Analysis of Orange County, Florida 311 System Service Requests During the COVID-19 Pandemic

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ABSTRACT

Orange County, Florida is intimately familiar with impacts of natural disasters because of the yearly threat of hurricanes in the southeastern United States. One of the tools that has aided them in their efforts to monitor and manage such disasters is their 311 non-emergency call system, through which local residents can issue requests to the municipality for disaster-related information or other services. This paper provides a preliminary examination of the potential for the Orange County 311 system to provide actionable information to them in support of their efforts to manage a different type of disaster: the COVID-19 pandemic. The potential of the system to support the County in this context is illustrated through several preliminary analyses of the complete set of service requests that were registered in the first ten months of 2020.

Keywords

Disaster management, COVID-19, 311 system, Orlando.

INTRODUCTION

Orange County, Florida, which includes the city of Orlando, lies within the southeastern part of the United States in a region that is particularly susceptible to hurricanes and other natural or man-made disasters. As a result, the county and city governments continually examine and enhance their capacity for disaster and emergency management (*Orange County / City of Orlando Consolidation of Services Study Commission Final Report*, 2006).

The 2004 Atlantic hurricane season was one of the most consequential in the history of the Orlando metropolitan area. In that year, much of the Central Florida area was directly impacted by four consecutive major hurricanes: Charley, Frances, Ivan, and Jeanne, which resulted in damage to one-fifth of the area's homes and the loss of 177 lives (NOAA National Centers for Environmental Information, 2005). It was an unusual disaster scenario since no other U.S. state has been affected by four hurricanes during a single season since 1886 in Texas. Consequently, media releases and local government reports reveal the Greater Orlando area's significant efforts towards preparing the region for future severe disasters (Williams, 2011; Williams & Phelan, 2011; Kennedy, 2015).

While the metropolitan area was getting prepared for hurricanes and other related emergencies, a novel coronavirus disease – COVID-19 – spread worldwide and became a global health crisis. The outbreak was declared a pandemic by the World Health Organization (WHO) on March 11th, 2020, and many countries have since announced shutdowns, travel bans, stay-at-home orders and other safety restrictions. As a result of the need to address the health consequences of the disease, the COVID-19 pandemic has yielded significant social and economic impacts (Parr et al., 2020), and caused unprecedented levels of disruption in almost all public and private sectors, such as education, transportation, and tourism (Pamukcu & Zobel, 2021). In the state of Florida, for example, drastic changes in traveling and daily routines caused statewide traffic volume to drop by 47.5% in 2020, from the previous year (Parr et al., 2020). In addition, Disney World also announced the longest park closure in

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its history due to the COVID-19 pandemic.

Even when a crisis such as this strikes a municipality, the local government maintains responsibility for continuing to provide critical services to citizens. Recently, smart technologies have become one of the types of tools that governments are using to maintain these services and to communicate with citizens before, during and after an emergency. Centralized systems for processing citizens' requests for help are good examples of smart technology implementations, as they bring government and citizens together to communicate and collaborate on maintaining the public's well-being (O'Brien, 2016). In the U.S. and Canada, there are several easy-to-remember three-digit request numbers designated for supporting such services. Some examples are 211 for community information and referral services, 311 for non-emergency services, 411 for general information, 511 for transportation, and 911 for emergency services. Although initially call-center based, these services have been improved over time by adding web-based service options such as web chat, online request, or smartphone app services.

The 311 call system was initially built to relieve the congestion in the 911 emergency system due to the high numbers of non-emergency calls (Schwester et al., 2009). Such 311 systems exist in many municipalities within the United States as part of a movement towards enabling smart cities (Zobel, Baghersad, & Zhang, 2017). Smart cities have many benefits such as improving the citizens' life quality, local economy, transportation and traffic management and interaction with government via incorporating information and communication technologies (Ismagilova, Hughes, Dwivedi, & Raman, 2019). Existing research efforts point out the 311 systems' high potential for the improved governmental service delivery in smart cities (Hartmann, 2019) and discuss the potential value of using 311 service data to enable more effective and efficient disaster management by leveraging enhanced citizen participation (O'Brien, 2016). In particular, this improved participation allows for more timely information exchange between the government and its citizens, not only during and after an emergency but also in preparation for it to occur (Pamukcu & Zobel, 2021). As a good example of this, prior investigation into the 311 call system in New York City (NYC) demonstrated that non-emergency call data is able to capture variations in citizen reactions to the COVID-19 pandemic and the city government's associated actions. The city's commitment to utilizing the 311 system enables it to capture a variety of information about the ongoing crisis and provides it with the potential for improving service delivery effectiveness (Pamukcu & Zobel, 2021).

Although recent studies highlight the potential value of using 311 call data in emergency preparedness and response, the literature on the role of 311 systems in disaster management is still rare. Existing efforts mostly focus on resiliency to sudden-onset natural disasters (Zobel, Baghersad, & Zhang, 2017, 2018; Zobel & Baghersad, 2020). In contrast, the COVID-19 pandemic provides an opportunity to examine 311 system reactions to a long-term global-scale crisis, which is both rare and unique in terms of its scale and impact. In addition, although different 311 systems have a shared mission of serving citizens' non-emergency service and information requests, they vary in how they categorize service requests and in how they collect and report data. Such variations in system implementations point to the opportunity to examine not only common attributes across such systems but also to study locally-specific attributes that provide potential for even better utilization of system resources and systems performance analysis before, during, and after a crisis event. The COVID-19 pandemic enables observing locally-specific response efforts to the same global health crisis. This will contribute to the disaster management literature by capturing differences, similarities, and new opportunities for comparative analysis.

The value of non-emergency call data to local government emergency management efforts and the variations in 311 system implementations across different metropolitan areas indicate that there is potential for further examination of 311 system performance in different areas, during the COVID-19 pandemic in particular. With this in mind, the current study expands on previous efforts by focusing on the use of the Orange County 311 system during this significant and ongoing crisis. By considering the specific structural differences within the system, and in this new context, our objective is to uncover new opportunities to capture and manage fluctuations in service and information request behavior before, during, and after emergencies.

The Role of 311 Non-Emergency Call Systems in Disaster Management

When the 2004 hurricanes hit the Orlando metropolitan area, the local government used the 311 non-emergency call system to receive post-hurricane services requests. Recognizing the system's significant contribution to informing citizens, collecting needs, and responding to requests effectively during the 2004 hurricane season, the local government in Orange County began to promote 311 as a reliable source of information during an emergency and to encourage residents reporting disaster-related problems to the 311 Service Center (Williams & Phelan, 2011; Kennedy, 2015). Today, Orange County's 311 system is an integral part of their emergency preparedness and response activities (Williams & Phelan, 2011).

As we mentioned before, despite the shared mission of 311 systems on serving citizens' non-emergency service and information requests, they vary in how they categorize service requests and in how they collect and report data. For example, unlike the NYC 311 system, the Orange County 311 System provides the option for a detailed

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textual description of each service request and it also supports specifying the request's relative priority. Moreover, Orange County's system separates requests for information from other types of service requests, and it utilizes a detailed tree of sub-categories to capture specific behaviors more accurately. In contrast, the NYC 311 system simply assigns a descriptor attribute to each request from a pre-determined set of options, and it identifies the corresponding name of the agency to which the request is directed (Pamukcu & Zobel, 2021). Neither of these characteristics are presented in the Orange County 311 data. These variations in non-emergency system implementations point to the opportunity to examine not only common attributes across such systems but also to study locally-specific attributes that provide potential for even better utilization of system resources and systems performance analysis before, during, and after a crisis event.

Researchers have recently begun to highlight the potential value of 311 systems in disaster and emergency management. Schellong and Langenberg (2007), for example, discuss the greater need for knowledge sharing during a disaster situation, and they mention the benefits of 311 systems in their ability to provide timely access to continuously updated information and services. More recently, O'Brien (2016) explores how residents' participation in identifying and reporting Hurricane Irene's consequences via the 311 system sped up damage assessment in the City of Boston and greatly improved the city government's capability to address disaster outcomes and rebuild the public infrastructure. Zobel et al. (2018) note that the significant amount of historical and time-based information about citizens' non-emergency service needs provide great potential for capturing the varying effects of a disaster on a city by examining the changes in 311 service request behavior of citizens. This initial work was then extended to characterize and quantify the multi-dimensional nature of a municipality's disaster resilience, based on the type, number, and duration of 311 service requests (Zobel et al., 2017; Baghersad et al., 2020; Zobel & Baghersad, 2020).

From a practitioner's standpoint, the Orange County Public Safety Communications Division Assistant Manager William and Consultant Phelan (2011) summarizes the benefits of the 311 system during an emergency in terms of the following characteristics that support resilient behavior: faster information dissemination, automated system processes, transparent and quick responses to citizens, and decreased communication errors. 311 call systems provide a great opportunity for city governments to better manage limited resources and capacities, thanks to residents' collaboration with identifying and reporting the consequences in their neighborhoods (O'Brien, 2016). Given their growing prevalence, there is need for effective 311 systems that can meet communication needs during a disaster, including sharing up-to-date information with emergency response personnel and responding to public requests (Williams, 2011).

ORANGE COUNTY 311 NON-EMERGENCY CALL SYSTEM

The Orange County Government Information and Services System, or "311 system," was initially established in 2002 as a pilot program. Like the 911 Emergency System, the 311 calls were automatically routed to corresponding municipalities while the 311 system was being tested. Following the pilot program, however, the County took on the role of the initial responder to and facilitator of such calls (*Orange County / City of Orlando Consolidation of Services Study Commission Final Report*, 2006).

Today, the Orange County 311 system provides phone and web-based services to residents to get help or information about local government services. Orange County residents can connect to 311 system via phone call, web chat, online request or smartphone app. In this way, residents can inquire about various non-emergency issues such as debris, damaged trees, traffic matters, road conditions, and animal or neighborhood concerns (Orange County, n.d.). 311 service providers are responsible for answering questions, coordinating complaints, and handling service requests. 311 call data is well-structured and consists of a pre-determined list of attributes for each entry, which are specifically defined by the given municipality. Table 1 presents some of the selected features of the Orange County 311 System, including the exact time of the service request, detailed description of the incident category, resolution status, the priority of the complaint, contact method, coordinates of the incident, and so on. Figure 1 subsequently provides an example of the attribute assignment process for each service request within that system.

The detailed complaint descriptions in the Orange County 311 data resemble social media data (e.g., tweets or Facebook posts), where we can examine citizen needs in more detail using text analytics tools, but it has advantages over such social media data. For example, since each entry has a complaint category, 311 data do not necessitate an additional labeling process based on the complaint descriptions. Additionally, 311 data includes exact location information for each entry, which is not always available in the significant proportion of the social media data (Banweer et al., 2018). Moreover, the *mthd_of_contact* attribute gives the method used to submit the request, i.e. "app," "chat," "email," "phone call," "voice mail," or "web."

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Table 1. Selected attributes of Orange County 311 System Requests

Attribute Name	Description
UID_number	Unique identifier
created_on	Date and time the record was created
closed_on	Date and time the record was closed
complete_category	Complete description of incident category
category	Main category of complaint
sub_category	Sub-category of complaint
sub_category_detail	Detailed sub-category of complaint
sub_category_detail_ext	Extra detailed sub-category of complaint
status_desc	Description of resolution status
priority	Priority of the complaint
mthd_of_contact	Method of contact
client_type	Client type
full_address	Full address of the incident
zipcode	Zip code of incident location
latitude	Latitude of incident location
longitude	Longitude of incident location
issue_desc	Detailed description of complaint
issue_resol	Resolution information of complaint

As mentioned above, the Orange County 311 system also assigns priority labels to each request, such as "Critical," "Important," and "Routine", in order to define its urgency in response. This attribute enables doing analyses and making conclusions about the operational performance of the 311 system. For example, the priority attribute allows us to make sense of different service performance for the request types and examine if service delivery behavior matches the labeled priority categories
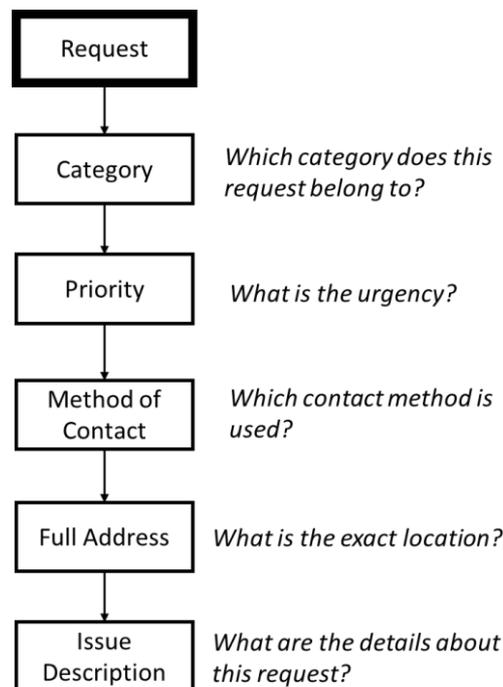

Figure 1. The creation of each data entry in 311 database

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ORANGE COUNTY 311 SERVICE REQUESTS DURING THE COVID-19 PANDEMIC

Orange County declared a State of Local Emergency on March 13th, 2020 when the County had its first confirmed case. Disney World, in the neighboring Osceola County, subsequently announced the longest park closure in its history. Because Disney World has such a prominent place in the economic activity of the area, many people have struggled with the financial impacts of the pandemic, including tens of thousands of workers and local entrepreneurs in this well-populated county. The Walt Disney Co. has announced at least a $5 billion loss to its theme parks and film production efforts during the pandemic (Watson, 2020), and in order to try to offset this, they reopened Disney World in the summer with serious updates and enhanced health and safety precautions (Walt Disney World, n.d.).

The Orange County government received $243.2 million in Coronavirus Relief funds to meet the immediate needs of residents, business owners, nonprofits, municipal and community partners in response to the pandemic. As a part of the *Coronavirus Aid, Relief and Economic Security (CARES) Act*, the Orange County Government determined four funding and one replenishment categories: Small Business Financial Assistance, Social Services and Community Needs, Orange County Public Safety and Health Expenditures, Municipality and Constitutional Officer Expenditures and Orange County COVID-19 Eviction Diversion Program (Orange CARES, n.d.). The County has defined new information sub-categories under Public Safety (PS) in the 311 system to serve residents' information requests about CARES Act assistance programs.

Leveraging an existing partnership with the East Central Florida Regional Planning Council, the authors were able to get access to the complete dataset of 311 service calls made in Orange County between January 1st and October 27th, 2020. The remainder of the discussion examines this dataset from the perspective of monitoring the impact of the COVID-19 pandemic on citizens' service request behavior in Orange County during this time period. The dataset consists of 206,179 requests that were made during the specified time period, and Figure 2 provides the six categories that received the highest number of requests overall.
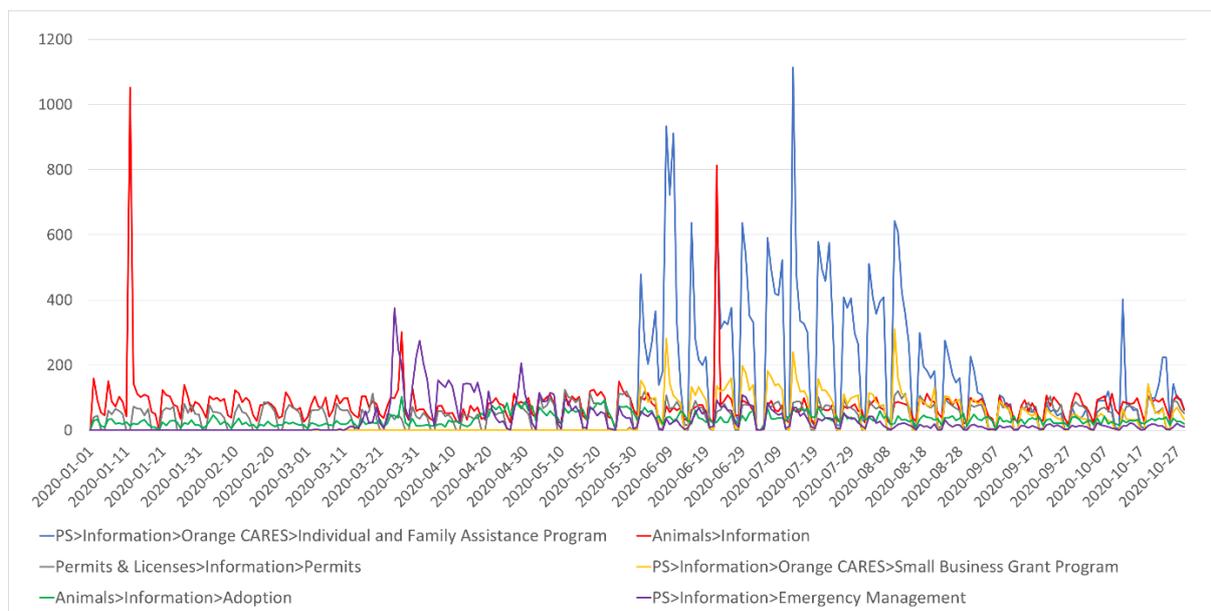

Figure 2. Orange County 311 calls – Top 6 categories of 2020

Figure 2 indicates that a significant portion of the 311 calls received during the health crisis were information requests associated with different Orange CARES funding programs. These information requests actually started a couple of days before each assistance program's application period. For example, the Orange CARES Individual and Family Assistance Program and Small Business Grant Program began on June 8th, 2020, whereas these programs' information requests started on May 30th, 2020. Similarly, the Orange CARES Eviction Program's information requests, which is the 10th highest requested category, began a couple of days before the applications were accepted on August 25th, 2020. It is also interesting to note that calls to Public Safety for Information about Emergency Management began to increase at the same time that COVID-19 was declared a pandemic by the WHO (March 11th), and a State of Local Emergency was declared in Orange County (March 13th). It is at this point that the relative regularity of call volumes across the different categories also began to become much more

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variable across a number of different call types. Additionally, animal information requests significantly increased after the Orange County Animal Services announced the inclusion of pets in the preparedness plan amid COVID-19 on March 10th (Orange County Animal Services, 2020a). Similarly, the animal information requests reached another peak volume just after the Orange County Animal Services have started to collect free pet food for pet owners financially impacted due to COVID-19 on June 23rd (Orange County Animal Services, 2020b).

Information Requests During the Pandemic

The 311 data also exhibit some interesting behaviors within the individual sub-categories of information-related service requests. To illustrate this, we selected the *Public Safety* category for our second analysis of citizens' information request behavior during the COVID-19 pandemic. Figure 3 represents the classification tree for the *Public Safety* category to provide a clear understanding of Orange County's 311 system's categorization method.
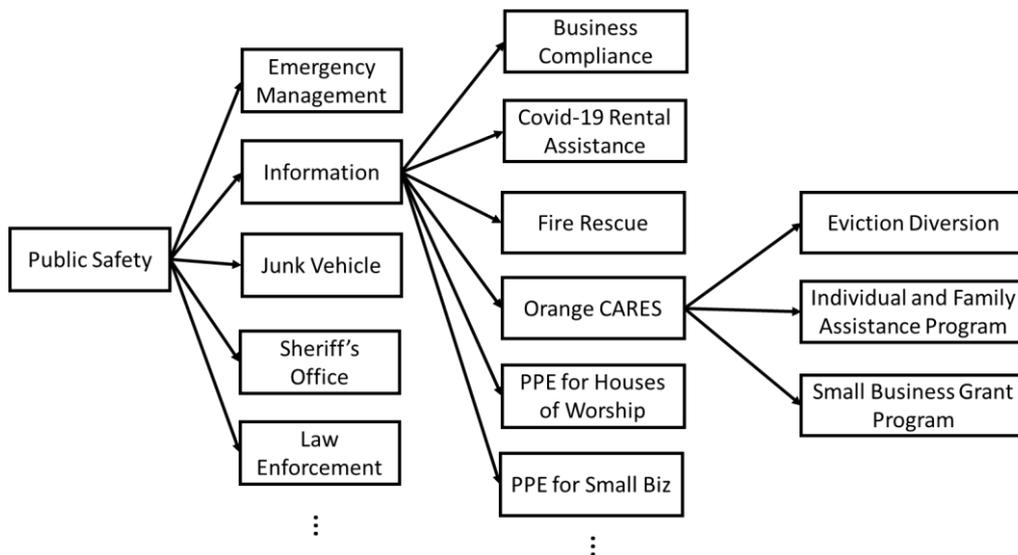

Figure 3. An example of the categorical classification of 311 calls

Figure 4 shows that 6 of the 10 top sub-categories within the *Public Safety* category, in terms of number of calls, were related to information requests, and in fact 92% of the Public Safety calls made between January 1st and October 27th were associated with requests for information. Figure 4 clearly shows the large increase in the numbers of such calls received after the start of the pandemic. Whether these new calls are associated with existing request types, or the result of new public assistance opportunities as discussed above, the County must somehow allocate resources to handle the increased call volumes.

We may assess the impact of this increased number of information-related calls by analyzing the difference between when each record was opened and when it was closed (see Table 1), as a measure of resolution time. According to the data, such information inquiries actually only correspond to 2.15% of the total resolution time associated with all *Public Safety* requests. In order to test this further, we calculated the average resolution time for each type of *Public Safety* service request. Whereas information requests took 1.25 hours to resolve on average, the other types of service requests in this same category had an average resolution time of 12.53 hours. The significance of this difference in average resolution times was verified by running a Student's *t*-test (at $\alpha = 0.05$), which resulted in a *p*-value less than 0.001. This is an important result from the perspective of the municipality because it indicates that the impact of an increase in service requests, in terms of the resources that they need to allocate to manage that increase, is much less for information inquiries than for other types of requests. Consequently, being aware of the different resolution needs and time requirements of varying request types will allow city governments to manage limited resources and capacities more efficiently.
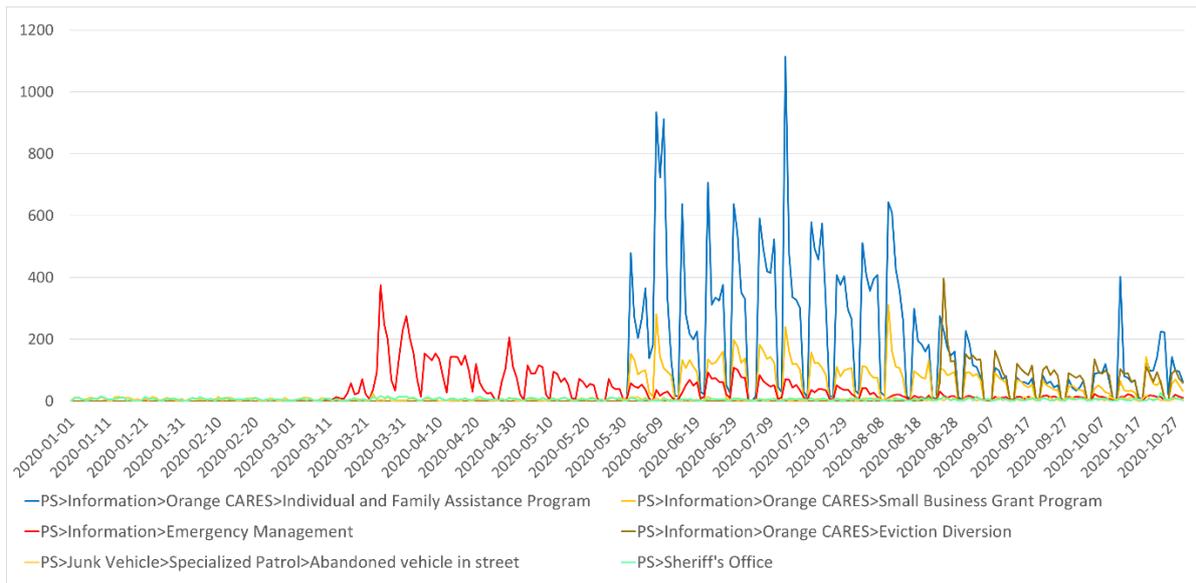
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Figure 4. Orange County 311 calls – Top 6 Public Safety (PS) sub-categories of 2020

Identifying Pandemic-specific Requests via Text Analysis

Our third analysis in this preliminary looked at the impacts of COVID-19 on Orange County's 311 system focuses on the detailed description of each service request: the *issue_desc* attribute. In particular, we analyzed these descriptions to see if the dataset can provide additional useful information about citizen needs related to the ongoing pandemic. The issue descriptions are detailed text-based explanations about the inquiries that are similar to the content of social media data such as tweets and Facebook posts. As such, we can examine the citizens' needs in more detail by using text analytics tools.

In this initial look at the *issue_desc* data, we selected "COVID," "social distancing," "face cover," "mask," "sanitizer," "corona," "virus," "pandemic," "epidemic," "lockdown" and "CARES" as keywords by which to filter 311 calls directly related to the COVID-19 pandemic. The resulting data subset is able to show when pandemic-specific requests began to be received by the system, regardless of the request type. The results also reveal the category types that are directly related to pandemic-specific calls, along with the call volumes associated with each of these request types.
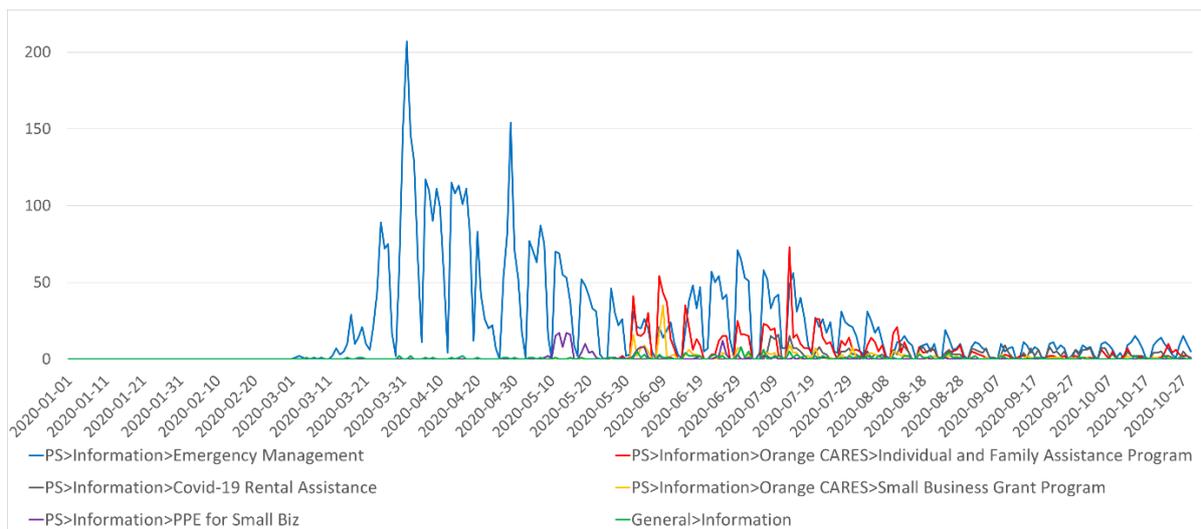

Figure 5. Orange County 311 calls – Coronavirus-specific requests only

Figure 5 provides the results, in terms of call volumes, for service requests that were filtered using the keywords given above. There were 8,850 unique requests that included at least one of these keywords in their issue descriptions. This is 5.15% of the total volume of requests after the State of Local Emergency was declared on March 13th. In particular, the figure shows that *Public Safety Emergency Management* information requests began in early March after the first warning of the Center for Disease Control and Prevention (CDC) was given on

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February 25th, and that they spiked up immediately after the State of Local Emergency declaration. The results also validate that information requests specific to COVID-19 started a couple of days before the assistance programs' applications begin. Based on Figure 5, we can say that most coronavirus-specific requests were assigned to the *Public Safety (PS)* main category, and that the majority of the calls were information requests, which require fewer resources to address than do other types of requests.

CONCLUSIONS

The traditional view of public service delivery involves a directed flow of governments providing assistance to citizens. Smart cities expand on this by incorporating online and electronic means of enabling interaction, which affords the opportunity to engage more effectively with citizens and allow them to take a more active role in service provision (Clark, Brudney, & Jang, 2013). Widespread internet connectivity, electronic databases, and new information and communication technologies help to resolve the difficulties in measuring and assessing government responsiveness (Clark et al., 2020). Moreover, multiple modes of access to government services provide a basis for participation from socioeconomically diverse neighborhoods and allow for much broader representation for the population (Clark et al., 2020). This is particularly important in times of disasters, when both sides need access to accurate and up-to-date information about an ongoing crisis.

The COVID-19 pandemic is a compelling example of a slow-onset, extended disaster that necessitates continuous participation of the residents in the city's efforts to resist, respond to, and recover from the disaster's impacts. Our preliminary analysis has shown that Orange County, Florida's 311 system provides significant potential for providing relevant information to the community and for uncovering specifics of how the community is reacting and responding to the evolving situation. Further analysis is needed to more fully characterize the community's response, and to identify new community needs in a timely and comprehensive manner. Particularly in the context of a significant, long-term event such as the COVID-19 pandemic, access to more and better information, such as that provided by public information systems like 311, can provide significant support for addressing those needs and improving the resilience of the community not only to the current conditions but also to the next disaster event that will occur.

There are many possible future research questions that could be analyzed by extending this preliminary analysis of Orange County, Florida's 311 data. For example, this same dataset could be used to identify changes in service request behavior after the pandemic. Specifically, the data could potentially explain how the pandemic impacted service request volumes and the corresponding response rates. Additionally, there is opportunity to examine if there is a difference between the number of requests made using traditional phone calls and the number made using web-based services, and how the COVID-19 pandemic affected the tendency of using alternative modes for accessing public services. Such a comparison could serve to enlighten the value of implementing new information and communication technologies in public services, especially during emergencies. Another future research opportunity would be to conduct qualitative analyses of the different challenges that service responders face during emergencies. For example, interviews and focus groups involving 311 service providers could help develop a more complete understanding of how well Orange County's 311 non-emergency call system supports preparing for, responding to, and recovering from the impacts of disasters. Another potential opportunity for future research would be to compare 311 systems with other centralized systems. For example, if 911 emergency report data were available, then one could analyze 911 and 311 data from the same time period and the same area when an emergency or a disaster occurs. This would allow for a more complete spectrum of self-reported data to be constructed which could augment the existing categories of data that can be reported from the 311 data system.

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REFERENCES

Baghersad, M., Zobel, C. W., & Behara, R. (2020). Evaluation of Local Government Performance after Disasters. *Proceedings of the 17th ISCRAM Conference*, (May). Blacksburg, VA.

Banweer, K., Graham, A., Ripberger, J., Cesare, N., Nsoesie, E., & Grant, C. (2018). *Multi-stage Collaborative filtering for Tweet Geolocation*. https://doi.org/10.1145/3282825.3282831

Clark, B. Y., Brudney, J. L., Jang, S.-G., & Davy, B. (2020). Do Advanced Information Technologies Produce Equitable Government Responses in Coproduction: An Examination of 311 Systems in 15 U.S. Cities. *The American Review of Public Administration*, *50*(3), 315–327. https://doi.org/10.1177/0275074019894564

Clark, B. Y., Brudney, J. L., & Jang, S. G. (2013). Coproduction of government services and the new information technology: Investigating the distributional biases. *Public Administration Review*, *73*(5), 687–701. https://doi.org/10.1111/puar.12092

Hartmann, S. (2019). Citizen relationship management for civic participation: How smart cities use 311 to involve citizens. In *E-Participation in Smart Cities: Technologies and Models of Governance for Citizen Engagement Public Administration and Information Technology* (Vol. 34, pp. 59–77). https://doi.org/10.1007/978-3-319-89474-4_4

Ismagilova, E., Hughes, L., Dwivedi, Y. K., & Raman, K. R. (2019, August 1). Smart cities: Advances in research—An information systems perspective. *International Journal of Information Management*, Vol. 47, pp. 88–100. https://doi.org/10.1016/j.ijinfomgt.2019.01.004

Kennedy, K. (2015). *ORANGE COUNTY OFFICE OF EMERGENCY MANAGEMENT ADVISES RESIDENTS TO PREPARE FOR POSSIBLE STORM IMPACT*. Retrieved from https://newsroom.ocfl.net/media-advisories/press-releases/2015/08/orange-county-office-of-emergency-management-advises-residents-to-prepare-for-possible-storm-impact/

NOAA National Centers for Environmental Information. (2005). *State of the Climate: Tropical Cyclones for Annual 2004*. Retrieved from https://www.ncdc.noaa.gov/sotc/tropical-cyclones/200413

O'Brien, D. T. (2016). 311 hotlines, territoriality, and the collaborative maintenance of the urban commons: Examining the intersection of a coproduction policy and evolved human behavior. *Evolutionary Behavioral Sciences*, *10*(2), 123–141. https://doi.org/10.1037/ebs0000063

Orange CARES. (n.d.). Retrieved April 11, 2021, from   https://www.ocfl.net/EconomicDevelopment/Orange CARES.aspx

Orange County. (n.d.). Retrieved April 11, 2021, from https://www.ocfl.net/

Orange County/ City of Orlando Consolidation of Services Study Commission Final Report. (2006). Retrieved from https://www.pinellascounty.org/charter/pdf/Orange-County-City-of-Orlando-Consolidation-of-Services-Study-Commission-Final-Report.pdf

Orange County Animal Services. (2020a, March 10). Orange County Animal Services Suggests Including Pets in Preparedness Plan Amid COVID-19 Concerns | OCFL Newsroom. Retrieved April 10, 2021, from https://newsroom.ocfl.net/media-advisories/media-alerts/2020/03/orange-county-animal-services-suggests-including-pets-in-preparedness-plan-amid-covid-19-concerns/

Orange County Animal Services. (2020b, June 23). Orange County Animal Services to Hold Drive-Through Pet Food Giveaway for Residents Financially Impacted by COVID-19. Retrieved April 10, 2021, from https://newsroom.ocfl.net/media-advisories/press-releases/2020/06/orange-county-animal-services-to-hold-drive-through-pet-food-giveaway-for-residents-financially-impacted-by-covid-19/

Pamukcu, D., & Zobel, C. W. (2021). Characterizing 311 System Reactions to a Global Health Emergency. *Proceedings of the 54th Hawaii International Conference on System Sciences*, *0*, 2216–2225. Retrieved from https://scholarspace.manoa.hawaii.edu/handle/10125/70885

Parr, S., Wolshon, B., Renne, J., Murray-Tuite, P., & Kim, K. (2020). Traffic Impacts of the COVID-19 Pandemic: Statewide Analysis of Social Separation and Activity Restriction. *Natural Hazards Review*, *21*(3), 04020025. https://doi.org/10.1061/(ASCE)NH.1527-6996.0000409

Schellong, A., & Langenberg, T. (2007). Managing citizen relationships in disasters: Hurricane Wilma, 311 and Miami-Dade County. *2007 40th Annual Hawaii International Conference on System Sciences (HICSS'07)*, 96–96. https://doi.org/10.1109/HICSS.2007.331

Schwester, R. W., Carrizales, T., & Holzer, M. (2009). An Examination of the Municipal 311 System. *International Journal of Organization Theory and Behavior*, *12*(2), 218–236.

Walt Disney World. (n.d.). Retrieved April 11, 2021, from https://disneyworld.disney.go.com/experience-

WiP Paper – Analytical Modeling and Simulation
Proceedings of the 18th ISCRAM Conference – Blacksburg, VA, USA May 2021
Anouck Adrot, Rob Grace, Kathleen Moore and Christopher Zobel, eds.   216

updates/

Watson, R. T. (2020, October 9). Why Disney World Is Open but Disneyland Is Closed - WSJ. *The Wall Street Journal Business*. Retrieved from https://www.wsj.com/articles/why-disney-world-is-open-but-disneyland-is-closed-11602235802

Williams, L. (2011). *Integrating 311 into Disaster Response & Recovery 2 Defining Roles, Responsibilities, and Relationships Orange County Government 3-1-1*.

Williams, L., & Phelan, A. (2011). *Integrating 311 into Disaster Response & Recovery 3 Pre-Event Planning Case Studies*.

Zobel, C. W., & Baghersad, M. (2020). Analytically comparing disaster resilience across multiple dimensions. *Socio-Economic Planning Sciences*, *69*, 100678. https://doi.org/10.1016/j.seps.2018.12.005

Zobel, C. W., Baghersad, M., & Zhang, Y. (2017). Calling 311: evaluating the performance of municipal services after disasters. *Proceedings of the 14th ISCRAM Conference*. Albi, France.

Zobel, C. W., Baghersad, M., & Zhang, Y. (2018). An approach for quantifying the multidimensional nature of disaster resilience in the context of municipal service provision. In *Urban Book Series* (pp. 239–259). https://doi.org/10.1007/978-3-319-68606-6_15

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