A Web-Based System for Infectious Disease Data Integration and Sharing: Evaluating Outcome, Task Performance Efficiency, User Information Satisfaction, and Usability

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Abstract. To better support the surveillance of infectious disease and epidemic outbreaks by public health professionals, we design and implement BioPortal, an advanced Web-based system for cross-jurisdictional information sharing and integration. In this paper, we report two empirical studies that evaluate the outcomes, task performance efficiency, user information satisfaction, and usability associated with BioPortal. Overall, our results suggest that the use of BioPortal can improve users' surveillance performance as measured by analysis accuracy and efficiency (i.e., the amount of time required to complete an analysis task). Our subjects were highly satisfied with the information support of BioPortal and considered it reasonably usable. Our evaluation findings show the effectiveness and value of BioPortal and, at the same time, shed light on several areas where its design can further improve.

Keywords: Infectious disease informatics; public health information systems; cross-jurisdictional information sharing; outbreak detection; system evaluation.

1 Introduction

The surveillance of infectious disease and epidemic outbreaks has become increasingly challenging to public health professionals [1]. Recent epidemic episodes of SARS, Foot-and-Mouth Disease (FMD), West Nile Virus (WNV), and potential outbreaks of avian influenza have attracted extensive media attention, thus creating enormous concerns at both national and international levels [2, 3]. Meanwhile, potential bioterrorism threats are also on the horizon and thereby bring additional complexity to the challenge of surveillance of infectious disease and epidemic outbreaks. As Siegrist [4] noted, bio-chemically competent terrorists can attack people living in a target geographic area by deliberately disseminating infectious diseases using biological agents.

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Surveillance of an infectious disease or an epidemic outbreak is information intensive and can be greatly supported by effective collection, integration, analysis, and visualization of diverse and voluminous data that are heterogeneous and stored in various sources spanning jurisdictional constituencies horizontally and vertically [5]. A systems-based approach to support important surveillance tasks is appealing. Yasnoff et al. [6] highlight the importance of fruitful collaborations among researchers and practitioners in public health and information systems. We designed and implemented BioPortal [7], a Web-based system that supports convenient access to distributed, cross-jurisdictional health data about several infectious diseases that include WNV, FMD, and Botulism. Specifically, BioPortal supports seamless data integration across different system platforms, contains advanced spatiotemporal data analysis functionalities, and has intuitive, effective visualization capabilities. Preliminary results show encouraging effectiveness of BioPortal, which however needs to be further assessed systematically and methodologically.

In this paper, we report two empirical evaluation studies of BioPortal that focus on outcome, task performance efficiency, user information satisfaction, and system usability. The first study is a controlled experiment that involves 33 graduate students and includes a prevalent spreadsheet-based system for benchmark purposes. The second study is a field evaluation that includes 3 experienced public health professionals affiliated with the State Health Services department in the United States. Overall, our results suggest that the use of BioPortal can improve users' surveillance performance measured by analysis accuracy and efficiency (i.e., the amount of time required to complete an analysis task). Our subjects are highly satisfied with the information support of BioPortal and consider it reasonably usable. Our findings show the effectiveness and value of BioPortal and, at the same time, shed light on several areas where its design can further improve.

2 An Overview of BioPortal

BioPortal is loosely coupled with state public health information systems in California and New York. Each source system transmits WNV and/or botulism related data through secure links to BioPortal using mutually agreed upon protocols. Architecturally, BioPortal is comprised of a Web portal, an internal data store, and a communication backbone. The Web portal provides the necessary user interfaces and allows users to search or query infectious disease–related data sets, visualize these data and analysis results in an intuitive spatiotemporal fashion, perform analysis tasks using built-in analytical models and functions, and identify alerts that signal the development or emergence of "hot spots."

HL7 standards are used as the main storage format to support the necessary data interoperability. All participating agencies transmit data to BioPortal as HL7-compliant XML messages through a secured network connection. HL7 XML-based standards are more advantageous than alternative methods that demand the internal data store to consolidate and maintain the data fields in the respective data sets and sources, hereby offering greater system scalability and extensibility. The communication backbone supports secure data exchanges between BioPortal and each data source. This backbone is built upon widely recognized national standards and provides the necessary modeling and ontological support. Overall, the communication backbone provides data transmission, receiving, and verification functions, together with source-specific data normalization and data security services (using robust encryption technologies). Currently, BioPortal houses several data sets, summarized in Table 1.

Table 1. Infectious disease data sets in BioPortal

Disease	Related data sets
WNV	• Human (NY, CA ’03); captive animal (NY ’03); • Bird sightings (NY ’01-’03, CA ’03, USGS ’99-’03); • Mosquito pool (NY ’03, CA ’00); mosquito treatment (CA ’04) • Chicken sera (CA ’03)
Botulism	• Adult (NY, CA ’01-’02); infant botulism (national ’04); • Avian botulism (USGS ’99-’03)
FMD	• Middle Eastern countries (Iran ’87-’03, Iraq ’85-’02, Afghanistan ’96-’03, Pakistan ’85-’03, Turkey ’85-’03); South America (Argentina ’01)

BioPortal includes spatial temporal visualizer (STV), an advanced visualization module that allows users to explore infectious disease data and examine query results in an intuitive and easily comprehensible manner. STV allows users to load and save spatiotemporal data dynamically for real-time information sharing or further analyses. STV supports several integrated and synchronized views that include periodic, timeline, and GIS. Periodic views enable users to identify prominent periodic temporal patterns. Timeline views provide two-dimensional timelines, together with a hierarchical display of the essential data elements organized in tree structure. GIS views display the reported cases together with their geographic locations on a map.

3 A Controlled Experiment Study

We adopted a randomized, two between-groups design of which the factors are system and general public health knowledge, each defined at two levels (i.e., BioPortal vs. a benchmark system, and low versus high general public health knowledge). Our design supported direct comparisons between BioPortal and the benchmark system and, at the same time, allowed examination of the effect of domain knowledge and its combined impact with the system used. Our subjects were graduate students from the business school or the public health school at a major research university located in the United States. Our subjects participated in the study voluntarily and differed considerably in general public health knowledge; i.e., high for public health students and low for business school students. Each subject was randomly assigned to use BioPortal or the benchmark system, but not both. We were mindful of maintaining a balance in the subject–technology assignment. We administered the experiment to subjects individually or in small groups of two or three.

To assess the outcome associated with the use of a system, we, with the assistance of several experienced public health researchers and professionals, created six analysis scenarios and designed a total of 11 tasks that ranged from simplistic frequency counts to complex trend detection or pattern identification. In Appendix A, we list the analysis scenarios and tasks used in the experiment. We examined task analysis accuracy using a "gold-standard" approach. The experts assisting in the task designs generated a gold-standard analysis result for each task included in the experiment. We measured the accuracy of a subject's analysis of a task on a 10-point scale, with 1 representing "completely incorrect" and 10 denoting "completely correct." We assigned a score of 1 to incomplete tasks. We also assessed task performance efficiency using the amount of time a subject took to complete an analysis task. Our study design administered a 50-minute time constraint, which is considered appropriate according to the results of a pilot study [8]. We explicitly informed each subject of this time constraint before he or she started the experiment tasks.

User satisfaction is fundamental to system evaluation [9]. Specifically, we examined user information satisfaction [10] which emphasizes the user's information requirements. The choice of our focus was made on the basis of the distinct importance of information support to public health professionals. In our study, user information satisfaction refers to the degree to which a user believes a system can satisfactorily meet his or her information needs for an analysis task. We adapted previously validated items to measure user information satisfaction, on the basis of a 7-point Likert scale with 1 being "strongly disagree" and 7 being "strongly agree." We assessed system usability using the QUIS [11], a common instrument that has been widely used in various information systems. The usability of each investigated system is evaluated in terms of a user's overall reaction to the system, his or her assessment of the screen layout and sequence, terminology and system information, system learnability, and system capabilities. Each usability dimension was measured by multiple items, on the basis of a nine-point Likert scale.[1] We used a scripted document to inform all subjects explicitly of the study's purpose, experimental procedure, and our analysis and management of the data to be collected in the experiment. We specifically addressed concerns about information privacy and ensure that we would perform data analyses at an aggregate level, not in any personally identifiable manner.

The hypotheses tested in the experiment are as follow:

H1: The outcome accuracy resulting from the use of BioPortal is significantly greater than that associated with the benchmark system.

H2: The amount of time a subject needs to complete an analysis task is significantly less when supported by BioPortal than by the benchmark system.

H3: The user information satisfaction associated with the use of BioPortal is significantly higher than that observed with the benchmark system.

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[1] Details of the scale used in QUIS are available in [11]. In general, lower scores represent more favorable usability assessments (e.g., easy, wonderful, clear) than higher scores (e.g., difficult, terrible, confusing), with 1 being the most favorable and 9 being the most unfavorable.

H4: Users are likely to consider BioPortal more usable than the benchmark system and assign higher usability scores for their overall reactions to the system, screen layout and sequence, terminology and system information, system learnability, and system capabilities.

4 A Field Evaluation Study

We conducted a field evaluation that involved experienced public health professionals. The objective of this study was to evaluate BioPortal by involving public health professionals in their work context. With the assistance of several domain experts, we designed analysis scenarios and tasks to mimic the surveillance tasks common to public health professionals. Our field study also focused on analysis accuracy, task performance efficiency, user information satisfaction, and system usability, using the same measurements from the controlled experiment described previously.

We also collected subjects' qualitative assessments of BioPortal, using the following semi-structural questions: "Does BioPortal provide sufficient query criteria or support (e.g., different ways to query)? If not, what additional query criteria or support should be included?"; "How useful are aggregated views? In what particular ways do such views help your performing an analysis or problem solving task?"; "How useful is the GIS tool? How can it be improved to better support your performing analysis or problem-solving tasks?"; and "How useful is the Timeslider? Please list 2 or 3 important ways in which this tool is helpful to your analysis or problem solving." We also used questions adapted from [12] to assess subjects' intentions for using BioPortal in their work contexts. The specific analysis scenarios and tasks used in the field study are listed in Appendix B.

5 Results and Discussion

5.1 Controlled Experiment Results

Our controlled experiment had 33 subjects, 17 using BioPortal and 16 using the spreadsheet system. In the BioPortal group, 9 subjects were public health students and the remaining 8 subjects were from the business school. In the spreadsheet system group, 7 subjects were public health students and the remaining 9 subjects were from the business school. We had 20 male subjects and 13 female subjects; our subjects have comparable demographic characteristics (including age and education) and are similar in general computer efficacy and Internet usage.

Analysis Accuracy: We used the corresponding gold-standard result to evaluate the accuracy of each analysis task performed by each subject. We aggregated the analysis accuracy for a subject across all the experiment tasks he or she performed and used the resulting accuracy to test the hypothesized effect of technology.[2] As we show in Table 2, our analysis demonstrated that technology has a significant effect on analysis accuracy. Specifically, the accuracy associated with BioPortal (mean = 81.94, SD = 21.23) was greater than that of the spreadsheet program (mean = 61.19, SD = 17.92), and the difference was significant at the 0.01 level. Thus, our data supported H1; i.e., the outcome accuracy resulting from the use of BioPortal would be significantly greater than that associated with the benchmark system.

Table 2. Analysis of effects on analysis accuracy

Source	DF	Type III SS	Mean Square	F-Value	P-Value
Domain knowledge	1	1,165.43	1,165.43	3.12	0.08
Technology	1	3,173.12	3,173.12	8.51	0.00
Domain knowledge x Technology	1	28.54	28.54	0.08	0.78

Task Performance Efficiency: We examined task performance efficiency using the amount of time a subject needed to complete an analysis task. As shown in Table 3, technology has a significant effect on the amount of time a subject needed to complete a task (p-value < 0.01). On average, subjects who used BioPortal could complete a task considerably faster (mean = 36.28 minutes, SD = 11.33 minutes) than their counterparts supported by the spreadsheet program (mean = 48.23 minutes, SD = 5.07 minutes); the difference was significant at the 0.01 level.[3] Thus, our data supported H2; i.e., the amount of time a subject needs to complete an analysis task would be significantly less when using BioPortal than using the benchmark system.

Table 3. Analysis of effects on task completion efficiency

Source	DF	Type III SS	Mean Square	F-Value	P-Value
Domain knowledge	1	673,239.59	673,239.59	2.43	0.13
Technology	1	4,395,727.04	4,395,727.04	15.84	0.00
Domain knowledge x Technology	1	344,002.34	344,002.34	1.24	0.27

User Information Satisfaction: According to our analysis, technology has a significant effect on user information satisfaction (p-value < 0.01). As shown in Table 4, subjects using BioPortal exhibited higher satisfaction with the information support

[2] When aggregating the analysis accuracy of a subject across experimental tasks, we assigned an accuracy score of 1 to each incomplete task. Our rationale is that an incomplete analysis, from a grading perspective, is not any better than one that is completely incorrect, particularly with regard to the corresponding gold-standard solutions in the assessment.

[3] For a task not completed within the specified time limit, we used 50 minutes as the time requirement. In light of the much lower task completion rate associated with the spreadsheet program, the actual time requirement difference between the investigated systems may be greater than that reported herein (which is already prominent and significant statistically).

(mean = 2.34, SD = 1.02) than their counterparts supported by the spreadsheet program (mean = 3.68, SD = 1.23); the difference was significant at the 0.01 level. Thus, our data supported H3; i.e., the user information satisfaction associated with the use of BioPortal would be significantly higher than that observed with the benchmark system.

Table 4. Analysis of effects on user information satisfaction

Source	DF	Type III SS	Mean Square	F-Value	P-Value
Domain knowledge	1	0.80	0.80	0.68	0.42
Technology	1	13.38	13.38	11.48	0.00
Domain knowledge x Technology	1	5.08	5.08	4.36	0.05

System Usability: According to our analysis, technology has a significant main effect on both overall reactions to the system (p-value < 0.01) and system capabilities (p-value < 0.05) but not on screen layout and sequence or terminology and system information. The effect on system learnability is somewhat significant statistically, as suggested by a p-value between 0.05 and 0.10. Overall, our subjects considered BioPortal generally usable and recognized its utilities for supporting their analysis tasks. However, the evaluation results indicated that the design of BioPortal may need improvement in its screen layout and sequence, as well as its language in terms of clarity and user friendliness. Our subjects considered learning to use BioPortal not particularly difficult, but its learnability could be enhanced further. Overall, our evaluation results suggested that BioPortal arguably is more usable than the spreadsheet program in most, but not all, the fundamental usability dimensions. Thus, our data partially supported H4; i.e., user would be likely to consider BioPortal more usable than the benchmark system and assign higher usability scores for their overall reactions to the system, screen layout and sequence, terminology and system information, system learnability, and system capabilities.

5.2 Field Evaluation Results

A total of three public health professionals took part in our study voluntarily (one female and two males). Our subjects were between 31 and 36 years old and had doctoral degrees in public health (or related disciplines). Our subjects self-reported reasonable general computer efficacy and used the Internet on a frequent and routine basis. Each subject was knowledgeable about epidemiological practice and showed great confidence in analyzing and interpreting data about different infectious diseases or epidemic outbreaks.

As a group, our subjects showed satisfactory analysis accuracy, scoring an average of 1.91 on a 2-point scale (2 = completely correct; 1 = partially correct; 0 = incorrect). On average, the subjects were able to complete all analysis tasks in one hour and twelve minutes (SD = 11.67), which, according to our subjects, was noticeably shorter than that commonly needed to complete their analysis tasks using existing systems. Analysis of our subjects' evaluative responses suggested high user information satisfaction; i.e., mean = 5.78 and SD = 1.12 on a seven-point Likert scale, with 7 being “strong agree.” Our subjects exhibited high intentions for using BioPortal in their work context; i.e., mean = 6.0 and SD = 1.24 on a seven-point Likert scale, with 7 being “strong agree.” Table 5 summarizes the results of subjects’ user information satisfaction and their intentions for using BioPortal in their work contexts.

Table 5. Summary of user information satisfaction and intention for using BioPortal

Measurement item	Mean	S.D.
User Information Satisfaction (UIS)	*5.78*	*1.12*
UIS-1: BioPortal offers valuable utility in my analysis of public health problems or trends.	6.25	0.96
UIS-2: I can understand the functions of BioPortal.	6.25	0.96
UIS-3: Using BioPortal can quickly generate the analysis results that I need.	6.00	0.82
UIS-4: The analysis results by BioPortal are reliable.	4.25	1.53
UIS-5: The visualization designs of BioPortal are good.	6.50	1.00
UIS-6: In general, I am satisfied with the response time of BioPortal.	6.50	0.58
UIS-7: Overall, I find the results generated by BioPortal to be relevant to my analysis of public health problems or trends.	6.25	0.96
UIS-8: The analysis results by BioPortal are accurate.	4.25	1.53
UIS-9: Overall, I have good control over using BioPortal to complete an analysis task.	5.75	0.96
UIS-10: BioPortal is flexible in supporting different analysis tasks in public health.	5.75	1.90
Intention to Use BioPortal	*6.00*	*1.24*
BI-1: When I have access to BioPortal, I would use it as often as needed.	6.00	1.41
BI-2: To the extent possible, I intend to use BioPortal in my job.	6.00	1.15
BI-3: Whenever possible, I would use BioPortal for my tasks.	6.00	1.15

The qualitative assessments of BioPortal were mostly positive. One subject commented, “Capability of BioPortal is huge–could link to state data and would have a great foundation. Serotypes also useful for linking cases epidemiologically.” According to our subjects, BioPortal has adequate design and is easy to use. One subject pointed out that “design is one of its strengths – very intuitive and user friendly.” Another subject noted that “BioPortal is a little easier to use than existing syndromic surveillance systems.” The subjects were particularly fond of the spatial temporal visualizer in BioPortal. As one subject commented, “The GIS thing is big! Especially West Nile virus is big in [our] County – [we] would like to be able to look at the geographic spread. This could influence mosquito intervention, and see movement over time, when cases stop and/or pop up somewhere else. Would also be good for rabies.” Similarly, the other two subjects also had positive feedback, commenting that “Just being able to pick a time period (for example, one week) and see how it unfolds. Also seeing the faded out cases very helpful," and that "Aggregated views are good for overall picture of data and for answering specific questions by choosing 2x2 table variables," respectively. Our subjects particularly liked the built-in hot spot analysis in BioPortal, commenting that "Hotspot analysis is instrumental to what this user does everyday – the job function is to detect any health event in the community before diagnoses;" and that "The hotspot analysis tool embedded in STV is very useful. When user clicked a mock data set, it went straight to STV, then used the tool to pick SatScan and parameters. Would be easier to use that way to change baseline."

Our subjects in general considered BioPortal reasonably usable, as manifested by a mean of 2.42 in overall reactions towards the system (SD = 1.40) (Table 6).

Table 6. Summary of BioPortal usability evaluation results

Measurement Item	Mean	S.D.
A. Overall Reactions towards the System	*2.42*	*1.40*
(wonderful/terrible)	2.50	1.29
(satisfying/frustrating)	3.25	1.89
(stimulating/dull)	1.75	0.96
(easy/difficult)	2.50	1.73
(adequate utility/inadequate utility)	2.25	1.26
(flexible/rigid)	2.25	1.26
B. Screen Layout and Sequence of System	*1.94*	*0.75*
Characters on the computer screen	2.50	0.58
Visual design of the screen simplifies task	1.75	0.50
Organization of information on screen	1.75	0.96
Sequence of screens	1.75	0.96
C. Terminology and System Information	*2.00*	*1.16*
Use of terms throughout system	2.00	1.15
Terminology presented on the interface is related to the "analysis task"	2.25	1.26
Position of messages on screen	1.50	0.58
Messages on screen which prompt user for input	1.50	0.58
Computer keeps you informed about what it is doing	2.75	2.22
D. Learning to use the System	*3.08*	*2.42*
Learning to operate the system	2.50	2.38
Exploring new features by trial and error	2.75	1.50
Remembering commands or making menu choices for performing searches and new analyses	2.50	2.38
Tasks can be performed in a straight-forward manner	3.25	2.63
System-provided help messages or instructions	4.25	3.40
Readability of system-provided instructions or online help	3.25	2.22
E. Capabilities of the System	*1.95*	*1.24*
System speed	1.50	0.58
System reliability	1.25	0.50
System tends to be	2.00	1.41
Correcting mistakes is	1.50	0.58
Experienced and inexperienced users' needs are taken into consideration	3.50	3.11

According to our analysis, BioPortal seems to be more usable in terms of screen layout and sequencing, system capabilities, and terminology and system information than in learning to use the system which represents one where the design of BioPortal needs to improve. In particular, built-in instructions need further improvement, as suggested by the subjects' lukewarm responses to "system-provided help messages or instructions" and "readability of system-provided instructions or online help."

6 Summary

We conducted two empirical studies to evaluate the outcome, task performance efficiency, user information satisfaction, and usability associated with BioPortal. Overall, our results were encouraging and suggested BioPortal can enhance public health professionals' surveillance of infectious disease or epidemic outbreak in terms of analysis accuracy and time requirements. Our findings show subjects exhibiting high user information satisfaction when supported by BioPortal. In addition, BioPortal appeared reasonably usable but its built-in instructions need to improve in order to better guide public health professionals to use the system to complete their analysis tasks. Our future research plans include performing field studies to evaluate the outcome and user impacts of BioPortal in real-world public health settings, and examine its acceptance by public health professionals and researchers using a large-scale survey study.

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Appendix A: Listing of Analysis Scenarios and Tasks Used in the Experiment

Scenario 1: Examine data related to WNV.
- Task 1: In 2002, which county in New York had the highest dead bird count?
- Task 2: Of the three listed bird species, Bluejay, Crow and House Sparrow, which had the highest number of positive cases of West Nile Virus?

Scenario 2: Examine a correlation between Botulism and gender.
- Task 3: In California, for year 2001, did more men or more women suffer from Botulism?
- Task 4: In California, for year 2002, did more men or more women suffer from Botulism?

Scenario 3: Determine the occurrence of Foot-and-Mouth disease in 2001 for three countries.
- Task 5: In 2001, in which week(s) do the highest number of Foot and Mouth Disease cases occur in Iran?
- Task 6: In 2001, in which week(s) do the highest number of Foot and Mouth Disease cases occur in Turkey?
- Task 7: In 2001, in which week(s) do the highest number of Foot and Mouth Disease cases occur in Argentina?

Scenario 4: Determine the location of the most intensive outbreak of WNV during 1999 in New York.
- Task 8: During 1999, where (in which county) and when did the most intensive occurrence (i.e., highest number of cases) of West Nile Virus happen in New York State?

Scenario 5: Describe the spread (geographically and over time) of dead crow sightings for New York in 2002.
- Task 9: Please describe the spread (geographically and over time) of dead crow sightings in New York in 2002.

Scenario 6: Determine correlations between the incidence of WNV and dead bird occurrences and mosquito pool counts.

- Task 10: Using the BioPortal system or the spreadsheets, as assigned, to investigate West Nile Virus disease can you determine if, during 2002, there is a correlation between the dead bird occurrences and mosquito pool counts?
- Task 11: (Continued with Task 10) If so, what correlation do you observe?

Appendix B: Listing of Analysis Scenarios and Tasks Used in the Field Evaluation Study

Scenario 1: BioPortal Website Functionalities

This scenario will focus on the use of the BioPortal website. In this scenario, the user is asked to provide characteristics of the target dataset. These characteristics include:

- the number of cases with certain syndromes within a time period
- the date of the first case of a certain syndrome
- detailed case information

In this scenario, the user will make use of the following BioPortal functionalities: query, case detail display, aggregate view and advanced query.

Dataset: Scottsdale Health Center Chief Complaint

- Task 1: Describe the number of positive cases in the current dataset:
- Task 2: Find the time coverage (first and last case dates) in this dataset
- Date of first case: _________; Date of last case: _________
- Task 3: Identify the week with the highest number of cases.
- Task 4: Identify how many female patients with GI syndrome can be found within this dataset.
- Task 5: Identify the patient ID of the first patient with Botulism syndrome within the given dataset.
- Task 6: For the female patients in the age group 30-39, identify the top three syndromes besides “unknown”:

Scenario 2: Spatial-Temporal Visualizer (STV)

This scenario, presented in two parts, will focus on the use of the STV tool to visually inspect the data distribution in both space and time. The user will be asked to identify information such as the peak number of cases, the area with the highest number of cases, and temporal and spatial distribution trends. The user will make use of the following tools provided in STV: Time Slider, GeoMap, Periodic Pattern Tool, Histogram and Timeline Tool.

Scenario 2-A

Dataset: User Study Test Dataset 1

- Task 1: Start STV with the User Study Test Dataset 1 and zip code boundary, isolate Botulism cases (by removing other syndromes from the map), and then identify the day of week with the most Botulism cases during the time period.
- Task 2: View the case distribution in Histogram tool and describe the temporal distribution.

- Task 3: Examine the spatial distribution using moving time window and expanding time window techniques and describe the spatial movement trend of Botulism cases.

Scenario 2-B

Dataset: Mesa Fire Department EMS data

- Task 1: Start STV with Mesa EMS data (between 9/1 2006 and 9/30 2006) and zip code boundary, change the color of categories with similar colors to avoid ambiguity, and then identify the hours of the most Trauma cases.
- Task 2: Identify the zip codes with the most Tox/Poison cases.
- Task 3: Identify the address of the youngest Cardio-Respiratory case in the Apache Junction Area (the most east zip code).
- Task 4: Isolate the Apache Junction area and identify the day of week with the most General Medicine cases:

Scenario 3: Hotspot Analysis

This scenario will target the use of the Hotspot Analysis tool embedded in the STV. The users will have 2 or 3 simulated datasets to evaluate. For each dataset, the user will be asked to identify outbreaks and investigate case details using STV.

Datasets: Under User Study Page (in our simulation process, the first 15-22 days are the made to be baseline data).

- Task 1: Regarding 167 Regarding Hemo syndrome cases with 1 injected outbreak, describe the outbreak you discovered.
- Task 2: Regarding 300 GI syndrome cases with 1 short term outbreak, describe the outbreak you discovered.