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NYC VS. COVID19: THE HUMAN AND FINANCIAL
RESOURCES DEPLOYED TO FIGHT THE MOST
EXPENSIVE HEALTH EMERGENCY IN HISTORY IN
NYC DURING THE YEAR 2020

by

ELMER ARTURO MALDONADO RAMIREZ

A master's capstone submitted to the Graduate Faculty in Data Analysis and Visualization in
partial fulfillment of the requirements for the degree of Master of Science, The City University
of New York

2022

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This manuscript has been read and accepted for the Graduate Faculty in Data
Analysis and Visualization in satisfaction of the thesis requirement for the
degree of Master of Science.

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Date

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ABSTRACT

NYC vs. Covid19: The Human and Financial Resources Deployed to Fight the Most Expensive Health Emergency in History in NYC During the Year 2020

by

Elmer Arturo Maldonado Ramírez

Advisor: Michelle McSweeney

The City of New York launched one of its largest and most expensive operations in history. The objective was to stop or at least slow down the spread of the Coronavirus disease first identified in Wuhan, China in 2019. A vast number of initiatives were implemented by the city government involving every city agency. The New York City Department of Health and Mental Hygiene was at the forefront of this response. This document will study the Human Resources deployed by said agency during the year 2020 to reveal how many assignments were given, dates and hours worked, number of employees deployed, strategies used, and types of talents most needed during such an emergency in the year 2020. Through this analysis, we hope to discover useful markers of performance by pairing this new insight to the patterns of infections, hospitalizations, and mortality rate to see whether the increase in assignments corresponds to a lower case-mortality rate. In addition, this study explores financial information provided by the Office of Management and Budget that can offer an understanding of how the money under the Covid19 nomenclature was used and how much was directed to the Department of Health compared to other agencies.

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DIGITAL MANIFEST

- 1. Capstone Project Whitepaper (PDF)**
- 2. CSV Files**
 - a. COVID-19_Expenditures_Report**
 - b. DOHMH HR Covid19 - Simplified**
 - c. Waffle Chart Template**
- 3. WARC Files**
 - a. Project Website**

Archived version of <https://nycovid19fight.commonsgc.cuny.edu/2022/04/24/new-york-city-year-2020/>

A Note on Technical Specifications

The website is hosted on CUNY Academics Commons and was created using WordPress system. The visuals were inserted using the HTML feature:

```
[embed][\embed]
```

CSS was used to adjust the appearance:

```
.container {  
  width: 70%;  
}
```

The WordPress Elementor tool was utilized to organize the layout of the website.

The visuals from this project are all available for download through the website. No special software or credentials are needed in order to navigate the website and it can be accessed via any internet capable device. To be able to edit the visuals Tableau 2022.3 is required. More information of how to install, download and edit the workbooks can be found at <https://www.tableau.com/resources>. Once the workbook is downloaded, the user will be able to look at all the components as well as the variables and calculations that went into creating the visualization. Certain modifications can be made to the graphs at this point. If the user wants to edit the visualizations in a way that involves modifying the dataset, downloading CVS file pertinent to the file will be required along with creating the connection from Tableau to said file.

1. Introduction

The City of New York launched one of its largest most expensive operations in history to contain a “100-nanometer-wide bubble of genes.”¹ The Coronavirus disease 2019, “also known as the coronavirus, or COVID19, is a contagious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The first known case was identified in Wuhan, China, in December 2019.”² The bill for NYC was of \$ 14,023,275,837.94 in 2020 alone and as of this writing (December 1st, 2021), according to John Hopkins University, this tiny threat had killed 5.2 million people worldwide and infected 263 million³. Unbelievable as it may sound, it could have been worse, much worse. Initial estimates reported similar death numbers but for the US in 2020 alone⁴. Several initiatives were put in place in an attempt to reduce the loss of lives, and though the public was constantly receiving counts of infections, hospitalizations, and deaths, via the media; not such a close count was being kept of the thousands of hours worked by the armies of men and women serving in the front lines during such times. This document will study the Human Resources deployed by the NYC Department of Health & Mental Hygiene dedicated to the emergency response during the year 2020 to reveal how many assignments were given, dates and hours worked, number of employees, strategies used, and types of talents most needed during the crisis of 2020.

¹ Zimmer C (26 February 2021). “The Secret Life of a Coronavirus – An oily, 100-nanometer-wide bubble of genes has killed more than two million people and reshaped the world. Scientists don’t quite know what to make of it”. <https://www.nytimes.com/2021/02/26/opinion/sunday/coronavirus-alive-dead.html>. Retrieved 28 February 2021.

² Page J, Hinshaw D, McKay B (26 February 2021). “In Hunt for Covid-19 Origin, Patient Zero Points to Second Wuhan Market – The man with the first confirmed infection of the new coronavirus told the WHO team that his parents had shopped there”. <https://www.wsj.com/articles/in-hunt-for-covid-19-origin-patient-zero-points-to-second-wuhan-market-11614335404>. Retrieved 27 February 2021.

³ John Hopkins University and Medicine, Coronavirus Resource Center, Accessed December 1st, 2021, <https://coronavirus.jhu.edu/map.html>.

⁴ Neil M Ferguson, Daniel Laydon, Gemma Nedjati-Gilani et al. Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand. Imperial College London (16-03-2020), doi: Accessed May 21, 2021. <https://doi.org/10.25561/77482>.

This research will harness the opportunity of the fact that the author has been working with, granted access to, and been allowed to publish inside data about human resources deployment, hours worked, and expenditures made in combating the spread of the virus. Through this analysis, we hope to discover useful markers of performance by pairing this new insight to the patterns of infections, hospitalizations, and mortality rate to see whether the increase in assignments corresponds to a lower case-mortality rate. In addition, this study includes financial information that can give us an understanding of how much was directed to the Department of Health as a whole, under the Covid19 nomenclature relative to other agencies. To achieve this, I will be using the COVID-19 Expenditures Report presented by the Mayor's Office of Management and Budget (OMB).

This analysis can serve local taxpayers have a better view of where their contributions went, what worked and what did not, what processes should be repeated in case a similar emergency occurs. It can also help inform voters of how their politicians delivered in times of crisis to make better informed decisions in the future. In time and ideally, these results could be compared with other operations in other cities and countries to see which ones worked best and serve as a framework for facing similar crises in the future.

It all started in February 2020. Weeks before, word was heard rather faintly from the other side of the globe. A new virus had appeared. It sounded like a rumor given the contradicting messages arriving to the office. Scary videos of very sick doctors were surfacing while authorities overseas kept reassuring us it was nothing relevant. Was it deadly? How deadly? Was this even real? We had so many questions, and upon receiving the same answer, we kept asking. We are the Department of Health after all, so we kept investigating. My direct supervisor erred on the side of caution. He visited my desk to bring the news "Elmer, apparently it is nothing to worry about, but remember that training you were very unlikely to ever use? I just want you to refresh on it a bit".

The visits to my desk then became more frequent. He seemed hastier every time. He had first decided to manage it all by himself, as he is used to during other health crises, but this time it was different. I guess he was hesitant of getting me involved. I was a young new hire. It took only one week for him to be overwhelmed by the number of requests for personnel across the city. The City of New York was already preparing for the worst. By February 29th we got our lab results, along with our own answers to our questions: Yes, the virus is real, deadly, very contagious and is here in New York City. He approached my cubicle one more time and said: “Elmer, I need your help, you are hereby being Activated”

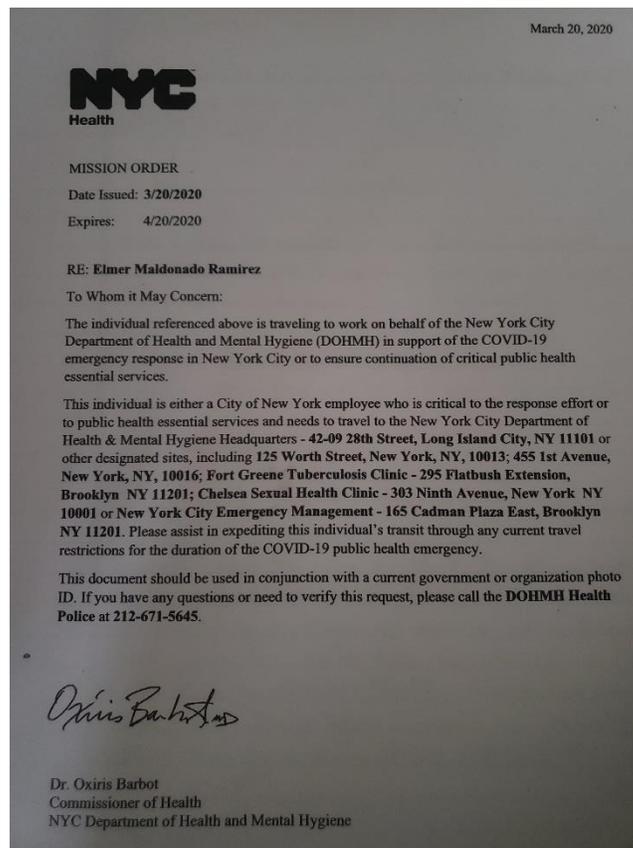


Figure 1: Mission Order

My first mission was to find a Mandarin translator for patients who were contracting the virus and could not communicate their symptoms or needs to the medical personnel. It was a life-saving position. This would have been an easy task under any other circumstance but Hospitals and

DOHMH were already using all their translators, this would require thinking outside the box. Then it occurred to me with little hope to ask an unlikely candidate: A financial analyst who works on the same floor with us to take the role. She had every reason to say no. She was not hired nor trained for that kind of work. There was panic, nobody knew how to treat the virus, there were no medications, and vaccines or treatments were not available. Who would dare to go talk face to face with patients who are provenly infected? I told her the job description; and before I even finished explaining how necessary the role was, she asked: “can I start today?”. I was impressed and moved by how resolute she was. I felt responsible, and worried for her but at the same time happy and proud. To this day I remember that response. I realized then that it would take people like her to win this fight, hundreds of them, and it was my job to find them. This mission had become personal.

On February 26th, I was granted access to the Samaritan placement system which is the software used by DOHMH to manage the needs of personnel that were occurring across the city. When a need occurred, a division created the personnel request that was entered on Samaritan. Once entered, the system notified us in HR, where we then utilized our every tool available to locate the qualified candidates within the agency to cover the need.

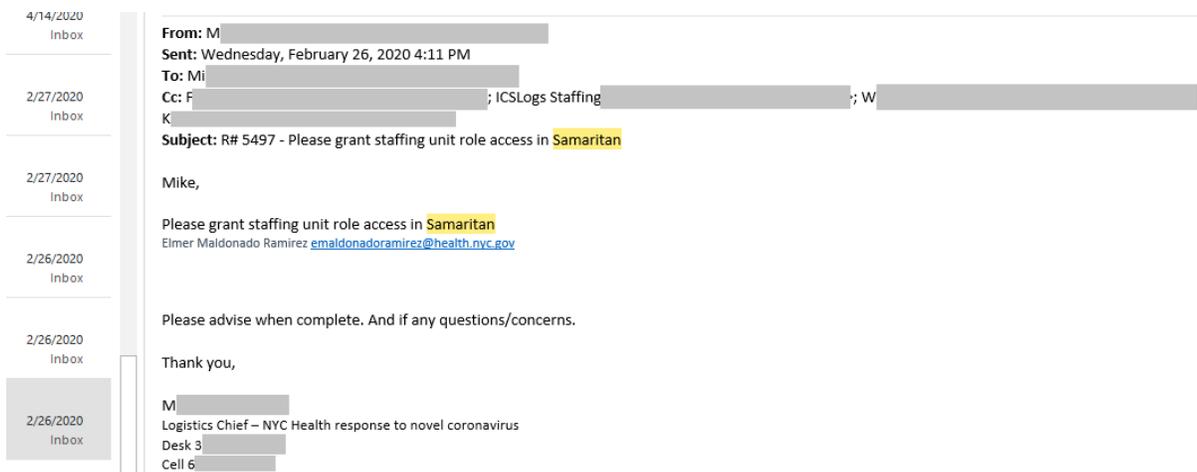


Figure 2: Samaritan Placement System, Access Granted

Once the candidate was identified, communication was established with the employee's supervisor and the employee to agree on a duration and schedule of the assignment. This data was entered into Samaritan. This cycle was repeated every time an employee was Activated, and every day of Activation meant one line of data.

Samaritan Staffing Schedule as of 7/5/2021 7:51 AM

Year	Month	Level	Division	Bureau	WU Code	Workunit	First Name	Last Name	Email	Assigned ER..	Emergency ..	Serving ERG	Serving Title	Start Date	Start Time	End Time
2020	January	Division	ADM	Administrati on Office	0080	Administration				Safety Officer	ICS Core Responder	Safety Officer	Desk Officer	1/30/2020	09:00	17:00
										Safety Officer	ICS Core Responder	Safety Officer	Safety Officer	1/30/2020	00:05	00:00
										Safety Officer	ICS Core Responder	Safety Officer	Safety Officer	1/31/2020	00:05	00:00
										Safety Officer	ICS Core Responder	Safety Officer	Safety Officer	1/30/2020	00:05	00:00
										Safety Officer	ICS Core Responder	Safety Officer	Safety Officer	1/31/2020	00:05	00:00
				Bureau of Human Res..	0089	HR Central				Logistics	ICS Core Responder	Laboratory	Lab Helper	1/30/2020	09:00	17:00
										Logistics	ICS Core Responder	Laboratory	Lab Helper	1/31/2020	09:00	17:00
				Bureau of Chronic Dis..	0946	Chronic Disease Prevention				Laboratory	Response Tier 1	Laboratory	Lab Helper	1/30/2020	09:00	17:00
										Laboratory	Response Tier 1	Laboratory	Lab Helper	1/31/2020	09:00	17:00

Figure 3: Samaritan, Data Structure

2. Historical Analysis and Research

Activation, Definition:

But what is an Activation? NYC Department of Health and Mental Hygiene (DOHMH) employees have official titles known as Civil Service Titles. During emergencies, DOHMH employees can be mobilized out of their official roles to attend an emergency, this is called an Activation. Once activated, their titles may change depending on the new assignments received, this is their Incident Command System Title (ICS). The duration of the new title will depend on the job at hand. It could last from one day, to the entire duration of the emergency or beyond. Since my activation in February 2020, me and my supervisor have been working as ICS Resources Unit Managers. This title can be found at the very bottom right corner of the ICS Titles tree map, as there were only two of us.

When the crisis was at its peak, me and my supervisor were constantly on the phone discussing the needs of staff across the city and strategies to resolve them. Then I noticed his voice was changing and he increasingly needed to apologize to cough. We were so absorbed by our task that we did not want to accept it: He had Covid19. There was a point where his body simply could not take it and he had no choice but to leave the unexperienced me leading the operation. He went through severe complications and various near-death experiences. He was not returning anytime soon and so I was the only Resources Unit Manger. This became even more personal. I had one more reason not to fail and was not planning to drop the ball.

The idea of the project layout is to start from a top-level view to then start slicing the data and presenting it in different ways to eventually get to the deepest view that shows what is under the surface, hence the analogy of it being an X-Ray of the operation. Additionally, X-Rays to these areas

of the body were elemental tools to diagnosing the illness and its effects. This inspired the design decisions such as the Thoracic images accompanying the title and the 3D Abstract section.

The project starts with a basic bubble chart that shows the total number of activations that were given following the logic of starting with the surface level of analysis. Next to it is the total number of translators activated for comparison. It not only shows how massive the operation was, but it also shows how unique the translator task was. Every one of them was activated by me, so there was a sense of personal worry that came with every activation of such a potential danger. This was a time when the virus was mostly of unknown nature, its mortality and contagion rate were to be calculated, protective measures were not clear, and treatment was indetermined. I could not help but feel concerned about receiving a notice saying, “remember that employee you sent there? She got sick”. Every one of them shares a story similar to the one presented above of an individual willing to take that risk far apart from their regular work.

That data was then split into the titles given to those activated. A tree map allowed us to rank all titles while showing the numbers of employees per every title. Arbitrary categories were then created to help the audience sort through the complexity of the numerous specific titles by placing them into more generalized buckets, such as Administration and Medical. This was presented in a simple bar chart which allows to show all the categories at a glance and gives a general idea of where was the majority of effort directed towards. One additional break down level in a form of a waffle chart shows percentagewise the top four specific skills most used during the pandemic response. First are Lab Helpers. Second are Contact Tracers and as their name suggest, their work became primordial in investigating positive patients who may have potentially infected others, thus their numbers increased dramatically. Following closely in third place is a title that makes me feel specially identified: Data Analysts. Not only because it is my field of study, but because numerous

sleepless nights were spent trying to find qualified candidates to fill these high demand roles. They became the eagle eyes that provided the feedback on how things were going at every front. Cases, hospitalizations, deaths, spending, percentage of workforce deployed, money spent, vaccines needed and a large etcetera. Some vital decision could not be made until the data was visualized. It all required up to date information that needed to be collected and presented in a way that leadership and the public would understand.

As a way to show the complexity of this operation, I mapped out the movement of personnel from their original work division to the ICS branch. The best way to do this is a flow chart which shows the number and activations of employees that were sent from their regular tasks to their emergency response role. This illustrates one additional consideration we needed to keep in mind while designing our staffing strategies: the balance required in the flow of personnel.

We had to be careful of not taking too many people from one Division as to not affect the most essential operations and services DOHMH normally provides. As the emergency progressed, disagreements with Division Managers were common, as every employee activation resulted in an increase in the workload for that Division because they had less employees. Employees were torn between wanting to help the city with the emergency and helping their supervisors. On various occasions, some employees were outstandingly efficient or had a particular skillset that made them essential for both work units. This made it part of our tasks to mediate between the ICS Supervisors, the regular Supervisors, and the employee so they could come to an agreement on a work schedule where the employee would work part time on both or even three areas simultaneously, all while trying not to burn out our personnel our personnel.

The latter explains why the number of activations is beyond seven thousand when DOHMH has about seven thousand employees. This is due to the fact that one employee can

sometimes receive assignments that are short in time –monthly, weekly, daily or part-time. Thus, one employee that received seven weekly assignments, will count as 7 different activations. In addition, during the most critical times, an employee can sometimes accept to cover two positions simultaneously, as explained above, which doubles the number of activations for that employee. To help address this complexity a special visualization was required that would allow to see in a per-day and even per-employee level of analysis of activations. Said graph will be explained in greater detail further down in this document to follow the order in which graphs are presented on the website.

To show the activations per month a density bar chart was created. The result coincides with that of the buildings on pretty photograph of Manhattan from National Geographic which guided the design decisions. The graph shows the highest number of activations is concentrated in the middle of the year, between May and September.

To accompany the personnel deployment, I thought it was useful to also present the progression of the virus throughout the year. This places the viewer within the context in which the personnel deployment was occurring. A line chart showing cases, hospitalizations, and deaths was made.

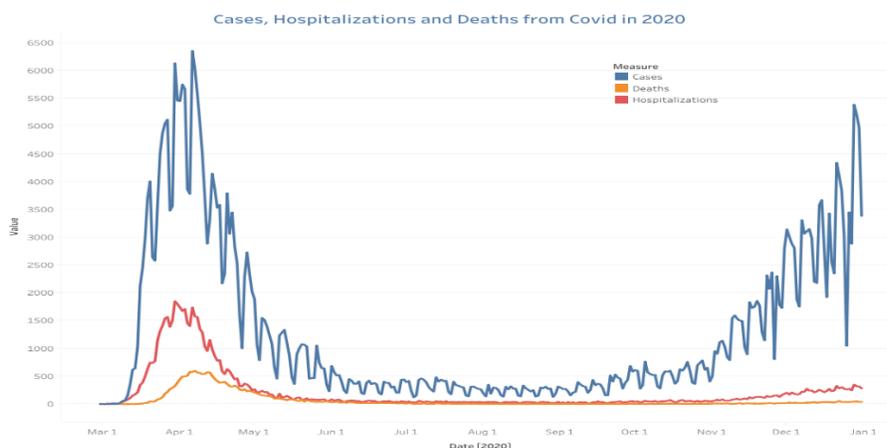


Figure 4: Line Chart, Cases Hospitalizations and Death Counts from Covid19 in New York City, 2020

It shows all three metrics were at its lowest between May and October. Notice that death rate never rose again to the initial levels. This illustrates the fact that though there was a second increase in people getting infected, there were not that many people hospitalized or dying. This study reveals that NYC had learned by then how to save the lives of its citizens.

The analysis at this point moves the focus from flow of human resources to the flow of monetary resources. We first start presenting the sources of the money or funding sources. Once the city declared the state of emergency, it was granted funding from several sources. The volume chart allows us to easily look at the spending over time even per day, along with the funding source and its totals. Notice how the beginning and end of 2020 show smaller numbers. According to DOHMH, the first cases were seen back on February 29th of 2020⁵. This is the date that DOHMH classifies as the beginning of the outbreak in NYC as well as the date of the first laboratory-confirmed COVID-19 case. Then there is a concentration of spending throughout the middle of the year and a decline towards the end. The main funding source is FEMA which transferred funds through the Emergency Declaration in 2020.

In 2020, according to documentation provided by the Mayor's Office in a dataset that includes "every expenditure transaction incurred by a city agency under a "CV" (for Covid) budget code" which is "taken directly from the City's Financial Management System (FMS) with very few alterations"⁶ a total \$ 14,023,275,837.94 was distributed as shown in the graph below. The money was distributed among the city agencies. To visualize this, I created what I call "building charts". These buildings represent the top agencies responsible for most of that spending and the orange

⁵ Department of Health and Mental Hygiene (DOHMH), COVID-19 Daily Counts of Cases, Hospitalizations, and Deaths, NYC Open Data, accessed December 1, 2021, <https://data.cityofnewyork.us/Health/COVID-19-Daily-Counts-of-Cases-Hospitalizations-an/rc75-m7u3>

⁶ Office of Management and Budget (OMB), COVID-19 Expenditures Report, NYC Open Data, accessed December 1, 2021, <https://data.cityofnewyork.us/City-Government/COVID-19-Expenditures-Report/thut-5mdg>,

windows represent the percentage spent by each. Included in this tiny city of building is CUNY, which is 28th place in spending, here for comparison and because it could be of special interest for CUNY students or staff reading this material.

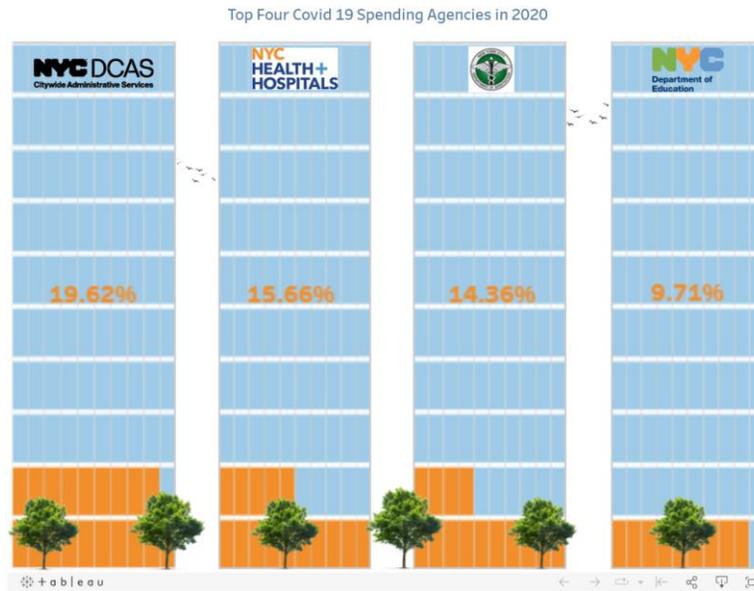


Figure 5: The City of Building

Speaking of buildings, DCAS is the grand building located at 1 Center Street. Just as its address suggests, it is at the center of the administration of all city resources. It is the agency overseeing all other agencies and as such, it is also in charge of most of the spending. Health and Hospitals Corporation is in charge of treatment of patients via its 70 locations, making it the largest healthcare system in the United States⁷, thus occupying the second place in this list with a total of over 2 billion dollars in spending in a single year. The Department of Education (DOE) ranks 4th among the agencies with most money spent. This is mainly because testing and then vaccination sites provided by the city were located in schools. This caused a series of needs in terms of logistics, security, transportation, equipment, personnel, and vaccines to be redirected to said facilities. A total

⁷ NYC Health + Hospitals (H+H), About NYC Health and Hospitals, accessed December 1, 2021, <https://www.nychealthandhospitals.org/about-nyc-health-hospitals/>

of 1,552 testing sites were opened across the city.

The data contained codes for Object of Expenditure which is the smallest financial unit the city offers. This is very helpful because the audience can see with a considerable amount of precision what was bought or rented with the money. A tree map was built to that shows every one of the Objects of Expenditure and a waffle chart breaks down the data into larger categories. The Homeless Services category stand out as it almost equals that of Transportation, Fuel, Advertising, Construction and Overtime categories combined. Despite having broken down the spending to the smallest expression made public by the city government: Object of Expenditure, it is not possible to know exactly what resulted in that massive spending by DHS compared to other agencies, since almost all the funding is lumped under the single object “Individual Homeless Services”. This is different from all other agencies in the fact that others detail every specific expenditure such as masks, equipment, food, overtime, and so on, but DHS has that one Object of Expenditure which is larger than all 52 Objects of Expenditure from DOHMH combined, for instance. This is noteworthy because these are only Covid related expenses. It would be interesting to know how exactly that occurred but that would be the subject of another paper. This paper focuses on DOHMH, which brings us to the next step of our analysis.

3. Development and Visualization of The Story

This study has gone through a citywide analysis, then agencywide, then per object, then per title, and last is the deepest level of profundity in our analysis and the most important one: the individual. It shows how many hours per day every DOHMH employee dedicated to the fight against the pandemic.

This is the data I had not only been working with but producing with my hands throughout an incredibly intense year of work. Every data point comes from a person that I know and/or worked with. I wanted it to be unique, a tribute to that hard work. After trying several types of visuals, I started considering the inclusion of the enemy itself, an image of the Covid19 virus, but the graphs I had made did not work well with it. The images of the virus were circular and multicolored and did not sync well with the squared bar charts and tree maps I had come to create thus far. Additionally, the data was so massive and the employees so many, that it was difficult to represent it in a clear dynamic way. This is when the eureka moment happened, “can I make the data look like the virus is?” –I wondered. I tried the conventional circular graphs Tableau offers. Though the bubble map looked good, it did not achieve the level of originality I was aiming for, nor it could represent all the data. Then I remembered from a class a visualization called Radial Charts. Once I finally managed to make the data radial and conjoined it with the covid image, the result blew my mind. My graph looked like the Covid19 virus, and the employees that fought the pandemic were going to be the antibodies. I wanted to make the first graph as impactful and as exciting as it was for me when I first saw it come alive in my worksheet. In order to do this, I introduced it slowly in story, as a simple image that is not interactive at first. The image seems to be just sitting there boringly next to the text, as another part of the slide, too pretty and well-integrated to be an actual interactive graph. But then, as the viewer gets to the third slide, the Covid image comes alive and becomes interactive, and then

on the fourth slide the “antibodies” enter the scene, running through the veins of the city combating and vanquishing the huge once dominating Covid19 image. They are the employees activated.



Figure 5: The Individual Story: Slide 1



Figure 6: The Individual Story: Slide 4

The fullness of each small circle (the number of lines) determines the number of days in the year every person was activated, and the length of each line shows whether the person worked past the regular duration of the shift that day, while the larger graph represents how many activations occurred in general every single day of the emergency response in 2020.

4. Final Thoughts for This Paper and Possible Continuation of The Study

This study has revealed how many employees were deployed, the tasks they performed, the days and shifts they worked, funding sources, money spent, agencies involved, and even the objects that were bought. This can serve as a precedent for the city and can be used as an integral part of the creation of an Emergency Preparedness Plan for the future. The city can use this data to prepare resources to fast-track the hiring of qualified Data Analyst, or Lab Helpers, for instance. It provides tools to determine whether certain funds were applied efficiently, if purchases were proper, if the providers delivered as expected, if an object should have been rented, bought, or built. It allows for the projection of needs given a hospitalization, contagion, and mortality rates. The objectives of this research project were met and surpassed, but despite the enormous amount of data presented and analyzed here, there are many things that cannot be known within the one year covered. The result of some of the strategies applied are still being revealed and their effectiveness still to be measured. This project gives us a notion of how massive the data required to cover the full length of the pandemic is. It has also served us to know different effective analysis strategies. It readied the data that is to be compared with other cities as well as with the years to come.

Among all the discoveries, maybe the most important one is that of the human element, which is why we saved “The Individual” for last as a reminder to the city of the talent that it has, and that within its ranks, there are people who are willing to stop whatever they are doing, even when it means facing an unknown risk of death, if it is in order to help save someone else’s life.

Works Cited

Department of Health and Mental Hygiene (DOHMH). COVID-19 Daily Counts of Cases.

Hospitalizations, and Deaths, NYC Open Data. Accessed December 1, 2021.

<https://data.cityofnewyork.us/Health/COVID-19-Daily-Counts-of-Cases-Hospitalizations-and-Deaths/rc75-m7u3>.

John Hopkins University and Medicine. Coronavirus Resource Center. Accessed December 1st,

2021. <https://coronavirus.jhu.edu/map.html>.

Neil M Ferguson, Daniel Laydon, Gemma Nedjati-Gilani et al. *Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand*. Imperial

College London (16-03-2020), doi: Accessed May 21, 2021. <https://doi.org/10.25561/77482>.

Office of Management and Budget (OMB), COVID-19 Expenditures Report, NYC Open Data,

accessed December 1, 2021, <https://data.cityofnewyork.us/City-Government/COVID-19-Expenditures-Report/thut-5mdg>.

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<https://www.wsj.com/articles/in-hunt-for-covid-19-origin-patient-zero-points-to-second-wuhan-market-11614335404>. Retrieved 27 February 2021.

Zimmer C (26 February 2021). “The Secret Life of a Coronavirus – An oily, 100-nanometer-wide bubble of genes has killed more than two million people and reshaped the world. Scientists don’t quite know what to make of it”. Retrieved 28 February 2021.
<https://www.nytimes.com/2021/02/26/opinion/sunday/coronavirus-alive-dead.html>.