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SIMULATING HEALTH CARE IN PRISON SYSTEMS

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ABSTRACT

Due to the increase in gang violence in today's prisons, Corrections Departments face the challenge of keeping prison staff and inmates safe while meeting aggressive goals to provide healthcare in a timely manner. This paper discusses the approach of using simulation modeling to analyze and identify the most effective business processes to meet these goals in a complex Receiving and Release area of a State Prison.

1 INTRODUCTION

1.1 Background

1.1.1 History of Prison

California Department of Corrections and Rehabilitation (CDCR) houses over 170,000 inmates in 33 adult prisons. These prisons are constantly receiving prisoners into their system from jails and medical facilities and releasing prisoners for discharge, transfers, parole, and medical visits. Each prison will typically receive or release prisoners more than 60,000 times per year (30,000 receive + 30,000 release). Each time an inmate re-enters the prison, they are required go through a receiving process which includes custody processing (metal detector, paperwork, fingerprinting), a medical screening, a dental exam, and a mental health check.

1.1.2 History of Receiver

The office of the Receiver is the product of a 2001 class action law suit (Plata v. Schwarzenegger) that found the medical care provided by CDCR violated the Eighth Amendment of the U.S. Constitution, which forbids cruel and unusual punishment. The state was given several years to comply with the court order, but was not successful. In April of 2006, the federal judge moved the authority to improve the quality of healthcare to a federal Receiver (Perkins 2007).

1.2 Process Challenges

1.2.1 Gang Issues / Inmate Compatibility

The inmate population inside the prison system is extremely diverse. There are three main categories each prisoner falls under: Administrative Segregation (Ad-Seg), General Population (GP), and Sensitive Needs Yard (SNY). The Ad-Seg inmates are viewed as the most dangerous to both guards and other prisoners. They have the potential of fighting with other inmates, given the opportunity. Because of their unpredictable nature and general disobedience, they are only allowed on the floor of the Receive and Release (R&R) area one at a time, and only when all other prisoners are locked in their holding cells. General Population is the most common classification for a prisoner. About 85% of the population entering the prison falls under this classification. This is the initial classification given to all inmates unless they request or are assigned to one of the

other two classes. Even though these inmates are not as dangerous as the Ad-Seg inmates, they still may be a threat to one another. The Special Needs Yard inmates are separated from the general population for their own protection. These inmates usually consist of either gang dropouts or inmates that may be targeted in prison due to the nature of the crime for which they were convicted. The SNY inmates are combined regardless of their county of origin. If they cause problems with other SNY inmates, they can be barred from their protective custody housing and sent back to general population (Frank 2008).

Inmates establish gangs in the prison system for both protection and power. They compete with one another for control over criminal activity inside and outside the prison. When these gangs initially formed, an imaginary geographical boundary was established through the city of Bakersfield. As a general rule, any Latino gang member from the city of Bakersfield and north of the city became known as "norteños" (northerners) and became the power base for the La Nuestra Familia prison gang. Latino street gang members who lived south of Bakersfield became known as "sureños" (southerners) and formed the power base for the Mexican Mafia prison gang. When members of these two prison gangs come in contact, violence often ensues. Both gangs will attack one another wherever and whenever the opportunity presents itself, including inside the Reception center area (Valdez 2009). For this reason, all GP inmates are separated by county while moving through the R&R process.

1.2.2 Current Process Not Achieving Operational Goal

The current receiving process performs all of the custody activities along with a quick medical intake screening to immediately administer the tuberculosis (TB) test and handle any medical emergency. After completing the custody process, the prisoners wait in holding cells until a bed is assigned to them out in the main prison yard. Officers from each of the cell blocks come to the R&R to pick up the inmates and take them to their assigned cells.

The inmates will spend their second day locked in their cell with the exception of going to the cafeteria for meals. On day three, the inmates are escorted from their cell back to the R&R to complete the medical screening, dental exam, and a mental health check. During the medical screening, the nurse checks for the inmate's reaction to the TB test. If the inmate reacts positive to the test, they are sent to get a chest x-ray for further evaluation and separated from the other inmates. Because the TB test takes 48 hours to generate a result, CDCR combined all medical procedures with the TB result on day three.

There are several issues with waiting until the third day to begin the medical diagnostics. The first is inmates do not receive any prescribed medications until the third day. Inmates are not allowed to travel with medication. This is a problem for anyone taking daily meds. The second issue is close to 20% of the inmates do not make it down to medical diagnostics area inside the R&R on day three. There are multiple reasons this could happen, for example, the group needing to go to R&R are norteños, but sureños are out in the yard. In this case, a nurse travels to their specific cells to read the TB test, but the inmate is not able to complete the rest of the medical diagnostics process. When these inmates miss their assigned day to go to the R&R they often fall through the cracks in the system and take several weeks to receive any medical attention. This is one of the reasons the court appointed a Receiver to modify the medical care given to prisoners.

1.3 Toolset Capabilities

1.3.1 Process Modeling

A process is defined as a systematic series of actions directed to some end, such as the actions needing to be performed with an inmate before they are ready to leave the R&R. A process model can be a visual description of the process (e.g. drawing, flow diagram, etc.). To create an effective process model, both the modelers and users must establish a common vocabulary and ensure the lines of communication are open (Miller et al. 2008). When creating a process model, the ultimate goal is to define the process completely from beginning to end. To accomplish this in a timely manner, the level of detail being modeled must be considered with each process. This can be compared to looking at a map for driving directions. The level of detail needed and even the type of map required would not be the same if a person were traveling from state to state compared to around the city.

1.3.2 Simulation

Process modeling gives a good overview of the steps and sequence of activities in the process, but will not tell how the activities interact with one another. Complex processes, consisting of numerous activities with multiple rules and restrictions benefit from the "dynamic" process analysis provided by discrete event simulation (Crosslin 2005). Simulation allows the users

to apply business rules, priority of activities, and constrain the system with a set number of resources, both physical and human.

The simulation outputs information about the process such as resource utilization, queue behavior, and activity performance metrics. This information allows the user to understand the effect of changing parameters throughout the model. They can compare the results from multiple scenarios and make an informed decision in order to minimize risk (Miller et al. 2008).

2 PROJECT APPROACH

2.1 Objectives

2.1.1 Goal of CDCR

The main goal for California Department of Corrections and Rehabilitation is to ensure the safety of the staff and inmates at all times. Many companies strive to make safety a concern of the employees in order to reduce accidents and loss time of their employees, but at CDCR, being aware and ensuring safe conditions could mean the difference between life and death. Inmates may attack each other as well as the staff, given the opportunity. The focus of the project was to determine the most efficient process and identify the best number of resources for future facilities while ensuring all safety goals are met.

2.1.2 Goal of the Receiver

The vision of the Receiver is listed on their website as "To provide constitutionally adequate medical care to patient-inmates of the California Department of Corrections and Rehabilitation (CDCR) within a delivery system the state can successfully manage and sustain." Their top goals include ensuring timely access to healthcare services and establishing a prison medical program addressing the full continuum of healthcare services. The Receiver established a pilot program in one of the prisons. This program established that all custody and most medical programs occur on the first day.

2.2 Modeling the Prison

2.2.1 Workshops

Employees from all departments at three different facilities were invited to a week-long process modeling workshop. This committee included employees from both CDCR and the Receiver's office. CDCR employees included correctional officers, sergeants, and captains. Employees from the Receiver included registered nurses, nurse practitioners, medical doctors, dentists, and licensed vocational nurses. Each employee brought knowledge and expertise from their specific field and were able to ensure the processes in their area were in the correct order and given the proper amount of time. The knowledge base from the committee members helped the modelers identify which activities were dependent on others and understand the why and how of the process as well as the what.

2.2.2 Process Maps

Following the rules discussed in section 1.3.1, the committee mapped out the entire receiving process from beginning to end. First, the activities were listed and rules were established to identify all dependencies between the activities. The information collected for each activity included the amount of time the specific activity took and which resources were required to complete it.

The current process was documented to establish a mutually agreed upon baseline. This also allowed all participants the opportunity to clarify vocabulary when discussing the process. An interesting point that came out of this mapping was that each prison had a different process. They all included the same steps, but did not do them in the same order. Figures 1 and 2 show the overview of current reception processes at two different prisons. Figure 1 shows the three-day approach while Figure 2 shows the one-day approach recently established by the Receiver.

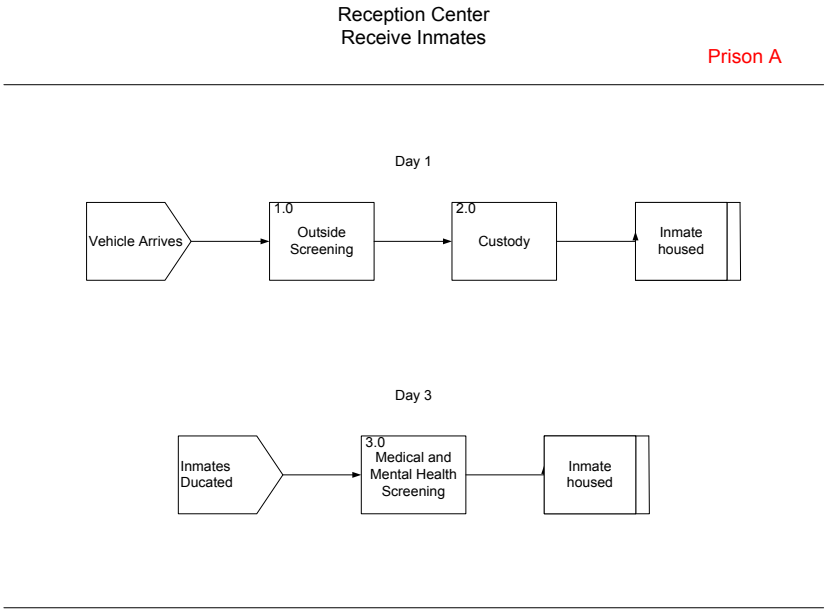

Figure 1: Receive process at prison A

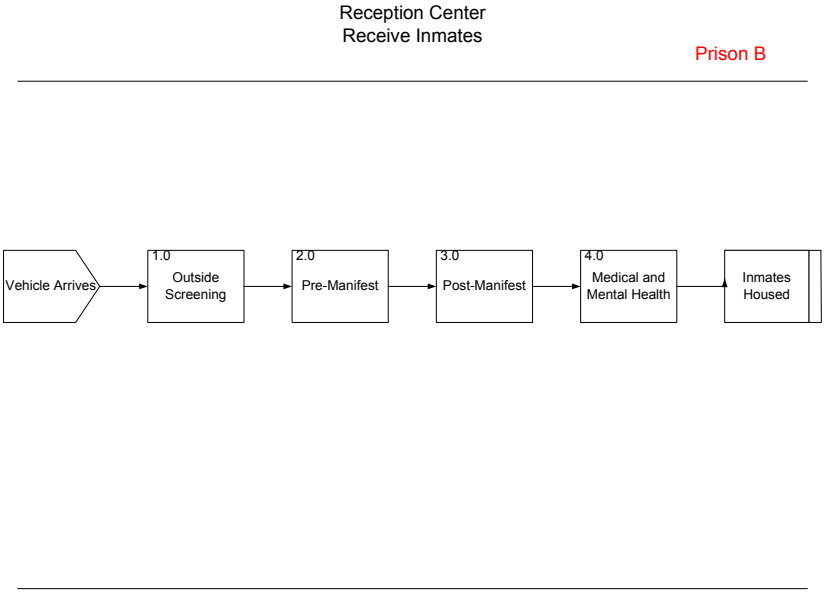

Figure 2: Receive process at prison B

Once the current processes were modeled, the committee participated in designing the future process map. The participants used all current process models as a base to determine the best approach. Figure 3 shows the overview of this process. It is distinctly different from all current models by eliminating most dependencies between activities. The vertical representation illustrates the inmates' ability to complete the process in no specific order. This process has a higher utilization for the resources, decreases queues, and decreases the total time a prisoner is in the system.

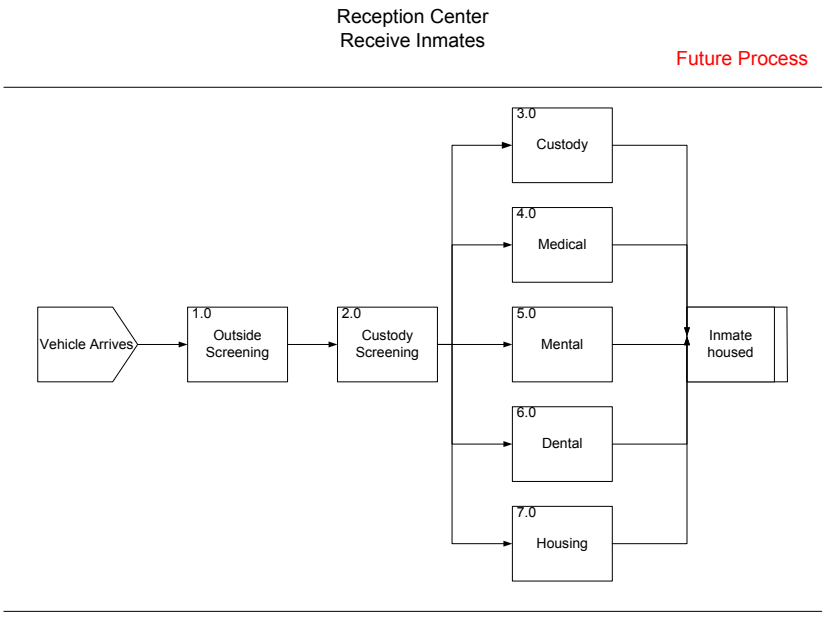

Figure 3: Receive process developed by committee

2.2.3 Observations

After collecting the activity order and durations from the process maps, observations are needed for validation. Observations were performed at four prisons. Several of the activities were changed as a result of these observations. One of the activities performed for the inmates as they arrive was to complete a mental health check. This activity was initially thought to be 3 – 15 minutes. After observing this activity, it was noted the screening is actually four different tests. All inmates needed to complete a 31 answer questionnaire which takes 3 to 5 minutes. Depending on their score on the questionnaire, they may be required to take up to three additional tests. These additional tests could add as much as 25 minutes to the process. The performance on these tests correlated to the inmates' county from which they arrived. A few counties had a much higher percentage of inmates that needed to take all four tests.

2.2.4 Key Performance Indicators

The Key Performance Indicators (KPIs) are the measurements throughout the model. These measurements help the modeler and client determine which scenario has more value. The main KPIs the client was interested in were: the time to begin healthcare for each type of inmate (Ad-Seg, GP, SNY), the time each inmate is ready to be placed in their permanent cell in the prison for each type of inmate, and the percent of inmates that complete the process within six, eight, and 10 hours.

2.2.5 Assumptions and Constraints

If all of the activity times were summed together, it would take an inmate roughly 90 minutes to complete custody, medical, mental health, and dental. With this knowledge, the receiver set a goal of completing 100% of the inmates within six hours. Initially it appeared this was an attainable goal, but it did not account for the separation of inmates and the queue times each group would face. If inmates from county A are out on the floor, then the inmates from county B, SNYs, and Ad-Seg inmates must be detained.

Aside from the separation of inmates, other assumptions in the model included the priority of processing an inmate. The first priority was to move the inmate off of the bus and into a holding cell. The activities to accomplish this goal are quick, and, once completed, the inmates are separated by county and type. If there are any inmates set for release, they are then processed. This process is also fairly quick and provides more room in the cells for incoming inmates to use. After these processes are complete, the guards start the reception process for the prisoners. The GP inmates are first, based on order of arrival. Once they are processed, the SNY inmates are seen to and finally the Ad-Seg inmates. Figure 4 shows how having

two counties arrive at the same time would put an inmate over the six-hour goal. In reality, some of the prisons may receive four or more county buses at within a few minutes of each other.

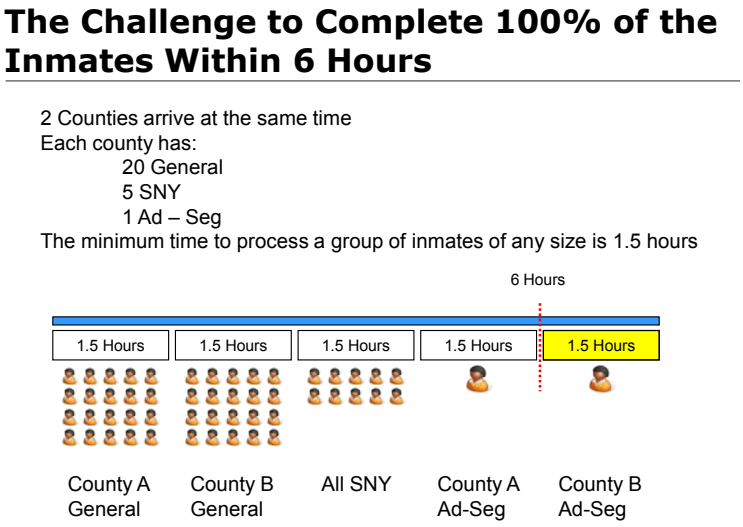

Figure 4: Current process prevents obtaining operational goal

2.3 Data Collection

Along with building the process model with the employees and validating the information with observations, data was collected to verify everything the modelers were told. Six months of data was collected from each of the sites. The data at the prisons had to be manually entered in order to fully analyze the information collected. The data collected derived the arrival rates and origin of the vehicles pulling in to drop-off / pick-up prisoners. The data showed the distribution of inmate type (Ad-Seg, GP, SNY) by county.

2.4 Software Development

2.4.1 Simulation Model

ExtendSim was used for this project. The ability to follow the process map and create a virtual model of the receive/release process was made easier by the proficiencies of the software.

2.4.1.1 Use of Databases in ExtendSim

The simulation models utilized the database feature in ExtendSim. Three databases were built with the same structure, but different values. The simulation model was then tied to the database with read blocks. The information inside the databases included everything from activity durations to arrival rates and number of inmates per bus. The model could then easily be switched from one prison to the other. This feature allowed the modeler the ability to store all of the information in one file. It eliminated the requirement for an input file as well as removed the need for multiple versions of the same file with different input data.

2.4.1.2 Model Validation

The modelers needed to ensure the simulation model behaved similar to the real system. They validated this model in multiple areas. The arrival and release rates for both the number of buses and number of inmates arriving by hour were recorded from the simulation and compared to the data provided. Figure 5 compares the simulation results of the number of vehicles arriving to the facility by hour of the day to the actual data over a one-year time period. Figure 6 compares the simulation results to the actual data of the number of inmates arriving to the facility by hour of the day over a one-year time period. The

red lines are the simulation results and the blue lines are the data results. The proximity of the lines validate the model is arriving both vehicles and inmates accurately. Comparing the two graphs reveals that even though there are a high number of vehicles arriving in the afternoon, they do not contain many prisoners.

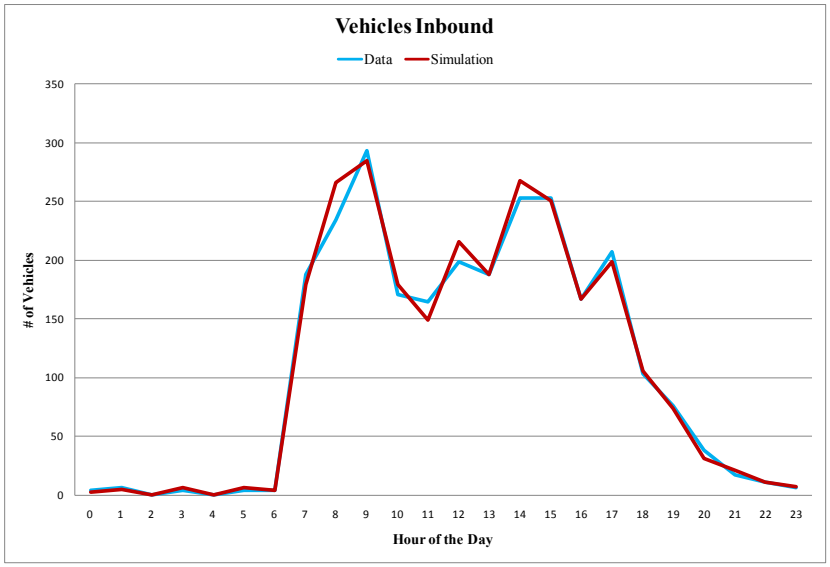

Figure 5: Vehicles arriving to prison by hour of day

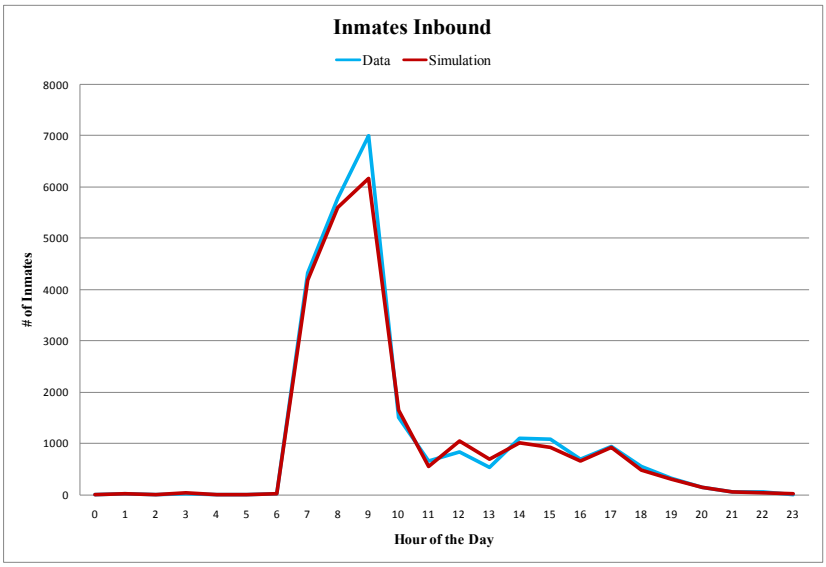

Figure 6: Inmates arriving to prison by hour of day

The validation process also compares the KPI values to the current statistics received from the prison system. For example, the simulation showed the current process at one of the prisons would take four hours to complete the first day's activities and an additional two hours to complete the medical diagnostics on day three. This correlated with the data received from the prison. If the KPI values were not within proximity of the actual performance of the prison, the developers may need to analyze and adjust the model for accuracy.

Once the simulation model was validated, the developers were able to start experimentation. This included adjusting the arrival and departure times of county buses, adjusting the number of resources available in the model, and adjusting business rules such as mixing the inmate population.

3 EXPERIMENTATION RESULTS

3.1 Recommendations

Over 350 simulation scenarios were run through the model. The future process proved to be more efficient than any of the current operating procedures. The new process could complete a higher percentage of prisoners within six hours compared to all current receiving processes.

Some scenarios had a huge improvement to the performance of the model. The single most effective scenario mixed the inmate populations. If the GP inmates are able to be out on the floor at the same time, it greatly reduced the amount of time it takes an inmate to complete the reception process. In one prison, the future model completed only 36% of the inmates within six hours, but if GP inmates were able to integrate, the percentage rose to 69% completed in six hours. As discussed earlier, if the wrong inmate populations are mixed, this could prove fatal. In order to mix the GP inmates, CDCR would need to adjust the arrival patterns. If the facility could receive inmates from Southern counties on Mondays, Wednesdays and Fridays and inmates from Northern counties on Tuesdays and Thursdays, this would put only compatible inmates in the R&R area at one time, thus allowing GP inmates from multiple counties to be out on the floor at one time. One of the prisons being modeled had just started experimenting with this idea with excellent results.

Other scenarios did little to improve the number of inmates completed within six hours. Reducing the amount of property an inmate brings with them to the facility is an example. The staff believed this was the largest bottleneck in the system. There were abundant complaints that too much time was wasted going through the inmates' possessions looking for contraband. The results from the scenario produced a 1% improvement in the percent of inmates complete in six hours. This showed that even though this might be an ill favored activity, it is not the bottleneck of the process. Even though it did not save much time towards completing inmates faster, other KPIs showed the prison would save 25 to 40 hours per week in staffing by reducing this time. The bottleneck of the operation was found to be the medical screening process. This process includes multiple lengthy activities. In order for the medical diagnostics to keep up with the other processes, the prison needs to hire two more RNs. This action alone will give a 42% increase in the percent of inmates complete in six hours.

The other two suggestions decrease the amount of time it takes an incoming prisoner to go from the bus to the cell and an outgoing prisoner to go from the cell to an outbound vehicle. If CDCR institutes these five recommendations, they can improve the percent of inmates complete in six hours from 36% to 91%. As discussed earlier, the prisons will not be able to complete 100% of the inmates in six hours even with combining the GP prisoners. Figure 7 is similar to figure 4 previously shown, but now the GP inmates from both counties are combined. The KPIs show the prison has the ability to complete a higher percentage of inmates within the six hour goal, but never reach 100% of the inmates.

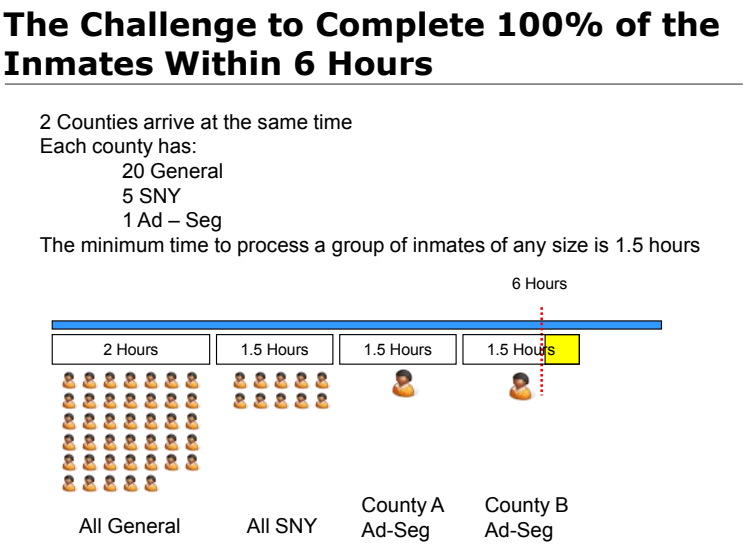

Figure 7: Future process defines new operating goal

4 CONCLUSION

The information and recommendations delivered at the conclusion of the project were well received by both CDCR and the Receiver's office. Figure 8 illustrates the opportunity the prison has to improve the percent of prisoners ready to go to housing within six hours. In order to effectively accomplish the mixing of inmates in the R&R, the prison system must establish coordination between the 33 prisons in the state, and local county sheriffs' departments.

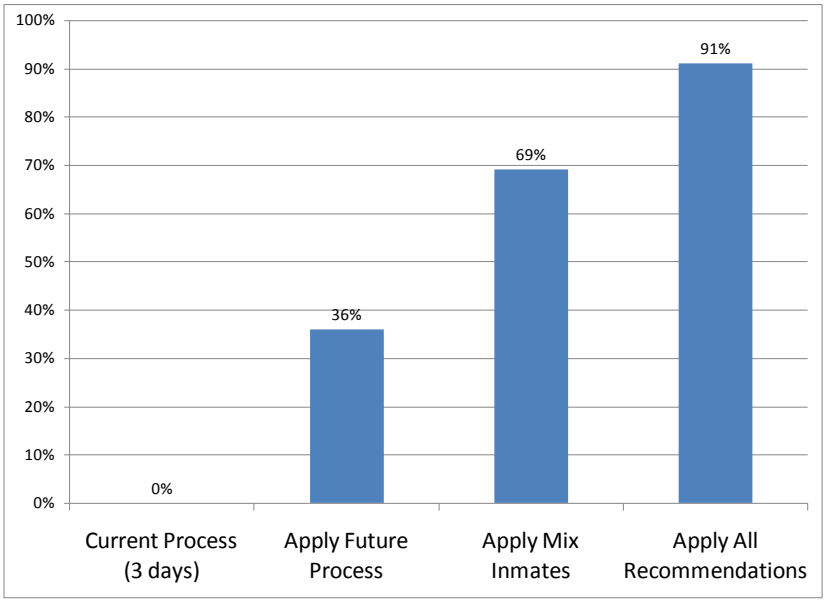

Figure 8: Percent of inmates complete within six hours

By following all of the recommendations, the goals of both CDCR and the Receiver are achieved. Inmates are able to receive medical attention within a timely manner while both guards and inmates are safe in the process. The Receiver understood that completing 100% of the inmates within six hours was not possible. A recommendation was made to start with a goal of 75% of the inmates complete within six hours and increase the percentage as prisons adjust their processes to match the process developed by the committee.

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