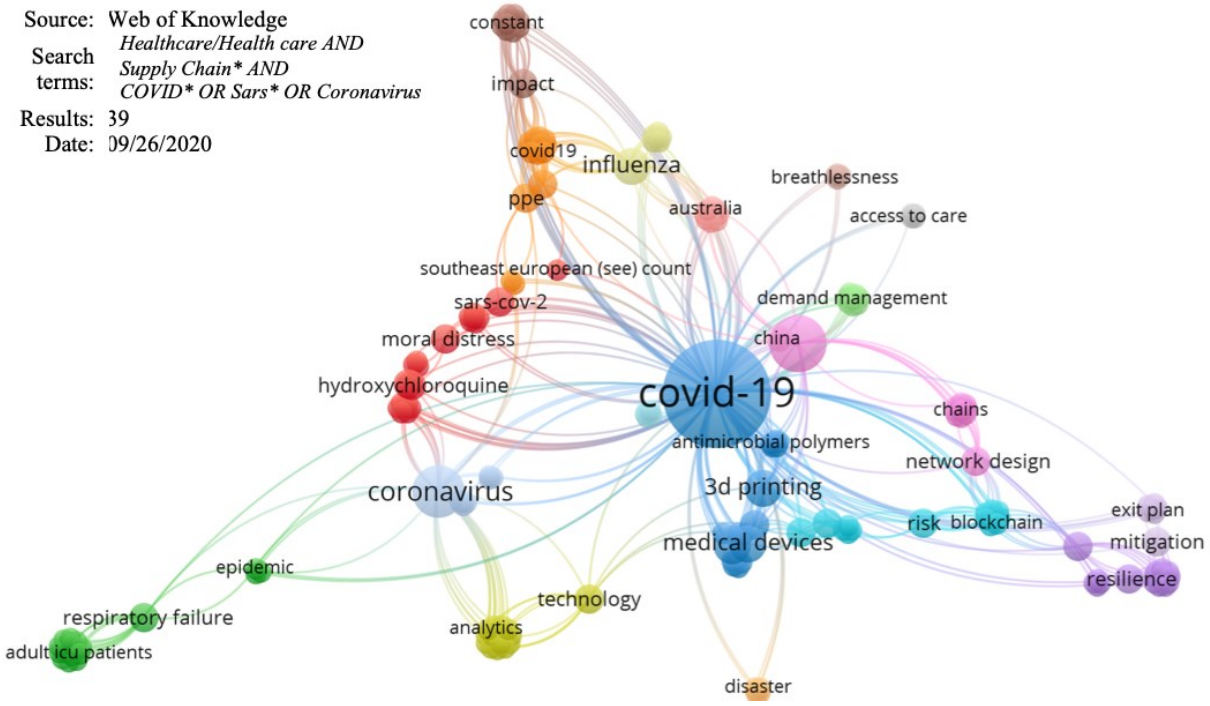


Figure 6. COVID-19 impact to Global Healthcare Supply Chain keyword co-occurrence network.

Top 10 keywords (excluding search terms):

1. *3D Printing*
2. *Medical Devices*
3. *Additive Manufacturing*
4. *Technology*
5. *Personal Protective Equipment (PPE)*
6. *Healthcare workers*
7. *Influenza*
8. *Risk*
9. *Hydroxychloroquine*
10. *Pharmacist*

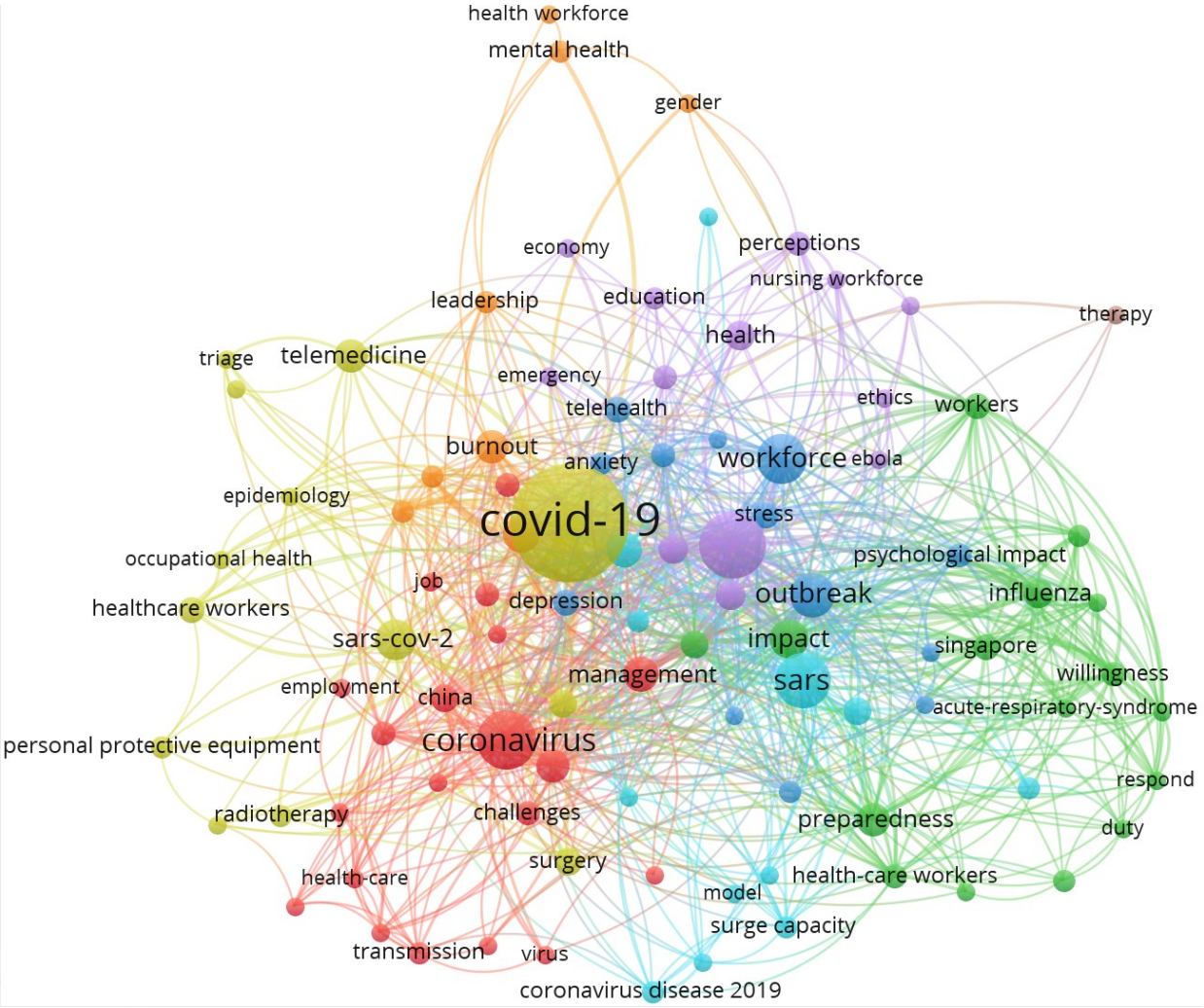


*Figure 7.- COVID-19 impact to Global Workforce keyword co-occurrence network with search terms covid*OR Sars* OR Coronavirus, 270 results from web of science (09/26/2020) .*

Top 10 keywords (excluding search terms):

1. *Outbreak.*
2. *Impact*
3. *Acute Respiratory Syndrome*
4. *Influenza*
5. *Preparedness*
6. *Risk*
7. *Stress*
8. *Nurses*
9. *Infection Control*
10. *Willingness*

4. Critical supplies and services regarding the health of the workforce

Critical supplies and services regarding the health of the workforce as defined by the Guidance on Preparing Workplaces for COVID-19 by the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA 3990-03 2020), include:

a) Development of an Infectious Disease Preparedness and Response Plan
b) Preparedness to Implement Basic Infection Prevention Measures
c) Development of Policies and Procedures for Prompt Identification and Isolation of Sick
d) People, if Appropriate
e) Development, Implementation, and Communication about Workplace Flexibilities and
f) Protections
g) Implementation of Workplace Controls
h) Engineering of Controls
i) Administration of Controls
j) Definition of Safe Work Practices
k) Procurement of Personal Protective Equipment (PPE)
l) Adherence to Existing OSHA Standards

A report card grading scheme will be used to define the status of threats, system vulnerabilities and impacts as these relate to each component of the health supply chain systems. The bulletin will include a summary of Lessons Learned on the U.S. and Mexico Health systems, to identify best practices that can support the regional economic development. In addition, the Bulletin will include a section to populate U.S. and Mexican academic, industrial and government agencies vested on each segment of the health supply chain, with the idea of foster collaborations and exchange information that can be established to support the continuous trade operations between U.S. and Mexico. As discussed previously, our team has been following closely the main DHS priorities and adjusting some of our project priorities accordingly. An example of this has been the discussion of key priorities from attended webinars and discussions.

Notice that content of the Bulletin will be primarily based on the analytics generated in the data- lake, which will be defined and prioritized by the taskforce. As the catalog of analytics is being developed and made available to CBTS' stakeholders via the data-lake, production of automated summary reports to integrate evidence collected up-to-date will be offered as an option. The automation of reports of available analytics will provide current evidence 'as needed' by the stakeholders. The goal is that by the end of each month analytics produced by the latest automated report will serve as the basis of the monthly bulletin content. Each automated report will include the latest commentaries, feedback and advice collected throughout the weekly meetings of the taskforce where the reports will be presented and discussed.

5. Performance Metrics Planned (KPI)

Metric 1 – CBTS leadership will develop rubric to be fulfilled every time the Taskforce meets. This rubric will include three main sections: datasets, models and expert opinions, to reflect the quantity and quality of the evidence being collected to formulate the Risk model. Minutes from the Taskforce meetings will include the rubric and a list of action items indicating the partners involvement required to complete the identification of key processes involved in the supply chain for the health infrastructure and for the health of the workforce.
Metric 2 – CBTS leadership will develop a rubric to assess the development and operation of the data-lake. This rubric will include three main sections: volume of data being processed, volume of model predictions being processed, and volume of expert opinion's being processed, for the identification of the key processes

involved in Risk model depicting the supply chain for the health infrastructure and for the health of the workforce.
Metric 3 – CBTS leadership will develop a rubric to assess the impact of the dissemination of the monthly Bulletin. This rubric will include three main sections: use of datasets, use of models and use of expert's opinions, as represented in the outcomes of the Risk analytics guided by the current Risk model.

The monthly Bulletin will be produced and submitted to DHS sponsor for review and clearance before dissemination to stakeholders and before this is published in the web. This to avoid any conflicts of interests between the U.S. and Mexico, since it has been established that this project must focus on scientific research and avoid any influence of political bias. The main purpose of producing risk analytics is to provide confidence to decision-makers involved in the supply chain of the health sector impacted by the COVID-19 pandemic, which is anticipated will have significant impact on all economic sectors.

Quarterly assessment reports (included under output 1) will be provided to DHS evaluating the scientific progress of this research. This evaluation will be integrated by the taskforce and complemented by Co-PIs of the project. This will include 1) progress of the operation of the taskforce, 2) progress on the design, implementation and operation of the data-lake, and 3) progress on the monthly publication of the bulletin.

VI. References

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