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# Applying Data Science to Justice Systems: The North Carolina Statewide Warrant Repository (NCAWARE)

## Draft Final Report

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# Table of Contents

# Appendices

# Tables

# Figures

# Executive Summary

This report describes a 3-year project that tested the efficacy of providing prioritized warrant lists to patrol officers. The expectation was that officers would use this information to better identify people with outstanding warrants that should be served during the proactive time available while on routine patrol. The field experiment was carried out in the Greensboro (North Carolina) Police Department (GPD). Warrant risk profiles were calculated from historical offense data provided by the North Carolina Administrative Office of the Courts (NCAOC). Predictive models were run to identify person-level characteristics that were associated with offending after a warrant was issued. The following predictive features were incorporated into the field experiment: misdemeanor charges and convictions, felony charges and convictions, violent charges and convictions, and age.

These historical risk factors were used to implement prospective risk assessment for warrants issued during the field experiment. A web-based system (WOMBAT) was developed to support data entry and dissemination of prioritized warrant information to officers in the field. On a daily basis, WOMBAT received an update on warrant information from the North Carolina Statewide Warrant Repository (NCAWARE). WOMBAT parsed the updates to existing warrants and identified all newly issued warrants and new people with warrants. Random assignment to treatment or control condition occurred at the person level. New people with warrants were flagged for review by a GPD representative who allocated the warrant to one of four GPD districts. The GPD system manager also queried and coded in criminal history data for each person with a warrant in order to produce the risk score.

Officers accessed the prioritized warrant list through a separate section of WOMBAT. They were provided with a map of active warrants (a novel view not available through any existing system), warrant information, and prioritization scores. The impact of WOMBAT was evaluated through a randomized control trial. People with warrants were randomly assigned to treatment or control condition, where the control cases were suppressed from the officer view. GPD has four districts; the main experiment was conducted in Districts 1 and 4. At the request of GPD, we brought Districts 2 and 3 online toward the end of the experiment, but our analysis focuses on Districts 1 and 4.

A variety of analyses were performed to establish (1) the effectiveness of the random assignment; (2) the impact of WOMBAT on warrant service in terms of volume, speed, and riskiness; and (3) potential tradeoffs between warrant service and other proactive activity. Results of the experiment were mixed, but generally suggest that the prioritization was not effective in promoting additional warrant service activity. Additionally, comparison of warrants served in the treatment and control groups found no difference in the risk scores of people served. However, a pre/during assessment of time to warrant service suggests that warrants were served more quickly during the experimental period, compared to the

year prior to the experiment. The process evaluation found that patrol officers and supervisors did not perceive warrant service to be a priority for their unallocated time.

The project identified considerable challenges with improving warrant service. Outside of officer availability, officers must also contend with inaccurate address information that reduces service efficiency. Officers must check multiple systems for actions such as verifying the warrant or looking up current contact information. Results suggests that more could be done to integrate disparate data systems and provide officers with a more cohesive view of warrants. However, even if technical challenges were addressed, there are substantial organizational barriers that would likely limit the ability to increase warrant service attempts by patrol units.

# 1. Purpose

Warrants have been a persistent challenge for law enforcement agencies (LEAs). In practice, the volume of new warrants issued every day quickly leads to a considerable backlog. Relatively few warrants are for serious violent or property crimes. Warrants for these serious events are often served by specialized units within LEAs. That leaves the service of the majority of warrants, typically for minor offenses or violations of court orders, at the discretion of patrol officers. Unfortunately, agencies have little research from which they can draw from to prioritize which warrants should be served.

This report documents a multi-year development, implementation, and evaluation of a warrant prioritization framework. Almost four years of historical criminal history data were used to identify the risk and protective factors of individuals being rearrested for an offense after a warrant was issued. This risk profile information was implemented in the field through a web-based dashboard that collected criminal history data for risk scoring, generated prioritized warrant lists, and facilitated a field experiment exploring the utility of this approach.

This project was carried out by RTI International. The field research was conducted in cooperation with the Greensboro (North Carolina) Police Department (GPD). The North Carolina Administrative Office of the Courts (NCAOC) facilitated the project by providing historical warrant and criminal history data, along with documentation needed to conduct analyses. Researchers at the Police Executive Research Forum (PERF) conducted the process evaluation, which included interviews and focus groups with patrol officers and command staff.

# 2. Project Subjects

We conducted the warrant prioritization intervention in cooperation with the GPD. The GPD is a large municipal law enforcement agency with staffing in excess of 650 sworn officers. The subjects of the intervention were people residing in Greensboro with outstanding warrants, GPD officers that were responsible for serving warrants, and GPD command staff that participated in project implementation and process evaluation.

# 3. Project Design and Methods

This was a multiphase project including (1) analysis of historical data to determine risk and protective factors associated with new offending after a warrant was issued, (2) a field experiment testing the implementation of a web-based platform for patrol officers that prioritized warrants for service, and (3) a process evaluation to assess warrant service and the changes brought about through warrant prioritization.

The project was guided by the research questions in Table 1. Questions addressed two primary areas of inquiry. First, did warrant prioritization reduce time between warrant issuance and warrant service? Because this research was conducted as an RCT, we evaluate this question two ways. Comparisons can be made at the warrant level by treatment versus control assignment. Alternatively, we can take advantage of the historical data to do pre/during comparisons before and during the experimental period.

Second, did the agency-level focus on serving outstanding warrants reduce other kinds of proactive activities? Patrol officers have a finite amount of time to engage in proactive policing. Increasing focus on warrant service may have reduced availability to conduct activity such as traffic stops. We explore the impact of implementing warrant prioritization on other officer activity.[1,2]

Table 1: Research Questions

| | |
|---|---|
| **Impact of Warrant Service** | |
| Time to Service | R1a. Are people with warrants assigned to the treatment condition served more quickly than people assigned to the control condition?<br>R1b. Are people with warrants with a higher priority score served more quickly than people with warrants with a lower priority score?<br>R2. Has the time between warrant issuance and warrant service decreased after implementation of WOMBAT? |
| Number of Warrants Served | R3. Are people with warrants assigned to treatment more likely to be served than people with warrants assigned to control?<br>R4. Has the number of warrants served increased after the implementation of WOMBAT? |
| Score of Warrants Served | R5. Was the average risk score of warrants served higher for persons assigned to treatment versus persons assigned to control? |
| **Impact on Proactive Self-Initiated Officer Activity** | |
| Traffic Stops and Self-Initiated Activity | R6. Did implementation of WOMBAT reduce proactive police patrol activities such as (a) traffic stops or (b) other self-initiated activity?[a] |

[a] GPD call records do not allow easy identification of calls that are both proactive *and* self-initiated. We describe this challenge in Appendix E.

[1] Our original intention was to understand a range of self-initiated proactive activity such as directed patrols and pedestrian stops. However, the details available about these events in GPD's records management system did not allow for that type of classification. More information is provided in Appendix E.

[2] An additional question around the impact of warrant service on crime was also considered. However, as discussed in other sections, we saw no significant impact on officer warrant service behavior. As such, there was no reason to think that this work would have had an impact on crime.

Approval from RTI's institutional review board (IRB) was achieved in stages. Approval for Phase I (access and analysis of the NCAWARE data) was obtained June 2016. Approval for Phase II (field experiment) was obtained June 2018, and a modification to include additional officers in Districts 2 and 3 was approved June 2019. Phase III (process evaluation) was approved August 2019.

## 3.1 Phase I – Risk Prediction

Historical criminal history data were provided by the NCAOC. These data were used to identify risk and protective factors for new arrests after a warrant was issued. Rather than use the raw criminal history database, NCAOC provided RTI with an extract of data from NCAWARE. The main benefit of using the NCAWARE extract was the availability of record-level identifiers that linked events to individuals. This identifier grouped warrants and criminal history events to a single unique person record.

After data cleaning (which included removing duplicate records), the analysis dataset contained 341,950 warrants corresponding to 248,398 individuals issued between January 1, 2013 and October 15, 2016. The criminal history of each person with a warrant was then appended.

For the classification task a gradient boosted trees algorithm was used to predict the outcome. For its flexibility, we used the XGBoost python package (xgboost 0.6a2). Six time frames were used to summarize criminal history information (counts of last 6-month, one year, two-year, five-year, ten-year, all-time) for six variables: counts of charges and convictions for misdemeanors, felonies, and violent crimes. To determine which time range of variables was most predictive of the outcome, models were created with each time-frame subset of variables and evaluated using cross-validation with the Area Under the Receiver Operating Characteristic (AUCROC) curve. Using all criminal history available provided the most accurate model and that subset of variables were used in the final model. A practical benefit of this approach is that using all history information is the easiest for records staff to input into the model.

Gradient Boosted Tree models do not have intuitive variable explanations compared with other modeling approaches like logistic regression. To a large extent, the models operate as a black box with little oversight by the researcher. However, we calculated relative feature importance, and conducted post-hoc interpretive techniques to understand how the model made predictions.

For the field experiment, rather than display the raw output of the predictive model, predictions were converted to a risk score. The risk score was the percentile of that predicted value out of all predicted values on the full model. For example, the model may output a predicted probability of 0.11, a score that is lower than 97% of all output predicted values. Thus, their risk score would be 3 (representing the 3rd percentile of all output

scores). These percentile-based risk scores were displayed for users as part of the field experiment. More information on the predictive models used to develop the risk scoring can be found in Appendix A.

## 3.2 Phase II – Field Experiment

The impact of risk predictions on warrant service operations was tested in a field experiment with GPD. To support the experiment, a web-based tool (WOMBAT) was developed to serve four main purposes: (1) access and process daily warrant updates from NCAWARE, (2) assign people with warrants to treatment or control conditions, (3) serve as a place for entering data needed for risk scoring, and (4) communicate prioritized warrant information to patrol officers in the field. Screenshots of WOMBAT management and officer views are provided in Appendix B.

The field experiment was conducted from March 01, 2019 through July 31, 2019. From March 01 through June 02, the experiment was conducted in two of four GPD districts (Districts 1 and 4). On June 03, the remaining districts (Districts 2 and 3) were brought into the experiment.

Deployment within the districts was conducted in stages as officer training opportunities became available.[3] Training of patrol officers and their first-line supervisors was conducted by patrol squad by a GPD captain. Training was done in person during their routine start-of-week briefings. The training demonstrated the WOMBAT platform and explained expectations for officer data entry during warrant service. Training typically took less than 30 minutes.

The development and deployment of WOMBAT altered not only data availability to officers but also the agencies' communication of the importance of warrant service. Agency executive staff sought to encourage patrol officers to increase attempted and completed warrant service activity. Throughout the duration of the experiment, officers were periodically prompted to conduct warrant service through email. To facilitate this action, approximately 60 days into the field experiment, a warrant service report was developed and incorporated into WOMBAT. The report provided information on the number of warrants served by patrol squad and the number of warrant attempts recorded in WOMBAT. An example of this report can be found in Appendix A. These reports were sent by the GPD captain to patrol supervisor.

[3] The application was available to officers prior to training, but information on how to access the system was provided during the training. If officers learned about the system from colleagues on other squads, they were able to access the tool. This accessibility only applied to the first 3 months of the experiment when access was limited to Districts 1 and 4. During this time, information on Districts 2 and 3 were not made available in WOMBAT. The training schedule can be found in Appendix C.

### *3.2.1 Criminal History Data and Risk Scoring*

Producing risk scores for people with warrants was a two-step process. A representative of the GPD entered criminal history data in WOMBAT. Information used in the risk scoring included misdemeanor charges and convictions, felony charges and convictions, and charges and convictions that included a violent offense. These data were retrieved from CJLEADS[4] by a GPD representative and manually keyed into WOMBAT. Once these data were entered, WOMBAT used predefined risk predictions identified in Phase I to calculate a risk score. These scores were assigned to a person-level record (as opposed to being assigned at a warrant or case level).[5]

### *3.2.2 Treatment and Control Assignment*

Consistent with best practices in experimental research, the decision on randomization to treatment or control was made systematically and automatically in WOMBAT without intervention from project or GPD personnel. Randomization to treatment or control condition was made at the person level. Randomization was conducted after the record's address was geocoded but prior to the entry of criminal history data and risk scoring. After geocoding, a record was assigned a random number (generated by the Python function *randint*[6]) between 1 and 100. If their random number was 50 or less, they were assigned into the control group. If the number was 51 and above, they were assigned into treatment.

## 3.3 Phase III – Process Evaluation

The process evaluation was designed to assess how the implementation of WOMBAT affected officers' work. The structure of this project made it impossible to disentangle the impact of different project components. For example, the WOMBAT platform provided information on risk of reoffending for each warrant but also provided warrant data in a spatially referenced map. The process evaluation sought to better understand which parts of the WOMBAT platform were relevant to agency operations.

Interviews and focus groups were conducted over 2 days in July 2019. Discussions were conducted with (1) officers who had used WOMBAT; (2) officers who had not used WOMBAT; (3) patrol supervisors of squads who had some use of WOMBAT; (4) patrol

[4] CJLEADS is North Carolina's centralized repository for information about offenders. Of relevance to the current study, CJLEADS provides law enforcement agencies with access to consolidated state-level criminal history data. More information can be found at: https://it.nc.gov/cjleads.

[5] Data in NCAWARE can be organized into person-, warrant-, and case-level information. For the purposes of this analysis, we were interested in person- and warrant-level information. Randomization to treatment or control occurred at the person level. Analyses presented in this report are done at the person or warrant level, depending on the research question. The term "process" is a more general category of events from which warrants were identified. For consistency, we use the term warrants throughout.

[6] *Randint* is a function of the random python module. It generates a pseudo-random number using the Mersenne Twister random number generator. More information about random can be found at: https://docs.python.org/2/library/random.html.

supervisors with less use of WOMBAT; (5) a member of command staff; and (6) a data entry clerk responsible for entering criminal history data in WOMBAT and NCAWARE. Interviews and focus groups were conducted by a team composed of two representatives from PERF and one representative from RTI. A total of nine GPD personnel were involved in group or individual interviews. The discussion prompts are in Appendix D.

## 4. Data Analysis

Data analyses addressed four issues:

1. Random assignment to treatment or control conditions was made at the person level. The effectiveness of the random assignment in producing equivalency was checked by comparing the two groups on number of warrants, risk score, and demographics.
2. The impact of warrant prioritization on characteristics of warrant service such as time between warrant issuance and warrant service, number of warrants served, and the risk score of the warrant served. Analyses compared treatment and control during the experimental period and pre/during comparison using historical data.
3. Potential tradeoffs between warrant service and other officer activity were examined using regression models to examine changes in traffic stops, pedestrian stops, and directed patrols before and during the experimental period.
4. Results of the interview and focus groups were examined to assess the impact of warrant service and prioritization on patrol officers.

Details on the analytic strategy are presented in Table 2.

Table 2: Analysis Summary

| Characteristic | Source[a] | Comparison | Analysis | Time Period[b,c] | Periodicity | Unit of Analysis |
|---|---|---|---|---|---|---|
| Assessment of Randomness | | | | | | |
| Number of warrants per Persons | WOMBAT | Tx vs. Ctrl. | T-Test | Experimental Period | -- | Person |
| Average Risk Score | WOMBAT | Tx vs. Ctrl. | T-Test | Experimental Period | -- | Person |
| Demographics of Persons with Warrants | WOMBAT | Tx vs. Ctrl. | T-Test or Chi-Square | Experimental Period | -- | Person |
| Impact of Warrant Service | | | | | | |
| Number of Warrants Served, by Number of Outstanding Warrants | WOMBAT | Tx vs. Ctrl. | T-Test | Experimental Period | -- | Warrant |
| Number of Warrants Served per Person | WOMBAT | Tx vs. Ctrl. | T-Test | Experimental Period | -- | Warrant |

(continued)

Table 2: Analysis Summary (continued)

| Characteristic | Source[a] | Comparison | Analysis | Time Period[b,c] | Periodicity | Unit of Analysis |
|---|---|---|---|---|---|---|
| Time to Service | WOMBAT | Tx vs. Ctrl. | Survival Analysis | Experimental Period | -- | Warrant |
| Time to Service[f] | NCAWARE | Pre/During | Survival Analysis | Data Availability Period | -- | Warrant |
| Average risk score of warrants served | WOMBAT | Tx vs. Ctrl. | T-Test | Experimental Period | -- | Warrant |
| Number of Warrants Served by GPD[e] | NCAWARE | Pre/ During | Regression | Data Availability Period | Weekly | Warrant |
| Impact on Proactive Self-Initiated Officer Activity | | | | | | |
| Traffic Stops | CFS | Pre/During | Regression | 5+ years | Weekly | Incident |
| Other Activity[d] | CFS | Pre/During | Regression | 5+ years | Weekly | Incident |
| Process Evaluation | | | | | | |
| Effect of Warrant Prioritization, Platform Implementation | Interviews/ Focus Groups | N/A | Thematic | N/A | N/A | N/A |

[a] WOMBAT = Source is NCAWARE data that were processed by WOMBAT. CFS = Calls for service data provided by the GPD.

[b] Experimental Period was a 4-month field experiment period covering March–June 2019.

[c] Data Availability Period includes warrants with any change in status between January 1, 2018 and August 21, 2019.

[d] See Appendix E for a description of proactive self-initiated activity.

[e] All warrants served by GPD officers regardless of the assigned agency.

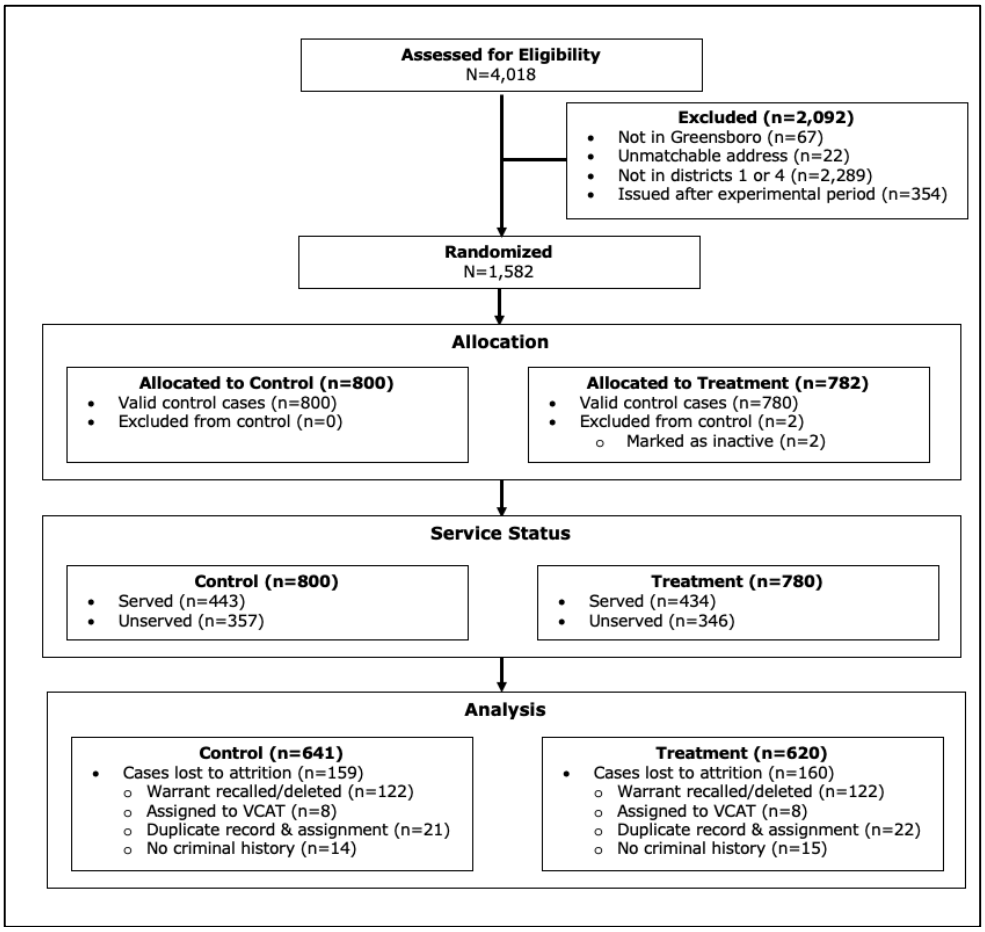
[f] Due to data availability, this analysis only includes warrants issued and accepted by GPD starting January 1, 2018. Warrants issued prior to this date were not available in the historic dataset we used to populate WOMBAT.

Consistent with best practices in experimental research, we provide a Consolidated Reporting of Trials (CONSORT) flow chart in Figure 1. Our unit of assignment to treatment or control condition was at the person level. Attrition was experienced at several steps in the process. The first losses came from assigning warrants to participating Greensboro districts. Non-Greensboro addresses, or bad addresses, were excluded from randomization. During the first 2 months of the field experiment, only Districts 1 and 4 were participating. Therefore, cases in Districts 2 and 3 were excluded. Once cases had been assigned to treatment or control, cases were marked as inactive or assigned to VCAT.[7] Either of these

[7] VCAT is the violent crime apprehension team responsible for service of high priority warrants. VCAT-assigned warrants were removed from the officer view because the GPD did not want patrol officers attempting to serve warrants that were being worked by VCAT.

manual updates, performed by the system administrator at GPD, would prevent the case from displaying in the officer view. Other exclusion criteria included warrant recalled or deleted, death of the person with the warrant,[8] out of jurisdiction,[9] or assigned to VCAT.[10]

Figure 1: CONSORT Flowchart




# 5. Findings

## 5.1 Assessment of Randomness

Analyses were conducted to determine if the random assignment protocol was effective at producing equivalent treatment and control groups along the following dimensions: number of warrants per person, risk score, age, race, and sex. Comparison between treatment and

[8] There was no systematic effort to identify the death of people with warrants. However, officers made notes about this when recording an attempted service in WOMBAT.
[9] Officers or management may mark a case out of jurisdiction if they had credible evidence that the person was no longer residing in Greensboro.
[10] We attempted to remove VCAT cases prior to making them available to patrol officers. However, the VCAT assignment was only determined after several weeks in the field. Additionally, a person may have been eligible because of existing warrants but removed from eligibility if a later VCAT-assigned warrant was issued.

control on the number of processes per person, risk score, and age were compared using t-tests. Sex and race were coded as categorical variables; evaluation of the significance between treatment and control groups was made using Pearson Chi-Square. Table 3 summarizes the results.

Table 3: Comparison of Treatment and Control Allocations

| Variable | Assignment | N | Mean | (SD) | t (p) |
|---|---|---|---|---|---|
| Number of processes per person | Control | 641 | 1.43 | 1.09 | 0.34 (.73) |
| | Treatment | 620 | 1.41 | 1.09 | |
| Average risk score | Control | 641 | 39.01 | 28.02 | -0.49 (.62) |
| | Treatment | 620 | 39.77 | 27.09 | |
| Age | Control | 637 | 33.26 | 11.96 | -1.98 (.05) |
| | Treatment | 619 | 34.64 | 12.83 | |
| Variable | Assignment | Group | N | % (Total) | Chi-square (p) |
| Race[a] | Control | Black | 464 | 37 | 0.79 (.67) |
| | | White | 139 | 11 | |
| | | Other | 38 | 3 | |
| | Treatment | Black | 439 | 35 | |
| | | White | 147 | 3 | |
| | | Other | 34 | 12 | |
| Sex[a] | Control | Female | 197 | 16 | 0.44 (.51) |
| | | Male | 444 | 35 | |
| | Treatment | Female | 179 | 14 | |
| | | Male | 441 | 35 | |

[a] Difference assessed using Pearson Chi-Square.

No statistically significant differences between treatment and control group were found in the number of processes per person ($t=0.34$, $p=.73$) or risk scores ($t=-0.49$, $p=.62$). There was a small but significant difference between age of people in control (mean=33.26) versus treatment (mean=34.64; $t=-1.98$, $p=.05$). No significant differences were found between treatment and control on race ($\chi2(2)=0.79$, $p=.67$) or sex ($\chi2(1)=0.44$, $p=.51$).

## 5.2 WOMBAT Activity

Within WOMBAT, officers were able to log information about attempted and successful warrant services. Additional fields allowed officers to share unstructured text content, such as information about the attempted service (e.g., the attempt was unsuccessful, but the person likely lived at that location) or about the address attached to the warrant (e.g., an

officer may receive information about an address where the wanted person was living). Table 4 contains information on the activity reported in WOMBAT.

Table 4: WOMBAT Activity

| Variable | Districts 1 & 4[a] | Districts 2 & 3[b] | Total |
|---|---|---|---|
| Attempted services | 44 | 17 | 61 |
| Successful Service | 12 | 2 | 14 |
| Notes[c] | 8 | 2 | 10 |

Note: Activity is reported based on district assignment of officer, not district assignment of the process.

[a] Count of activity covering the period March 01, 2019 through July 31, 2019.

[b] Count of activity covering the period June 03, 2019 through July 31, 2019.

[c] There were several opportunities for officers to enter free form text notes, including during reporting attempted services, while reporting information about addresses, or as general person-level notes.

It is important to note that officers were not required to log information in WOMBAT. Information entered in WOMBAT did not update NCAWARE. For this reason, we do not believe that all activity facilitated by WOMBAT was captured. Officers may have used WOMBAT to identify a warrant to serve but never returned to log the action.

## 5.3 Impact on Warrant Service

We conducted analyses that explored both how warrant service changed after implementation of WOMBAT (i.e., a pre/during comparison) and how warrants were handled when they were available in WOMBAT (the treatment) versus those that were suppressed from the system (the control). The analyses presented in this section were from the main experiment conducted in Districts 1 and 4.

*Number of Warrants Served (Treatment vs. Control)*—We sought to determine if more warrants were being served when assigned to the treatment condition. No differences were found on the number of warrants served ($z=1.18$, $p=.24$) between treatment and control assignment (Table 5).

Table 5: Number of Warrants Issued and Served

| Assignment | N (Warrants) | N (Warrants Served) | % Served | z (p) |
|---|---|---|---|---|
| Control | 698 | 371 | 53 | 1.18 (.24) |
| Treatment | 627 | 313 | 50 | |

Note: Unit of analysis was at the process level. Comparison is between cases assigned to treatment and control.

*Number of Warrants Served per Person Served (Treatment vs. Control)*—During the experimental period, 488 people were served (control n=253; treatment n=235). From this, we tested whether there were differences in the number of outstanding warrants per person between the treatment and control groups (Table 6). We hypothesized that officers may be more likely to attempt service on individuals with more outstanding warrants. On average, the individuals assigned to treatment, and whose warrants were served, had fewer warrants than the control group, but this difference was not significant (t=1.31, p=.19).

Table 6: Number of Warrants Served per Person Served

| Assignment | N (People Served) | Mean | SD | t (p) |
|---|---|---|---|---|
| Control | 253 | 1.47 | 1.34 | 1.31 (.19) |
| Treatment | 235 | 1.33 | 0.87 | |

Note: Unit of analysis was at the person level. Comparison is between cases assigned to treatment and control.

*Time to Service (Treatment vs. Control)*—Differences in time to service between the treatment and control groups were evaluated through survival analysis (Table 7). Log-rank tests between the survival distributions of the treatment and control groups revealed no significant differences (z=0.86, p=.35). Additionally, a Cox proportional hazards model with a binary treatment/control indicator was fit to the data, with experimental group assignment resulting in a non-significant coefficient estimate ($\beta$ = -0.07; 95% CI = (-0.22,1.08)) and underfit model (concordance = 0.51).

Table 7: Time to Service, Treatment vs Control Comparison

| Assignment | Mean Time at Risk (Days) | Median (Days, if Served) |
|---|---|---|
| Control | 91.9 | 19 |
| Treatment | 94.4 | 21 |

Note: Unit of analysis was at the process level. Comparison is between processes assigned to treatment and control.

*Time to Service (Pre/During)*— Differences in time to service between the pre-intervention and during-intervention periods were evaluated through survival analysis (Figure 2). This analysis was conducted on the subset of warrants that were assigned to districts 1 and 4 and were served by GPD. Log-rank tests between the survival distributions of the treatment and control groups revealed significant differences (z=29.24, p<.001). A Cox proportional hazards model with a binary pre-during indicator was fit to the data, with the during group assignment resulting in a significant coefficient estimate ($\beta$ = 0.29; exp($\beta$) = 1.33; 95% CI = (0.18,0.39)) and underfit model (concordance = 0.53). The exponentiated coefficient indicates that warrants during the experimental period were

served 33% faster with a hazard ratio of 1.33. A plot of the smoothed survival function is presented in Figure 2.

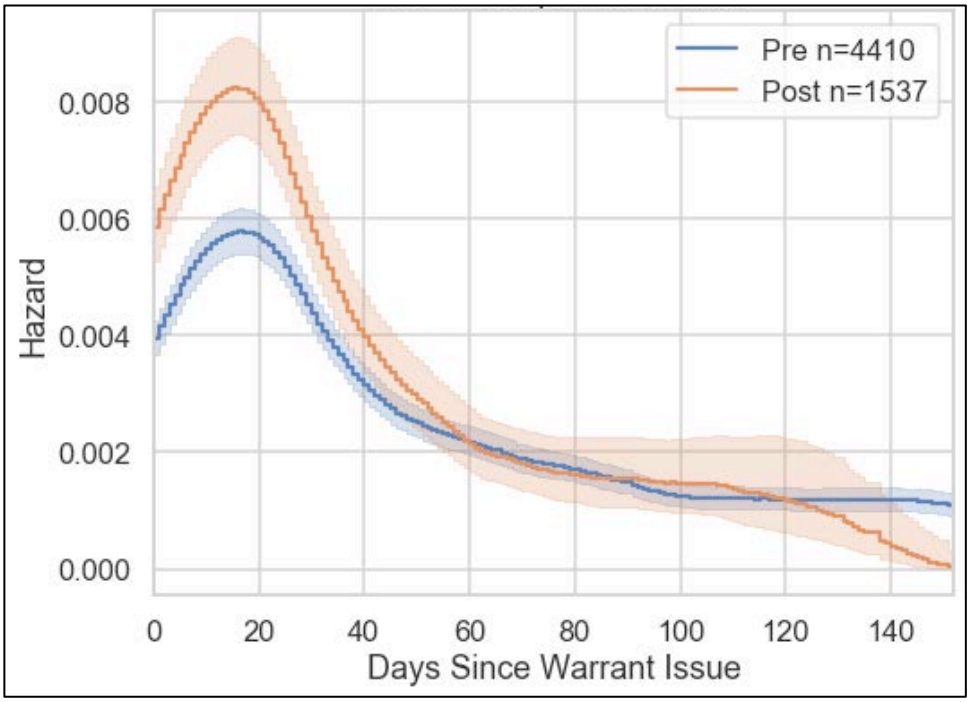
Table 8: Time to Service, Pre/During Comparison

| Assignment | Mean Time at Risk (Days) | Median (days, if served) | N | % Served |
|---|---|---|---|---|
| Pre | 247 | 36 | 4410 | 40% |
| During | 58 | 14 | 1537 | 32% |

Note: Unit of analysis was the warrant. Comparison is between warrants issued from January 1, 2018 to February 28, 2019 (pre-experiment) and March 01, 2019 through July 31, 2019 (during experiment).

[a] Due to the unequal length time tracked during the pre-experimental time and during-experimental time, we would expect the mean days to be longer for the pre-experimental group.

Figure 2: Smooth Hazard Function, Pre/During Experiment




*Differences in Risk Score (Treatment vs. Control)*—This analysis assessed if the warrants served by GPD varied in risk score based on their assignment to treatment or control. A reasonable hypothesis would be that the risk scores should be higher for those in the treatment group, compared with the control group, if officers were using WOMBAT to identify higher priority people for warrant service. Although the risk scores of people served with warrants was higher when assigned to treatment (Table 9), the difference was not significant (t=-0.39, p=.69).

Table 9: Risk Scores

| Assignment | N | Mean | SD | t (p) |
|---|---|---|---|---|
| Control | 371 | 45.04 | 29.43 | -0.39 (.69) |
| Treatment | 313 | 45.91 | 28.02 | |

Note: Unit of analysis was at the process level. Comparison is between cases assigned to treatment and control.

Number of Warrants Served (Pre/During)—We conducted a separate analysis that considered the impact of the project, overall, on the number of warrants served by GPD. This ignores the treatment and control allocation, and instead explores the potential total impact of WOMBAT implementation and the agency's focus on warrant service (Table 10). Number of warrants, by week, were calculated from the NCAWARE data. These were warrants served by GPD, regardless of assigned agency.[11] Negative binomial regression models were conducted. The intervention period was modeled with a binary indicator variable for the weeks while the experiment was in the field. Models included controls for month. See Appendix F for the complete model results. The experimental period was not associated with changes in warrant service activity.

Table 10: Impact of Experiment on Warrant Service, Traffic Stops, and Proactive Activity

| Model | B | SE | z | P | 95% CI | |
|---|---|---|---|---|---|---|
| Outcome 1: N Warrants Served | 0.07 | 0.09 | 0.76 | .45 | -0.14 | 0.28 |
| Outcome 2: N Traffic Stops | -0.13 | 0.08 | -1.67 | .10 | -0.29 | 0.02 |
| Outcome 3: N Other Proactive Activity | -0.23 | 0.08 | -2.94 | <.01 | -0.38 | -0.08 |

Note: Models specified as negative binomial regression. Unit of analysis was weekly counts of activity. Comparison is between weeks pre-intervention and weeks during the intervention. Outcome 1 included controls for month. Outcomes 2 and 3 included controls for month and year. See Appendix F for complete model results.

## 5.4 Impact on Proactive Officer Activity

Officers have a finite amount of time to spend on proactive activity, so we assessed whether officers substituted attempted warrant service for other kinds of proactive activity. We analyzed traffic stops independently from other officer activities that were likely to be proactive. The modeling strategy was consistent with the evaluation of warrants served, described above. Models for traffic stops (Table 10, above), suggested no change in activity comparing pre- and during-experiment periods. Models of other proactive activity suggests less activity during the experiment relative to the pre-intervention period. However, given

[11] Unlike previous the analyses presented previously, the impact on warrant service ignores the assigned agency/district of the process/warrant. Instead we calculated all service activity conducted by officers.

no apparent change in warrant service, it is difficult to suggest that officers were conducting warrant service in place of other proactive activity.

## 5.5 Process Evaluation

The process evaluation was conducted approximately 3 weeks after the conclusion of the field experiment. The process evaluation was conducted through interviews and focus groups with officers from the GPD. The discussions were structured into four sessions: command staff, system manager, "active" WOMBAT users, non-users, and patrol supervisors. The focus groups and interviews were conducted by two researchers from the PERF and one researcher from RTI.

*Warrant service is not an agency-wide, and consistent, priority*—We heard repeatedly that warrant service was not a priority activity for officers. Instead officers and command staff prioritized other activities, such as hot spots policing, for their proactive patrol time. In the past, GPD had a warrants squad with dedicated personnel. Some reported that the disbanding of this group signaled that proactive warrant service was not important. The implementation of WOMBAT was not perceived as a renewed focus on warrant service.

*Warrant service is perceived as time/resource intensive and inefficient*—Three issues were reported explaining why warrant service was not more prevalent. First, officers and first-line supervisors reported that they simply did not have time to conduct warrant service. Existing workload and staffing levels do not leave sufficient proactive time to peruse warrant service. Second, warrant service can be perceived as burdensome. For example, officers have to check multiple systems to identify potential warrants worth serving (of which WOMBAT contributed to another system for officers to review). Additionally, the agency practice generally suggests that warrant service attempts should be conducted by two officers. Third, attempted warrant service was highly prone to failure. One officer stated that attempted service failed 95% of the time.[12] Much of these failed service attempts were due to people not being home and bad addresses. Bad addresses, in particular, were cited frequently in focus groups and within-WOMBAT notes.

*Technology fragmentation hurts perceived efficiency*—Officers reported that there were multiple systems they had to consult when serving warrants. To some, WOMBAT added to the technology overload rather than mitigating challenges of existing systems. Accessibility restrictions of the NCAWARE system would prevent tighter integration between WOMBAT and NCAWARE without development action from the State of North Carolina.

*The experiment may have been noticeable to officers*—Some officers reported not seeing warrants in WOMBAT that they knew to be outstanding. This may have been because half the warrants were suppressed to serve as the control or because older warrants were not

[12] Based on data submitted through WOMBAT, warrant service was successful in 19% of attempts.

placed into the Officer View. Officers reported concern over these missing warrants and questioned overall reliability of the system.

*WOMBAT helped fill important gaps, and officers had several suggested enhancements*— Officers reported that the system was very easy to use, and they appreciated that they did not need login information to access the system. Despite challenges with address accuracy, users reported that the mapped view of outstanding warrants was a worthwhile feature. For future development, officers reported that they would like to include date of birth[13] and a photo of the person with a warrant. Officers also reported that they would have liked the ability to add or update address information.

## 5.6 Limitations

Because of the structure of this implementation and evaluation, we are unable to disentangle the impact of the warrant prioritization from the broader impact of prioritization, warrant data availability, and agency focus on warrant service. The warrant prioritization was provided to patrol officers through a web-platform that radically improved accessibility of warrant information. This was combined with additional directives from command staff that warrant service is an important proactive police activity. Because of this, we cannot say that the prioritization scores, independent of the data availability and leadership focus, had an impact on warrant service. As such, the project must be considered an evaluation of the total warrant prioritization program rather than the value of simply scoring warrants for their future risk of reoffending.

There were several challenges in using the historical data to determine risk profiles. We were limited to crimes known to, and solved by, the police. Research has established that a considerable amount of crime is never reported to the police and, of the crime reported to the police, only a small percentage is solved through arrest. These two characteristics mean that the inputs for our predictive models were censored and undercounted events.

There were limitations on our ability to identify unique people within the NCAWARE data. It is possible that the same person had multiple person entries in WOMBAT. Matching process to person records required the same name and address. If the name was different (perhaps due to typographical errors) or if the address changed between the previous process and the new process, a new person record would be generated in WOMBAT.

Finally, the experiment may have had unintended consequences on the perceived utility of the WOMBAT platform. Officers reported being aware of warrant information suppressed from WOMBAT. This may have negatively affected perceptions of system reliability. Additionally, we became aware of the inaccurate address situation early in the project. Bad

[13] Within WOMBAT, we provided the age but not date of birth. Provision of age, instead of actual date of birth, was a compromise in order to secure IRB approval to conduct the study.

addresses are a well-known limitation of NCAWARE. Nevertheless, to protect the experiment, we did not allow reassignment of warrants once they were assigned to a place.

## 6. Implications for Criminal Justice Policy and Practice

There are considerable practical challenges for using NCAWARE for proactive policing operations. During the course of the project, many officers reported that it was difficult and time consuming to operate, especially for officers in the field. WOMBAT addresses many of these issue with usability by improving accessibility and providing officers with more useable information.

Nevertheless, we observed that measurable use of WOMBAT was low.[14] We took considerable efforts to facilitate WOMBAT adoption including (1) designing an easy-to-use system, (2) engaging command staff in promoting adoption, (3) providing tailored end-user training, and (4) producing customized reports on officer actions that were disseminated to officers. Despite these efforts, we found that warrant service activity was low. Officers still perceived attempted warrant service to be low priority and that there was insufficient time available for proactive activity. This is consistent with other studies that have found it difficult to modify officer behavior by introducing new technology.

Warrant service by patrol officers is inefficient. Notes provided by officers indicate that bad addresses and no answers were repeated challenges on efficient warrant service. Of the 81 notes filed by officers through WOMBAT, 39 (48%) were related to bad address information.[15] Notes on 36 cases (44%) indicated that the officer got no answer or was unable to locate the subject. There may be room for considerably improving efficiency if additional research, or outside datasets, were attached to warrant information. Information outside of NCAWARE, such as those contained in public records aggregators (e.g., Lexus Nexis) could contribute to improved accuracy of residential address.

Our discussion with multiple agencies identified varying patterns in the recording of attempted warrant services within NCAWARE. Although officers have the capability to report failed warrant service attempts, many indicated that it was cumbersome to do so. We found that agencies reported wide variability in procedures dictating if this activity should be reported in NCAWARE.

Taken together, the results of this experiment are mixed. Officers did not appear to serve more warrants (when comparing either treatment vs. control or pre vs. during) after the

[14] Measurable use would include logging services, attempted services, or case/address notes. Other activity, such as just reviewing records or outstanding warrants, could not be measured.
[15] During the development of WOMBAT, we considered allowing officers to enter new address information and using that information to reassign warrants to their correct district. However, we decided against this approach due to the implications for the experimental assignment and integrity of the evaluation. Additional research is needed to understand how best to track and update potential addresses for persons with warrants.

implementation of WOMBAT. Comparing treatment vs. control assignment, the warrants served were not associated with higher risk individuals nor were there differences in the number of warrants served per person. We did find, however, that warrants issued during the experimental period were served more quickly relative to the previous year. This suggests that although WOMBAT did not promote more warrant service, the combined impact of WOMBAT and additional focus on warrant service by command staff, may have resulted in officers serving warrants more quickly. Warrant issuance date was available in the main officer view of WOMBAT, which may have contributed to focus on newer warrants (instead of focusing on more risky warrants like we had intended). The focus on newer warrants would be consistent with our qualitative work where officers reported very little interest in going after “stale” warrants.

# Appendix A: Predictive Models

A historical extract of NCAWARE criminal history data was obtained from the NCAOC. RTI developed processing scripts to calculate previous convictions and charges for individuals over different timeframes (e.g., previous 1 year, 5 years). Processing identified additional complications related to demographic variables; records that were identified as being associated with a person occasionally had different demographic characteristics. Additional scripts were written to reconcile birthdate, sex, and race of person-level records.[16]

An analysis set was created consisting of warrants issued between January 1, 2013 and October 29, 2016. Warrant number was no longer consistently recorded in this database starting in 2008, so deduplication was used in an attempt to reduce the number of identical warrants present in the dataset as follows (in addition to data cleaning steps presented):

- Records came from three tables:
    - An aoc_case table, with an anonymized individual id (cluster_id).
    - A case table, with disposition dates.
    - An offense table with warrant issue and service dates.
- Records were joined across tables using source_id – a linking case-level identifier.
- We kept records that were warrants for arrest from district or superior courts and did not have a "Never to be served" disposition (where CRRPRC or CRRPRPS equaled 'W' and CRDMOD did not equal "NS")
- Duplicated records by only retaining unique combinations of cluster_id, warrant issue date, warrant service date, and disposition date.
- Records with null service dates were filled with October 15, 2016, to represent the end of the measured risk period
- Warrants that had a service date prior to or on the issue date were dropped from the analysis dataset.
- The dataset was further deduplicated by only keeping unique combinations of cluster_id, issue date, and service date (and removing disposition date)
- The dataset was further deduplicated by only keeping the warrant that was outstanding the longest for a given cluster_id and issue date.

After completion of these steps, a dataset of 279,509 records was created that included warrants issued between January 1, 2013 and October 15, 2016 corresponding to 204,281 individuals. Descriptive results are provided in

Table A-1 and Table A-2. Individuals in the dataset were overwhelmingly male and predominantly White or Black.

[16] Sex was calculated for everyone by retaining the majority value of CRRSEX across all database records for a given cluster_id, after dropping values of 'X' and 'U'. The same method was used to calculate the race for everyone using CRRACE and the birthday for everyone using CRRDOB.

Table A-1: Sex and race of people included in the analysis dataset

| Characteristic | % |
|---|---|
| Sex | |
| Male | 73 |
| Female | 27 |
| Unknown | 0.03 |
| Race | |
| White | 48 |
| Black | 46 |
| Hispanic | 2 |
| Indian | 2 |
| Other | 1 |
| Asian | 0.2 |

Note: May not sum to 100 due to rounding.

Table A-2: Descriptive Characteristics of people included in the analysis dataset

| Characteristic | Mean | SD | Median | Max |
|---|---|---|---|---|
| Misdemeanor Charges | 14.73 | 18.85 | 8 | 550 |
| Felony Charges | 12.97 | 23.20 | 4 | 779 |
| Violent Crime Charges | 4.27 | 6.75 | 2 | 525 |
| Misdemeanor Convictions | 4.94 | 9.10 | 2 | 424 |
| Felony Convictions | 1.91 | 5.21 | 0 | 288 |
| Violent Crime Convictions | 1.12 | 2.28 | 0 | 45 |
| Age | 31.73 | 12.39 | 30 | 141 |

Note: We report the maximum values as reported in the historical dataset. However, when running models, we truncated values to the 97.5 percentile to prevent undue influence of extreme outliers.

Criminal history for each individual was appended to data for each warrant. All, misdemeanor, felony, and violent charges and convictions over the time frames of all previous, past 10 years, past 5 years, past 2 years, past year, and past 6 months were calculated. Also calculated was the age of the individual at their first (1) of any charge or conviction, (2) misdemeanor, (3) felony, and (4) violent charge and conviction. Additionally, the time since last (1) of any charge or conviction, (2) misdemeanor, (3) felony, and (4) violent charge and conviction was calculated.

The dataset did not provide a single indicator of violent offense. Therefore, a model was built to identify violent offenses based on offense description. 3,400 offense descriptions were manually labeled for violent or non-violent crime type. Data were then split 90/10 for

training and validation. The resulting model was 99.9% accurate in identifying violent offenses; this model was applied to the remaining 588,511 unique offense descriptions.

We next identified whether an individual committed a new violent offense while they had an active warrant available for service. This was done by determining:

| | | |
|---|---|---|
| If an individual had a charge for a violent offense with a disposition date on or after the date of warrant issuance | AND | On or before the date of warrant service<br>OR<br>If the warrant is still active, on or before the date of the database pull |

Warrants where a new violent offense was not charged during the risk period were considered to be right censored for the purposes of analysis. The dataset was split into a training and validation sets: training data including warrants issued prior to Jan 1, 2016 and validation including warrants that were issued past that date.

## Training Data

For the final analysis, the dataset was split into training and validation subsets. The training dataset contains all warrants prior to Jan 1, 2016, and the validation dataset contains all warrants from Jan 1, 2016 to Oct 15, 2016. The validation set remained untouched during model building and evaluation and served as a final test of the model's performance. All features were truncated at the $97.5^{th}$ percentile – values above that percentile were replaced with the percentile value.

## Model Training – Gradient Boosted Trees

For the classification task, a gradient boosted trees algorithm was used to predict the outcome. For its flexibility, we used the XGBoost Python package (xgboost 0.6a2). These types of models have been demonstrated to perform well on classification tasks and have several advantages relevant to this study:

1. Speed – With 270,000 records traditional machine learning models can take a long time to train and evaluate.
2. Missing data – Given the prevalence of potentially missing data in criminal history it's important that this missingness is addressed with a model rather than potentially biasing the model with imputation techniques.
3. Collinearity among input variables – In comparison to traditional statistical models like logistic regression, we're able to accurately estimate a prediction without worrying whether a statistical model can converge.
4. Conditional, non-linear effects – These models can weigh the relative importance of features cooccurring at once. That is, the importance of three prior felony charges

should be different if they also had three prior felony convictions rather than 0 prior felony convictions.

## Time-Frame Feature Selection for Criminal History

Six time frames were used to summarize criminal history information (counts of past 6-month, 1-year, 2-year, 5-year, 10-year, all-time) for six variables: counts of charges and convictions for misdemeanors, felonies, and violent crimes. To determine which time range of variables was most predictive of the outcome, models were created with each time-frame subset of variables and evaluated using cross-validation with the AUCROC statistic (Table A-3).

Table A-3: AUCROC by Time Period

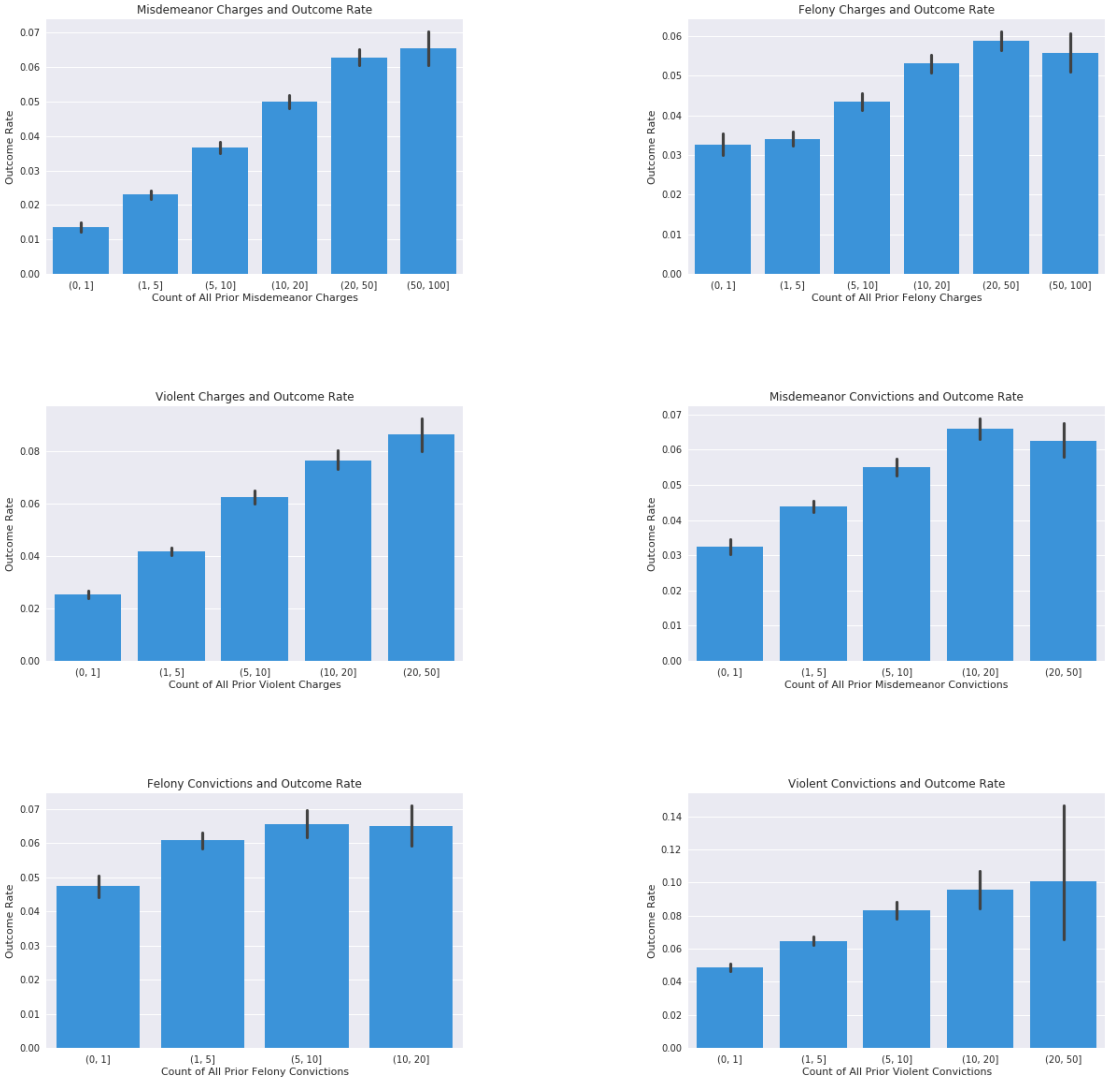
| Time Frame | AUCROC |
|---|---|
| 6 months | 0.734 |
| 1 year | 0.736 |
| 2 years | 0.739 |
| 5 years | 0.745 |
| 10 years | 0.747 |
| All | 0.765 |

Using all criminal history available provided the most accurate model and that subset of variables were used in the final model. In addition, using all history information is the easiest for records staff to input into the model.

## Relationship of Criminal History to Outcome

Figure A-1 shows the relationships between the criminal history variables and the outcome. In general, increasing values of each variable is associated with increases in the outcome, indicating the more extensive of a criminal history an individual has, the more likely they are to have the outcome.

Figure A-1: Bivariate Relationships Between Criminal History Variables and Outcome Rate




Notes:

(1,5] interval means including 1 up to, but not including, 5.

Black bars indicate 95% bootstrap confidence intervals.

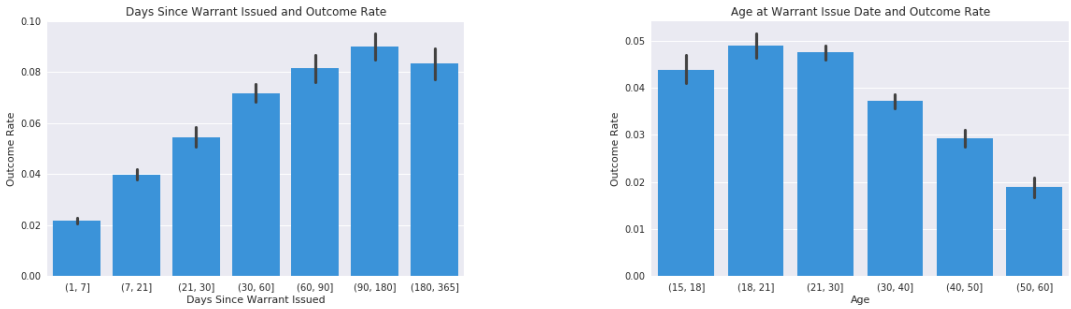
## Other Variables

Other variables of interest are the "time to event" and "days since warrant issued," as well as the age of the individual when the warrant was issued. The days since warrant issued addresses the fact that our censoring process, that is, being removed from the risk frame, is informative. It is likely that high risk warrants are already served sooner, so warrants with fewer days since issue are less likely to have our outcome, since these riskier individuals

would be served the warrant sooner. Age is also important as a moderator of the criminal history variables. For example, having several felonies at age 21 means something different than having several felonies at age 50, and the effect of these variables on prediction changes depending on age.

The relationships visualized in Figure A-2 indicate that the longer the warrant is out, the more likely an individual is to be arrested for a violent offense which is likely a function of risk exposure. Consistent with research on the age-crime curve, the older an individual is, the less likely they are to be arrested for a violent crime.

Figure A-2: Bivariate Relationship Between Other Variables and Outcome Rate




## Model Performance and Production

The final model had seven input variables

1. Misdemeanor charges
2. Misdemeanor convictions
3. Felony charges
4. Felony convictions
5. Violent-crime charges
6. Violent-crime convictions
7. Age of person

5-fold cross-validation was used to choose the best set of parameters for the models, based on the AUCROC scores. Models showed very little variation across the hyperparameter space, with mean AUCROC values around 0.75 for all models. The best model was chosen from this parameter tuning, but there is little reason to believe the default settings for this type of model would perform worse due to the low variation among scores.



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### *Test Set Performance*

After performing cross-validation, the model performance was evaluated on the test set. Originally the data were split into training (warrants before Jan 1, 2016) and test datasets (warrants after Jan 1, 2016). The model applied to the test dataset yielded an AUCROC value of 0.745. This value is within the same range we would expect from the cross-validation step and gives us a measure of accuracy of the model on an unseen dataset.

### *Production Model*

The final model used was fit on the combined training and test data to ensure that future predictions are made from a model given the most data possible.

### *Model Explanations*

Gradient Boosted Tree models do not have intuitive variable explanations compared with other modeling approaches like logistic regression. To a large extent the models operate as a black box with little oversight by the researcher. However, post-hoc determination of feature importance can be done based on how often a feature appears in the set of trees generated by the gradient boosted tree model. Feature importance values are presented Table A-4. Results suggest that of the individual characteristics, the number of past violent and misdemeanor charges were the most useful in predicting future violent offenses.

Table A-4: Feature Importance

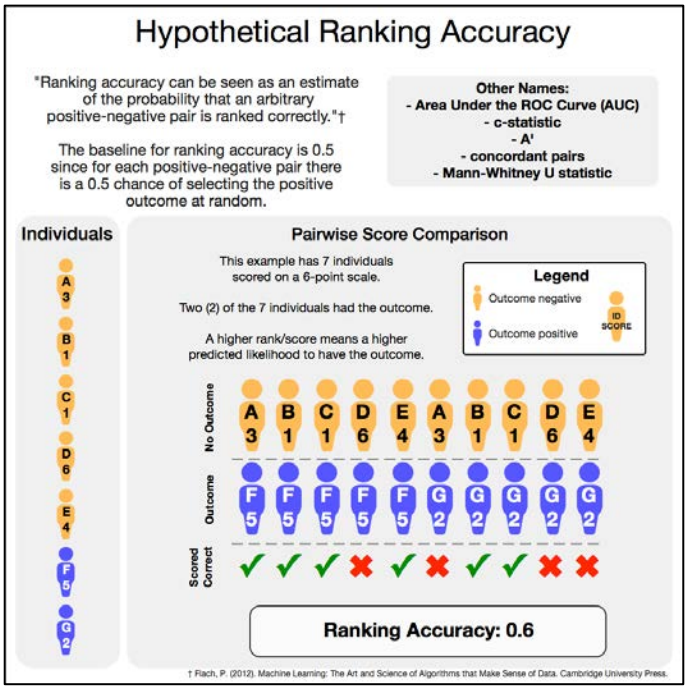
| Importance | Feature |
|---|---|
| 85 | Age |
| 58 | Number of Misdemeanor Charges |
| 45 | Number of Violent Charges |
| 37 | Number of Felony Charges |
| 32 | Number of Felony Convictions |
| 24 | Number of Misdemeanor Convictions |
| 21 | Number of Violent Convictions |

The order should reflect what is seen in the visualizations by comparing the differences between the outcome rates for individuals with the lowest value of that feature to the outcome rates of individuals with the highest value of that feature (e.g., there's a 5% difference in outcome rate when comparing individuals with 0 misdemeanor charges to those who have 20 or more).

## Risk Score Calculation

Rather than display the raw output of the predictive model, predictions were converted to a Risk Score. The Risk Score is the percentile of that predicted value out of all predicted values on the full model. For example, a predicted probability of 0.11 is lower than 97% of all predicted values. Thus, the risk score for this probability is 3 (representing the 3rd percentile of all output scores). This transformation, therefore, provides an easy interpretation—for example, a Risk Score of 75 means an outcome prediction that's higher than 75% of other individuals in the dataset. Figure A-3 explains hypothetical ranking and classification.

Figure A-3: Explication of Rankings

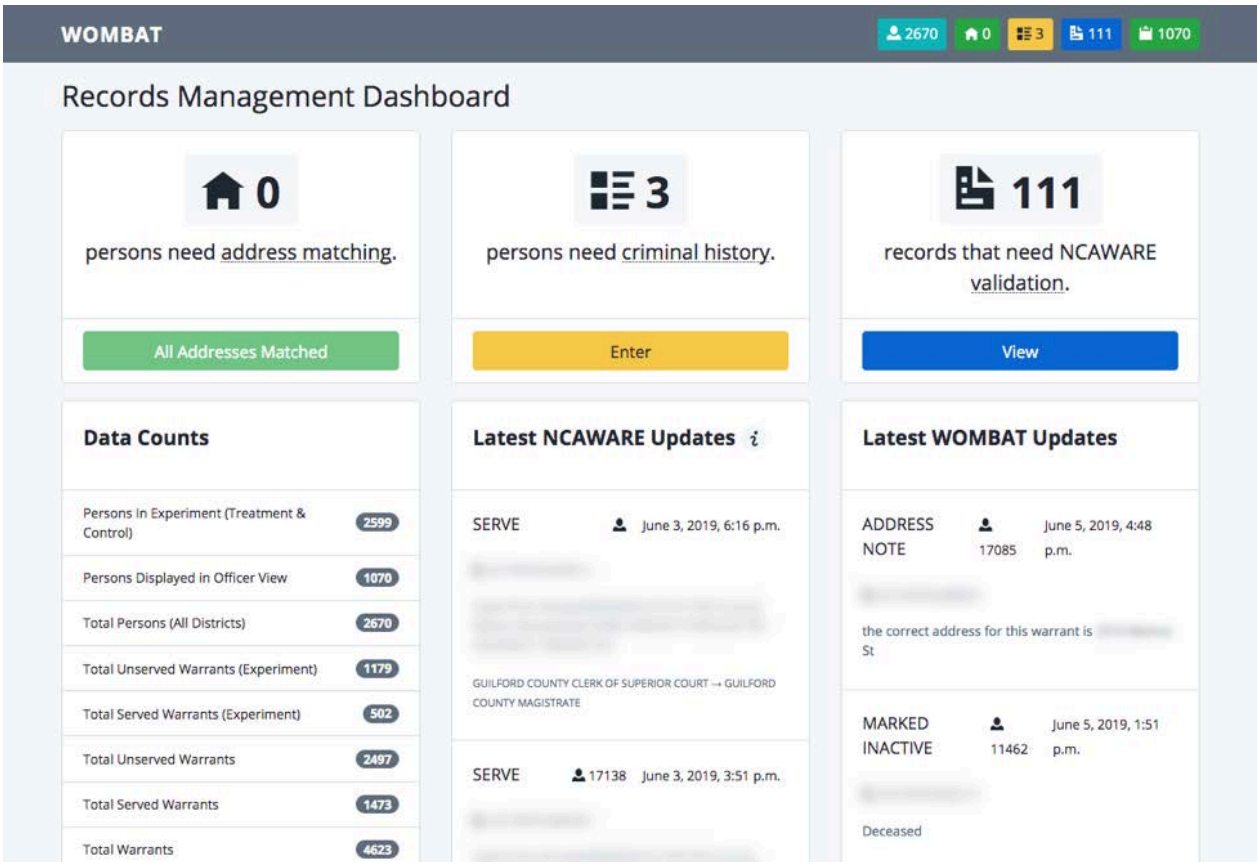


# Appendix B: WOMBAT Workflow

WOMBAT was developed to facilitate processing warrant data and delivering prioritized warrant information to field operations. The tool has two main components: (1) a management view where address matching and criminal history data are entered and (2) an officer view designed to support the delivery of prioritized warrant information to officers in the field. The management dashboard view (Figure B-1) displays information about the status of people with warrants in WOMBAT.

A typical daily update can illustrate the workflow. At approximately 4AM an automated process begins on the GPD server. This process downloads the previous day's warrant update file. This update is applied to the GPD's warrant database. A subset of these data is sent to the WOMBAT platform. The daily update is applied to the WOMBAT database. New processes are evaluated to determine if they match an existing person record in WOMBAT. If an existing person record exists, the new process is appended to the existing person record. If a person record does not exist, two additional steps happen.

Figure B-1: Management åDashboard



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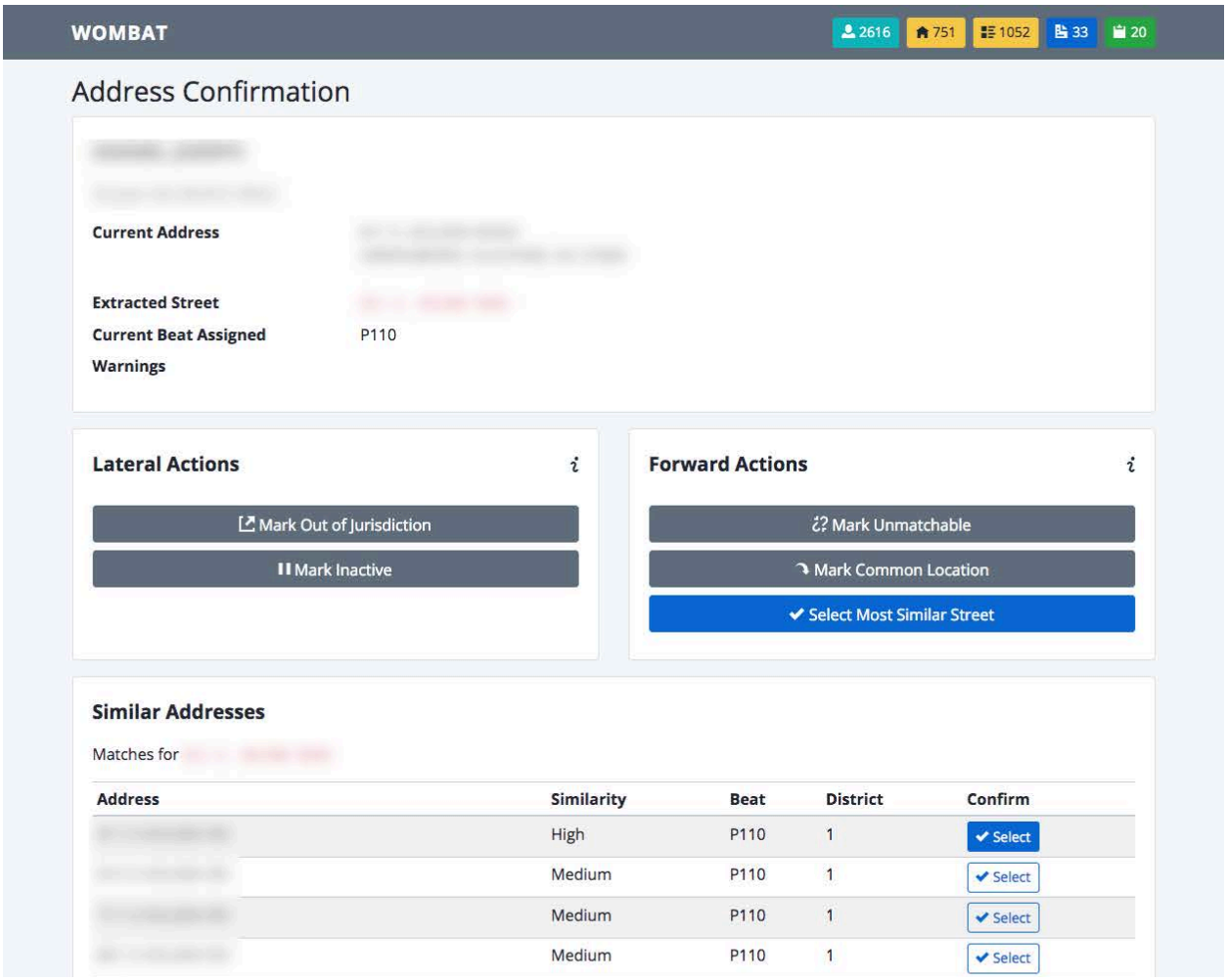
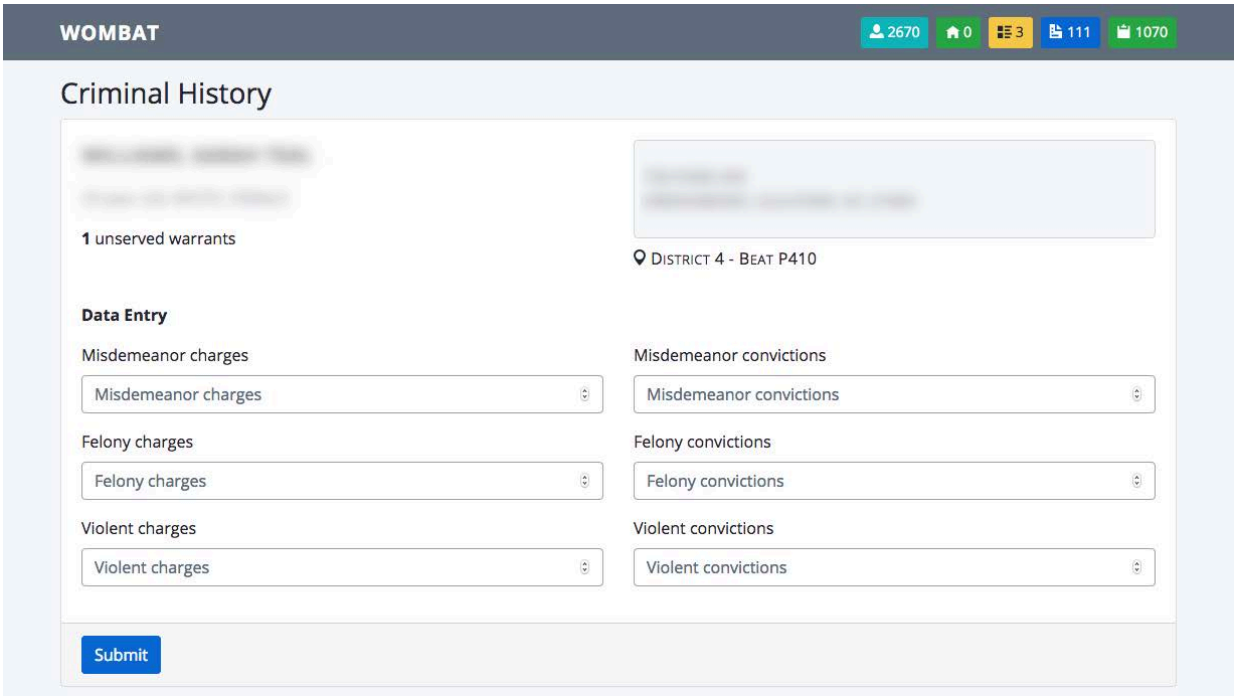
First, the address associated with the process is compared against a GPD-provided address file. This was necessary to assign the process-person to a GPD district and beat. Address matching is automated for cases where the process address exactly matched the address in the address file. If an address does not have an exact match, it is subject to manual review by a system administrator (Figure B-2). The reviewer is provided the address listed on the process and the closest matches in the address file. They can (1) match the address to the correct location, (2) mark the address as being out of jurisdiction, (3) indicate the address is unmatchable or not valid, (4) assign the address to a common location, or (5) marked as inactive. Common location was developed because of a number of cases that use undefined locations, such as "homeless," for their address. Marking a case as inactive or out of jurisdiction removes it from the officer view.

Figure B-2: Address Matching



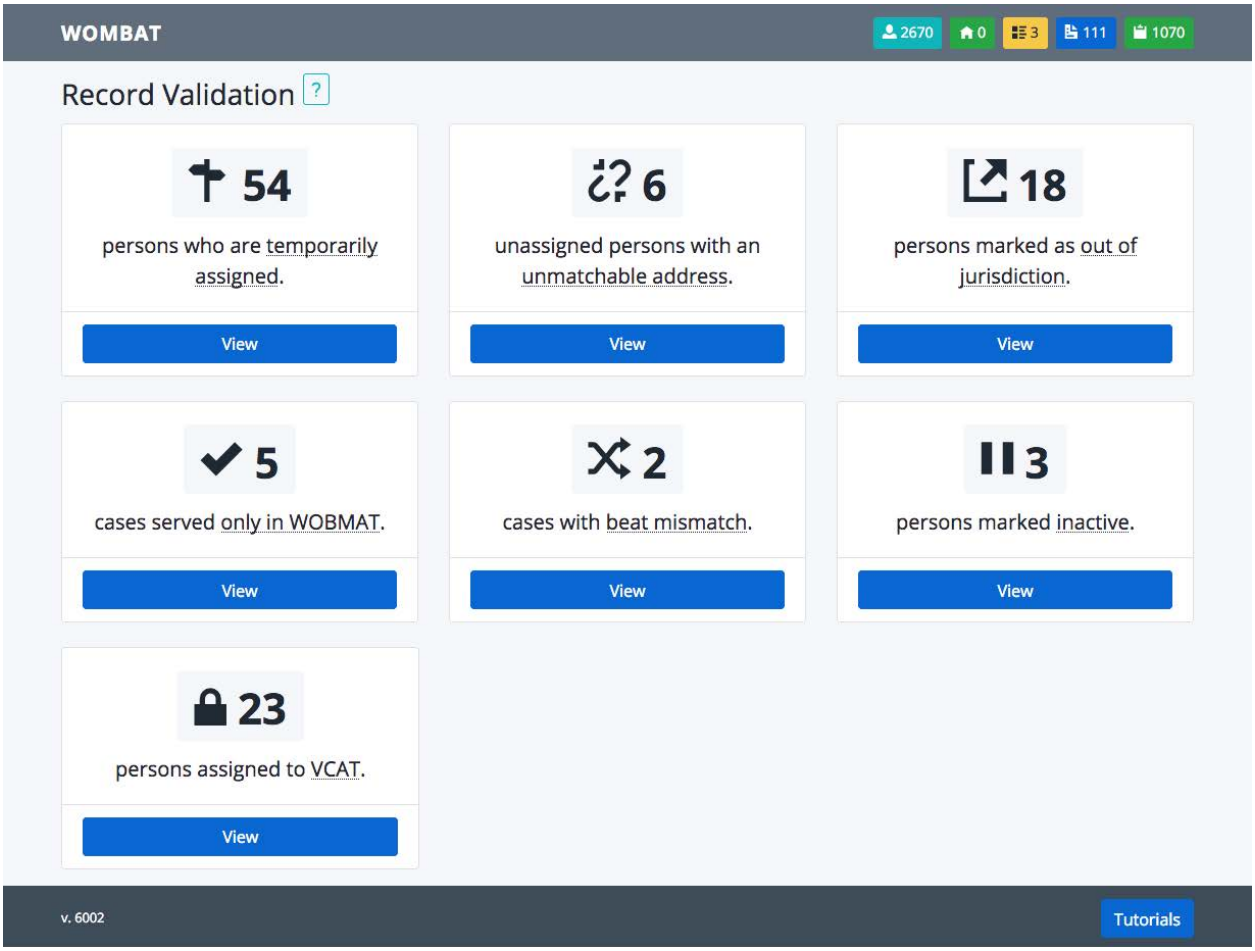
After address information is entered, the case is queued for criminal history entry. Our analysis of historical data provided by the state reduced the number of risk and protective factors to the number of past: (1) misdemeanor charges, (2) misdemeanor convictions, (3) felony charges, (4) felony convictions, (5) charges for crimes that involved violence, and (6) convictions for crimes that involved violence (Figure B-3).

Figure B-3: Criminal History Data Entry




Once address and criminal history data are entered, the case is made available to the patrol officer view. A separate view was created to facilitate review of cases that may have been in need of additional attention. This allows a system manager to quickly identify and review cases that may require corrective actions (Figure B-4).

Figure B-4: Record Validation




A separate section of the platform was developed for field use. This view was organized by patrol district and beat to align with patrol operations. The home screen provided an overview of outstanding persons with warrants and warrants served by beat (Figure B-5).



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Figure B-5: Officer View

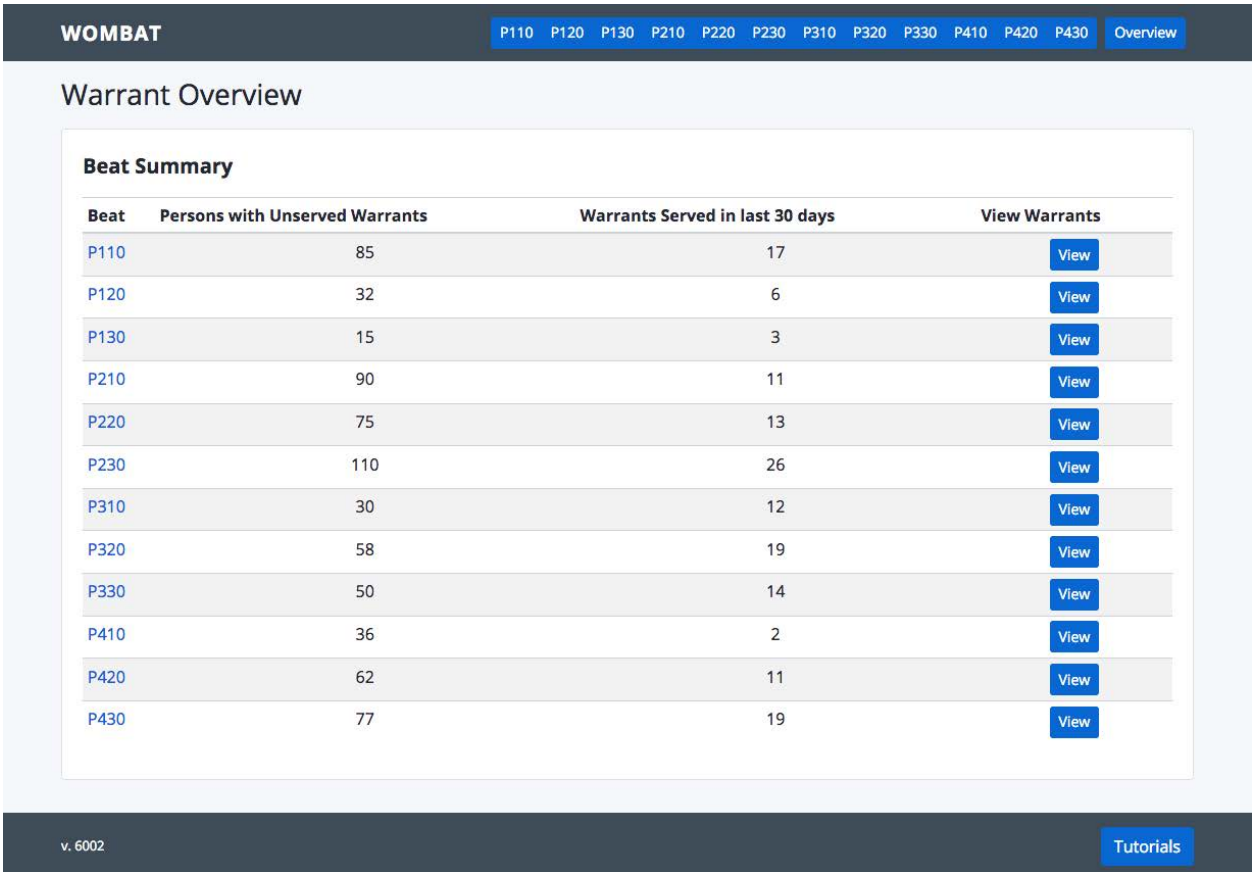


Figure B-6 demonstrates the officer view when reviewing warrants in a single beat. This is the primary view used by patrol operations. Officers can see the warrant risk prioritization and other information that may be relevant for making a decision on whether or not to attempt a service. Critically, WOMBAT was the only method that allowed officers to visualize the spatial distribution of warrants.



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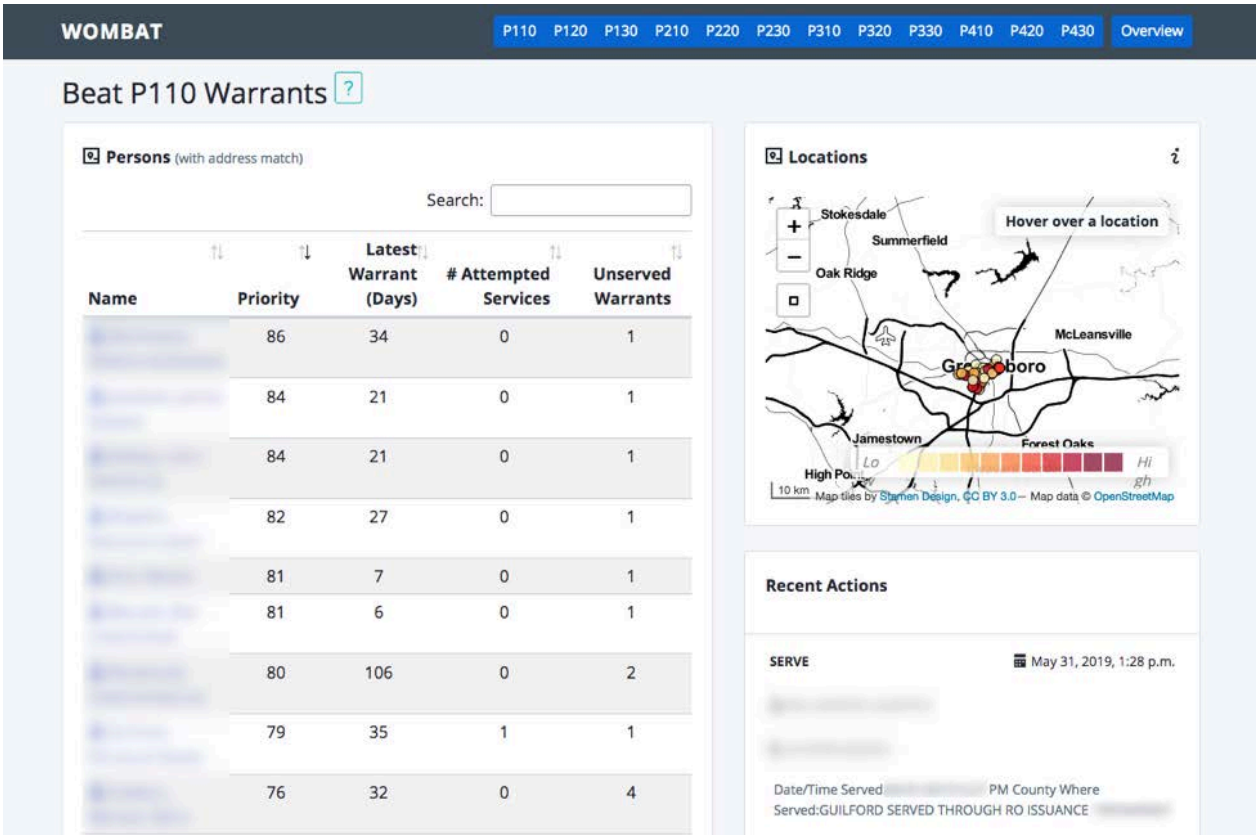
Figure B-6: Beat View




Officers can review additional content on individuals (Figure B-7). They can retrieve additional details about the criminal history used to determine their risk score and see active warrants. This view is also where officers record data about actions taken on a process/person. Actions available include (1) attempted service, (2) successful service, (3) notes, or (4) mark inactive.



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Figure B-7: Person View

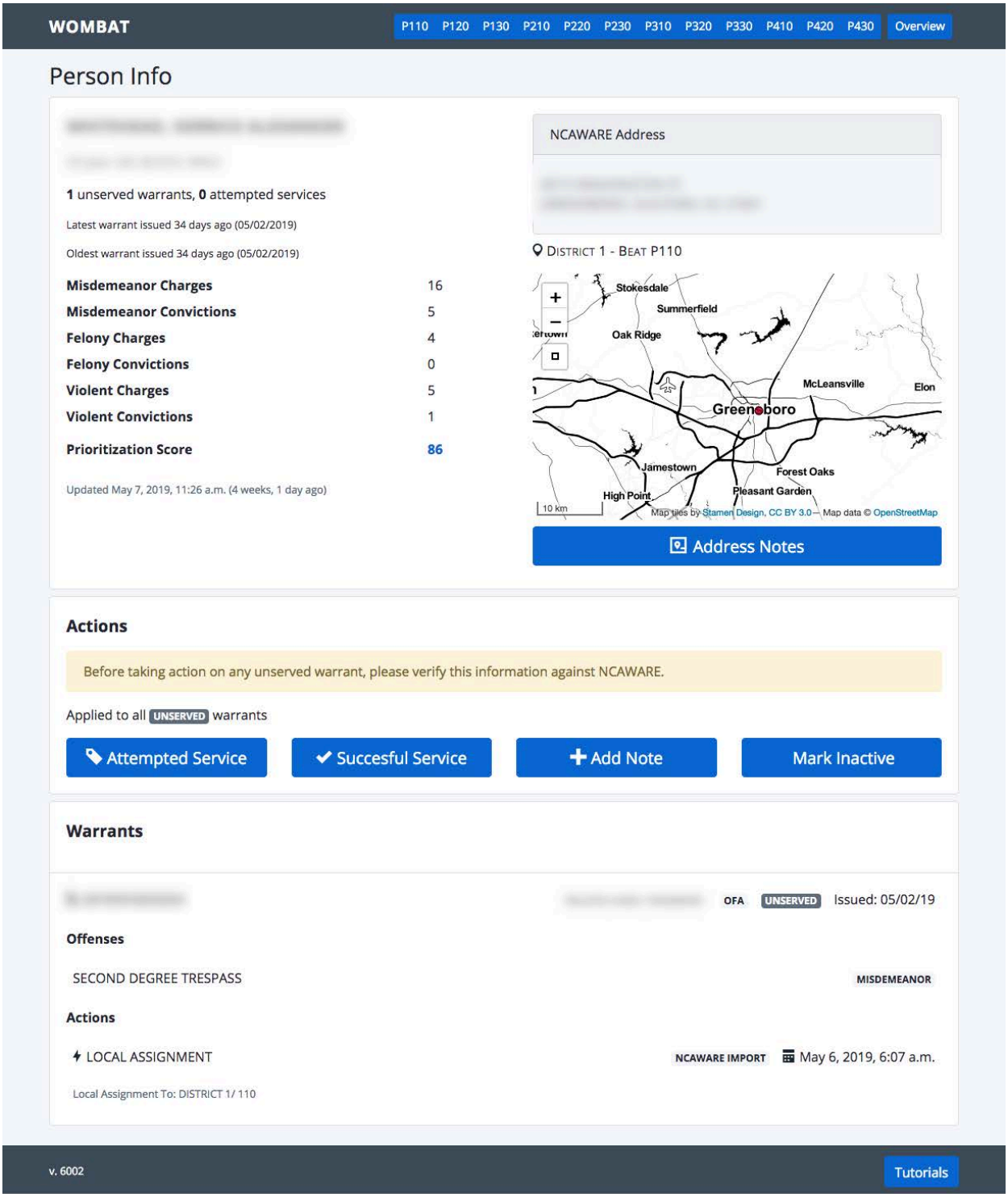




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Figure B-8 illustrates a warrant service report that was used by GPD command staff to prompt additional warrant service activity. This information had not been accessed prior to WOMBAT because of the difficulty in extracting this information from NCAWARE.

Figure B-8: Warrant Service Report

## District 1

**299** persons with an unserved warrant, **351** unserved processes

| Assignment | Served Processes | Served Persons | Attempted Services |
|---|---|---|---|
| D1-A | 26 | 12 | 1 |
| D1-B | 21 | 12 | 7 |
| D1-C | 30 | 22 | 2 |
| D1-CCRA | 10 | 7 | 0 |
| D1-CCRB | 6 | 3 | 1 |
| D1-CRO | 0 | 0 | 0 |
| D1-D | 18 | 13 | 5 |
| D1-E | 20 | 15 | 0 |
| D1-F | 29 | 23 | 0 |
| D1-G | 11 | 10 | 6 |
| D1-H | 13 | 9 | 3 |
| **TOTAL** | **184** | **126** | **25** |

# Appendix C: Greensboro Police Department Training

Patrol officer training was carried out by a GPD captain who attended the squad briefing at the beginning of each work week. The training schedule can be found in Table C-1.

Table C-1: Officer Training

| Squad | Date | N Officers |
|---|---|---|
| D1-B | 2019-03-03 | 9 |
| D1-C | 2019-03-03 | 9 |
| D1-G | 2019-03-07 | 8 |
| D1-H | 2019-03-07 | 10 |
| D1-E | 2019-03-09 | 9 |
| D1-F | 2019-03-09 | 8 |
| D4-B | 2019-03-11 | 9 |
| D4-C | 2019-03-11 | 8 |
| D1-A | 2019-03-13 | 9 |
| D1-D | 2019-03-13 | 9 |
| D4-E | 2019-03-17 | 8 |
| D4-F | 2019-03-17 | 10 |
| D4-G | 2019-03-17 | 8 |
| D4-D | 2019-03-19 | 8 |
| D4-A | 2019-03-27 | 10 |
| D2-E | 2019-06-03 | 5 |
| D2-F | 2019-06-03 | 8 |
| D3-E | 2019-06-05 | 8 |
| D3-F | 2019-06-05 | 8 |
| D3-G | 2019-06-05 | 8 |
| D2-A | 2019-06-07 | 8 |
| D2-B | 2019-06-07 | 7 |
| D2-C | 2019-06-07 | 8 |
| D2-G | 2019-06-07 | 6 |
| D3-A | 2019-06-10 | 6 |
| D3-B | 2019-06-10 | 6 |
| D3-C | 2019-06-10 | 7 |
| D3-D | 2019-07-03 | 6 |
| D2-D | 2019-07-04 | 7 |

Note: Due to scheduling challenges, there was one squad in District 2 and one squad in District 3 that did not receive training. Although they did not receive the training, the officers did have access to WOMBAT.

# Appendix D: Process Evaluation Discussion Guide

## Officers that had recorded use of WOMBAT

1. Can you describe the warrant service process?
    a. Where do you locate information about active warrants?
    b. What types of information do you look for about active warrants?
    c. What factors do you consider when deciding which warrants to serve?
        i. What is the most important factor you consider when determining which warrants to serve?

2. About how many warrants do you serve in a typical week?
    a. Roughly, what is the percentage of warrants served successfully/unsuccessfully?
    b. What is the most common reason for unsuccessful warrant service?
    c. What other actions might be taken on outstanding warrants?

3. When/how did you first hear about WOMBAT?
    a. Has your direct supervisor or command staff discussed/encouraged you to use WOMBAT?
    b. Have you discussed WOMBAT with your peers?
        i. How is WOMBAT perceived among the people in your agency who know about/use it?

4. Have you received any training on WOMBAT?
    a. *If yes,* can you tell me about the training you received?
        i. Do you feel the training adequately prepared you to use WOMBAT?
        ii. Do you feel that the WOMBAT training you received can be improved?
            1. *If yes*, what suggestions would you make to improve the training?

5. Have you ever used WOMBAT to aid warrant service?
    a. *If yes*, how often would you say you use WOMBAT (during, say, a typical shift)?
    *b. If no*, do you use any other tools or information sources to conduct warrant service?

6. Could you tell me about *how* you use WOMBAT to conduct warrant service?
    a. What types of information do you routinely access via WOMBAT?
        i. Active warrants in your/other districts? Beats?
        ii. Map of active warrants?
        iii. Details about persons with active warrants?
        iv. Location information?
        v. Prioritization scores?
            1. Are these scores a key factor in serving a warrant?
            2. Based on your knowledge of individuals in the community, do these scores accurately reflect the threat of future offending?
        vi. History of other officers' actions on active warrants?
    b. How do you use the information you access via WOMBAT?
        i. Have you attempted or successfully served any warrants you identified using WOMBAT?
            1. *If yes,* do you verify the warrant's status in NCAWARE before updating the warrant's status in WOMBAT?
            2. *If yes,* about how many warrants do you serve in a typical week?
                a. Roughly, what is the percentage of warrants served successfully/unsuccessfully??
            3. *If yes,* does the warrant prioritization score affect which warrants you serve (or the order in which you serve them)?

a. What other factors do you consider when deciding which warrants to serve?

ii. Have you taken other actions on warrants you have identified using WOMBAT?

1. *If yes,* what other actions have you taken on these warrants?

iii. Have you marked any warrants you have identified using WOMBAT as inactive?

1. *If yes,* can you explain why some warrants would have been marked as inactive?

iv. Do you regularly update the warrant's status in WOMBAT after taking an action?

1. *If yes,* why?
2. *If no,* why?

c. Do you use any other tools or information sources to conduct warrant service besides WOMBAT?

i. *If yes,* can you tell me how you use these tools when conducting warrant service?

d. Has WOMBAT changed the way you conduct warrant service?

i. *If yes,* please explain.

7. What are your perceptions about the quality of addresses in WOMBAT? In NCAWARE?
   a. What processes do you go through when you determine an address is inaccurate or not current?
   b. How much effort will you put in to serve a warrant if unable to locate on first attempt?
      i. Does the type of crime impact your level of effort?
         1. For example, if there is a warrant for a failure to appear related to a misdemeanor property crime and you are unable to locate on the first attempt due to an inaccurate address, would you continue to try to serve the warrant?
      ii. Does the person's criminal history impact your level of effort?
         1. *If yes,* how do you determine criminal history? Do you focus on names you recognize from other encounters?
8. What do you like about WOMBAT?
   a. Easy to use?
   b. Contains pertinent information?
   c. Is the warrant prioritization score informative? Accurate?

9. What do you dislike about WOMBAT?
   a. Have you experienced any *technical* or *logistical* challenges with WOMBAT?
      i. *If yes,* what resources are available to resolve these challenges? Have you used them?
   b. How can WOMBAT be improved?
   c. What other information would you like to see in WOMBAT?

10. Do you feel WOMBAT is a useful tool for patrol officers?
    a. Do you feel WOMBAT has made it easier to manage the warrant service process?
       i. *If yes,* please explain.
       ii. *If no,* please explain.
    b. Do you feel more informed about outstanding warrants in your beat?
       i. *If yes,* please explain.
       ii. *If no,* please explain.
    c. Do you feel it has improved your ability to serve more outstanding warrants?
       i. *If yes,* please explain.
       ii. *If no,* please explain.

## Officers that had no recorded uses of WOMBAT

1. Can you describe the warrant service process?
   a. Where do you locate information about active warrants?

   b. What types of information do you look for about active warrants?
   c. What factors do you consider when deciding which warrants to serve?
      i. What is the most important factor you consider when determining which warrants to serve?

2. About how many warrants do you serve in a typical week?
   a. Roughly, what is the percentage of warrants served successfully/unsuccessfully?
   b. What is the most common reason for unsuccessful warrant service?
   c. What other actions might be taken on outstanding warrants?

3. What are some challenges you face with the current process of serving warrants?
   a. How could the warrant service process be improved?

4. What are your perceptions about the quality of addresses in NCAWARE?
   a. What processes do you go through when you determine an address is inaccurate or not current?
   b. How much effort will you put in to serve a warrant if unable to locate on first attempt?
      i. Does the type of warrant impact your level of effort?
         1. For example, if there is a warrant for a failure to appear related to a misdemeanor property crime and you are unable to locate on the first attempt due to an inaccurate address, would you continue to try to serve the warrant?
      ii. Does the person's criminal history impact your level of effort?
         1. *If yes,* how do you determine criminal history? Do you focus on names you recognize from other encounters?

5. Have you ever heard of the warrants' prioritization application WOMBAT?
   a. *If no*, end interview.
   b. *If yes,* when/how did you first hear about WOMBAT?
   c. Has direct supervisor or command staff discussed/encouraged you to use WOMBAT?
   d. Have you discussed WOMBAT with your peers?
      i. How is WOMBAT perceived among the people in your agency who know about/use it?

6. Have you received any training on WOMBAT?

7. Have you ever used WOMBAT?
   a. *If yes,* how often would you say you use WOMBAT (during, say, a typical shift)?

## First-Line Supervisors

1. Can you describe to me the warrant service process?
   a. Where do patrol officers locate information about active warrants?
   b. What types of information do patrol officers look for about active warrants?
   c. What factors do patrol officers consider when deciding which warrants to serve?
   d. What is the most important factor patrol officers consider when determining which warrants to serve?

2. About how many warrants do patrol officers serve in a typical week?
   a. Roughly, what is the percentage of warrants served successfully/unsuccessfully??
   b. What is the most common reason for unsuccessful warrant service?
   c. What other actions might be taken on outstanding warrants?
   d. What do patrol officers do when they discover that a warrant may be inactive?

3. What challenges do patrol officers face with the current process of serving warrants?
    a. How could the warrant service process be improved?

4. When/how did you first hear about WOMBAT?
    a. Has command staff encouraged you to use WOMBAT?
        i. How is WOMBAT perceived among the command staff?
    b. Have you encouraged patrol officers to use WOMBAT?
        i. How is WOMBAT perceived among patrol officers?

5. Have you received any training on WOMBAT?
    a. *If yes,* can you tell me about the training you received?
        i. Do you feel the training adequately prepared you to use WOMBAT?
        ii. Do you feel that the WOMBAT training you received can be improved?
    b. *If yes*, what suggestions would you make to improve the training? Have patrol officers received any training on WOMBAT?
        i. Do you feel the training adequately prepared officers to use WOMBAT?
        ii. Do you feel that the WOMBAT training patrol officers received can be improved? *If yes*, what suggestions would you make to improve the training?
6. Have you encouraged or directed your officers to use WOMBAT?
    a. How/why did you encourage use?
    b. Have you ever used WOMBAT?
        i. *If yes,* how often would you say you use WOMBAT (during, say, a typical shift)?

7. Do patrol officers use WOMBAT?
    *a. If yes,* how often would you say patrol officers use WOMBAT (during, say, a typical shift)?

8. Could you tell me about how patrol officers use WOMBAT?
    a. What types of information do patrol officers routinely access via WOMBAT?
    b. How do patrol officers use the information they access via WOMBAT?

9. What do patrol officers like about WOMBAT?
    a. Easy to use?
    b. Contains pertinent information?
    c. Is the warrant prioritization score informative? Accurate?

10. What do patrol officers dislike about WOMBAT?
    a. Can you describe any *technical* or *logistical* challenges officers encounter with WOMBAT?
        i. *If challenges,* what resources are available to resolve these challenges? Do officers use them?
    b. How can WOMBAT be improved? (e.g., interface, prioritization, process)

11. Do you feel WOMBAT is a useful tool for patrol officers?
    a. Useful for supervisors?

## Command Staff

1. What priority is given to warrant service, relative to other kinds of proactive work (e.g., directed patrols)?
    a. Are officers encouraged to engage in warrant service?
    b. Do officers have dedicated times to conduct warrant service?
    c. Does the department have any current standing orders or teletypes directing warrant service?
2. Do you believe there is significant value in having an automated tool to manage/display/prioritize warrants?

   a. With the current trial of WOMBAT, what would be considered a success for the program?
      i. Is there evidence of success so far?
   b. Has there been any feedback (positive or negative) to the tool?
   c. If continued to be available, how likely is the department to use WOMBAT following the trial?
3. Were there any challenges in rolling out the WOMBAT trial?
   a. If rolling out again, what would you do differently (if anything)?
4. Would you recommend this system to other agencies?

## WOMBAT Data Entry Personnel

1. Can you describe the records management process within WOMBAT?
   a. What information do you look for when matching addresses?
   b. What information do you include when inputting criminal history?
   c. Do you review the latest NCAWARE updates? WOMBAT updates?

2. Have you encountered any challenges during the address matching process?
   a. How could the address matching process be improved?

3. Have you encountered any challenges with entering criminal history information?
   a. Are there ways to improve the process for entering this information?

4. How often do you use NCAWARE to update or validate records?

5. Is the records management dashboard in WOMBAT easy to use?
   a. Are there ways to improve the functionality of the page?
   b. Do you have recommendation for improving the layout or design of the page?

# Appendix E: Self-Initiated Nature Types

Data contained in the GPD CFS dataset did not allow for easy identification of calls for service that were both self-initiated *and* proactive. For example, there were thousands of cases where responding to a vehicle collision with injuries was classified as a self-initiated event. Although the officer may have placed themselves on the call, these are not the activities that we would consider discretionary. We would not expect officers to be making workload tradeoffs between conducting an attempted warrant service instead of addressing a vehicle collision. As such, project staff manually reviewed nature codes associated with officer-initiated activity. After developing a preliminary list, we reviewed the classification with GPD representatives. Our analysis only includes activities that are both self-initiated and proactive, as best could be determined by the call's nature code. These nature types can be found in Table E-1.

Table E-1: Discretionary Self-Initiated Activity

| Nature code | N |
|---|---|
| Traffic Stop | 75.8% |
| Suspicious Subject | 5.4% |
| Suspicious Vehicle | 5.2% |
| Suspicious Activity | 5.0% |
| C5-Special Assignment | 1.8% |
| Narcotics Violation | 1.6% |
| Building Check | 1.2% |
| Liquor or Alcohol Violation | 1.1% |
| Trespasser | 0.9% |
| Follow Up | 0.8% |
| Parking Violations | 0.5% |
| Panhandler | 0.3% |
| Indecent Conduct / Exposure | 0.2% |
| Vice | 0.1% |
| Special Assignment | 0.1% |

# Appendix F: Regression Models (Full Output)

Table F-1: Count Model of Warrant Service

| Variable | B | SE | z | P | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| Intervention | 0.07 | 0.11 | 0.66 | 0.51 | -0.14 | 0.28 |
| Month2 | -0.03 | 0.16 | -0.17 | 0.86 | -0.33 | 0.28 |
| Month3 | 0.05 | 0.16 | 0.30 | 0.76 | -0.28 | 0.37 |
| Month4 | 0.22 | 0.15 | 1.38 | 0.17 | -0.09 | 0.52 |
| Month5 | -0.05 | 0.16 | -0.28 | 0.78 | -0.37 | 0.28 |
| Month6 | 0.23 | 0.16 | 1.46 | 0.14 | -0.08 | 0.54 |
| Month7 | 0.12 | 0.15 | 1.10 | 0.27 | -0.13 | 0.45 |
| Month8 | 0.07 | 0.16 | 0.63 | 0.53 | -0.21 | 0.41 |
| Month9 | 0.05 | 0.19 | 0.29 | 0.77 | -0.32 | 0.43 |
| Month10 | -0.12 | 0.18 | -0.64 | 0.52 | -0.47 | 0.24 |
| Month11 | 0.01 | 0.19 | 0.03 | 0.98 | -0.37 | 0.38 |
| Month12 | -0.12 | 0.18 | -0.64 | 0.52 | -0.47 | 0.24 |
| Constant | 3.78 | 0.11 | 35.48 | 0.00 | 3.57 | 3.99 |
| Log Alpha | -2.53 | 0.19 | | | -2.92 | -2.15 |
| Alpha | 0.08 | 0.02 | | | 0.05 | 0.12 |

Number of observations = 86
Wald chi2(12) = 18.63
Prob > chi2 = .10

Table F-2: Count Model of Traffic Stops

| Variable | B | SE | z | P | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| Intervention | -0.13 | 0.08 | -1.67 | .096 | -0.29 | 0.02 |
| Year 2015 | -0.48 | 0.05 | -10.26 | <.001 | -0.57 | -0.38 |
| Year 2016 | -0.84 | 0.05 | -17.63 | <.001 | -0.94 | -0.75 |
| Year 2017 | -0.75 | 0.04 | -21.26 | <.001 | -0.82 | -0.68 |
| Year 2018 | -0.85 | 0.03 | -25.89 | <.001 | -0.91 | -0.78 |
| Year 2019 | -0.71 | 0.05 | -12.95 | <.001 | -0.82 | -0.60 |
| February | 0.00 | 0.06 | 0.03 | .974 | -0.11 | 0.11 |
| March | -0.06 | 0.05 | -1.22 | .222 | -0.16 | 0.04 |
| April | -0.24 | 0.06 | -3.92 | <.001 | -0.36 | -0.12 |
| May | -0.23 | 0.05 | -4.11 | <.001 | -0.33 | -0.12 |
| June | -0.12 | 0.05 | -2.32 | .020 | -0.23 | -0.02 |
| July | -0.09 | 0.05 | -1.71 | .087 | -0.19 | 0.01 |
| August | -0.17 | 0.05 | -3.32 | .001 | -0.27 | -0.07 |
| September | -0.29 | 0.06 | -4.60 | <.001 | -0.41 | -0.16 |
| October | -0.32 | 0.05 | -5.86 | <.001 | -0.42 | -0.21 |
| November | -0.29 | 0.08 | -3.59 | <.001 | -0.46 | -0.13 |
| December | -0.38 | 0.09 | -4.11 | <.001 | -0.56 | -0.20 |
| Constant | 6.35 | 0.04 | 153.06 | <.001 | 6.27 | 6.43 |
| Log Alpha | -2.93 | 0.11 | | | -3.14 | -2.71 |
| Alpha | 0.05 | 0.01 | | | 0.04 | 0.07 |

Number of observations = 299

Wald chi2(12) = 1007.0

Prob > chi2 = <.001

Table F-3: Count Model of Other Proactive Activity

| Variable | B | SE | z | P | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| Intervention | -0.23 | 0.08 | -2.94 | .003 | -0.38 | -0.08 |
| Year 2015 | -0.51 | 0.04 | -12.31 | <.001 | -0.59 | -0.43 |
| Year 2016 | -0.61 | 0.04 | -15.30 | <.001 | -0.69 | -0.53 |
| Year 2017 | -0.54 | 0.03 | -16.03 | <.001 | -0.60 | -0.47 |
| Year 2018 | -0.73 | 0.04 | -20.53 | <.001 | -0.80 | -0.66 |
| Year 2019 | -0.62 | 0.06 | -10.85 | <.001 | -0.73 | -0.51 |
| February | 0.10 | 0.05 | 1.90 | .057 | 0.00 | 0.21 |
| March | 0.08 | 0.06 | 1.35 | .177 | -0.04 | 0.21 |
| April | 0.15 | 0.07 | 2.30 | .021 | 0.02 | 0.28 |
| May | 0.15 | 0.06 | 2.71 | .007 | 0.04 | 0.26 |
| June | 0.15 | 0.06 | 2.65 | .008 | 0.04 | 0.27 |
| July | 0.06 | 0.05 | 1.26 | .209 | -0.04 | 0.16 |
| August | 0.10 | 0.06 | 1.77 | .077 | -0.01 | 0.21 |
| September | 0.05 | 0.06 | 0.73 | .463 | -0.08 | 0.17 |
| October | 0.03 | 0.06 | 0.55 | .584 | -0.09 | 0.15 |
| November | -0.03 | 0.06 | -0.59 | .555 | -0.15 | 0.08 |
| December | -0.09 | 0.07 | -1.41 | .160 | -0.23 | 0.04 |
| Constant | 5.18 | 0.05 | 111.77 | .000 | 5.09 | 5.27 |
| Log Alpha | -3.46 | 0.12 | | | -3.69 | -3.23 |
| Alpha | 0.03 | 0.00 | | | 0.03 | 0.04 |

Number of observations = 299

Wald chi2(12) = 598.4

Prob > chi2 = <.001