Demonstration and Training on the Population Monitoring Throughput Estimation Tool

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SEREP Workshop

Nashville, TN

How long will it take to screen 10,000 people?

IT DEPENDS…

Review of Throughput Estimation

Breakdown of Throughput Estimation

- **Availability of resources**
- **Staffing**
- **Service Times**

Breakdown of Throughput Estimation

- Availability of resources
- Staffing
- **Service Times**

Current Service Times and Throughput Estimated

- **Based on limited measurements and educated guesses**
  - "The monitoring productivity rate per hour is the number of evacuees that can be monitored, per hour, by the total complement of monitors using an appropriate procedure…Monitoring sequences for the first six simulated evacuees per monitoring team will be timed… to determine where the 12 hour requirement can be met"*

This means:

$$Throughput_{hourly} = 20\% \text{ EPZ population / 12 hours}$$

$$Throughput_{hourly} = 1/\bar{T} * \#\ of\ Portal\ Monitors$$

$$\bar{T} = Avg\ Monitoring\ Time\ for\ 6\ individuals\ (hours)\ at\ 1\ portal$$

*Assessment Area 6.a FEMA REPP Manual January 2016 https://www.fema.gov/media-library/assets/documents/108189

TIMING DATA COLLECTION AND ANALYSIS

Comparison of Real Time Data

	Portal Monitor			Partial Body Screening w/ GM			Full Body Screening w/ GM		
Minimum Time (mm:ss)	00:01	00:01	00:06	0:04	00:04	00:24	00:32	00:04	02:00
Average Time (mm:ss)	00:18	00:22	00:15	01:28	01:28	00:47*	03:22	02:51	03:54*
Maximum Time (mm:ss)	04:05	06:21	00:45	08:02	08:02	01:00	11:17	11:17	05:00

Regional Exercise Data | National Exercise Data | FEMA REP 21/22

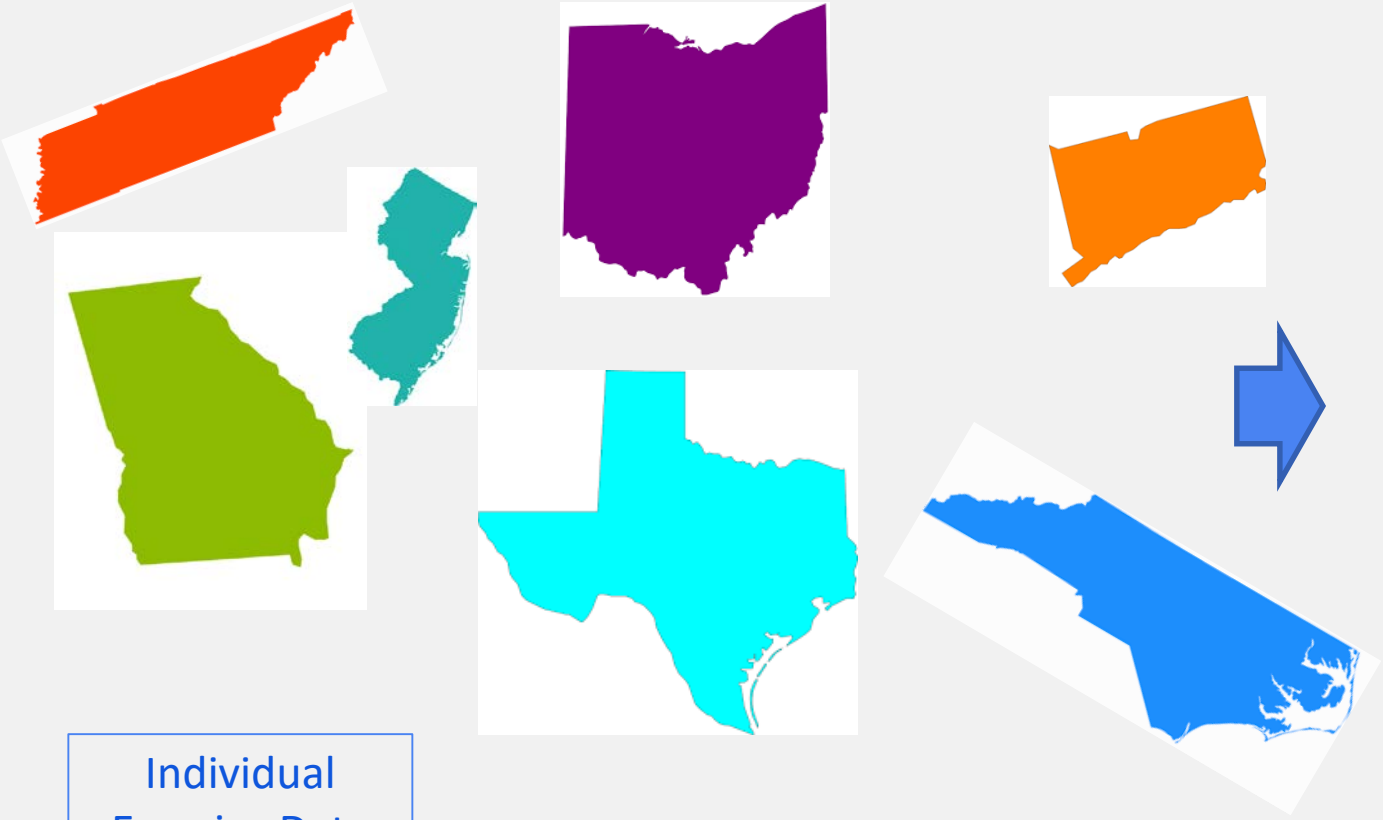
- * Numbers taken from FEMA *BACKGROUND INFORMATION ON FEMA-REP-22: CONTAMINATION MONITORING GUIDANCE FOR PORTABLE INSTRUMENTS USED FOR RADIOLOGICAL EMERGENCY RESPONSE TO NUCLEAR POWER PLANT ACCIDENTS https://www.remm.nlm.gov/background_info_on_fema-rep-22_october.pdf Table 4*

Importance of Sample Size

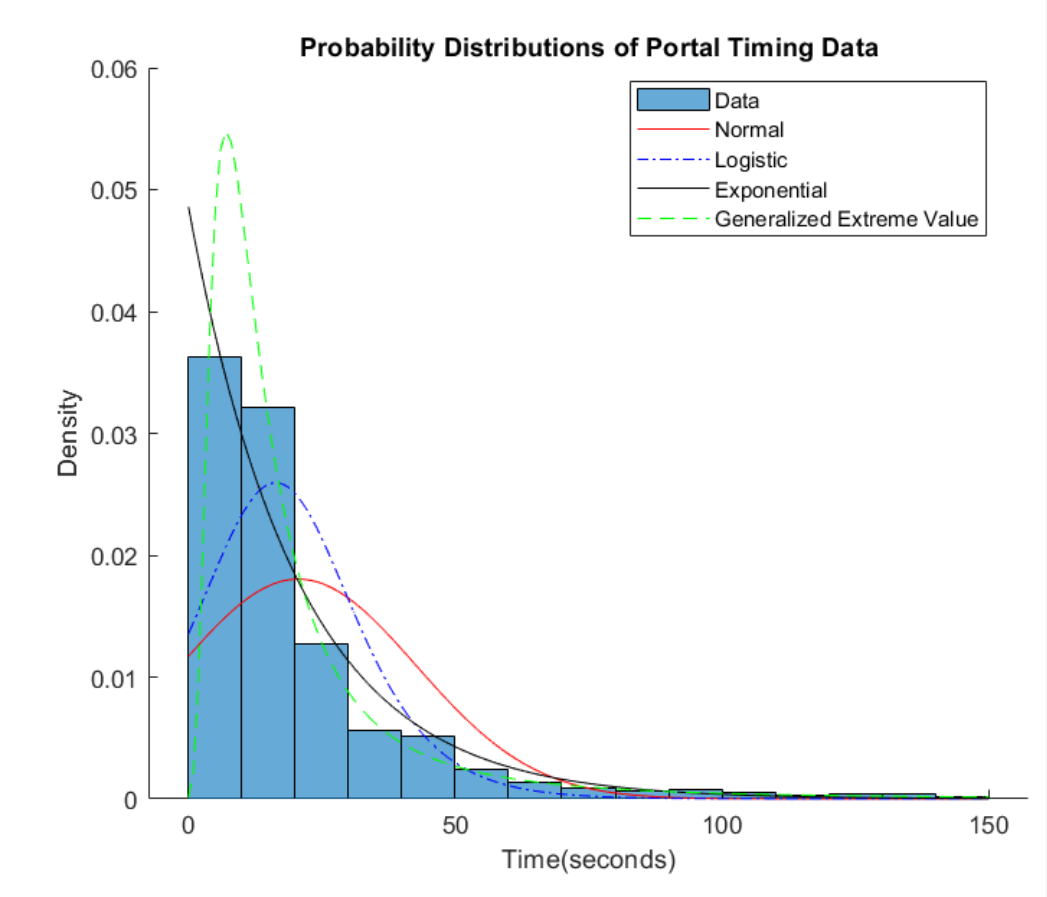
Service times can vary due to:

- **Staff training**
- **Individual needs:**
  - Additional instructions
  - Translation
  - Mental and behavioral health

Timing Data Collection and Distribution Fitting



Individual Exercise Data



Fitted Timing Distributions

Throughput Timing Exercises

What you would be tasked to do:

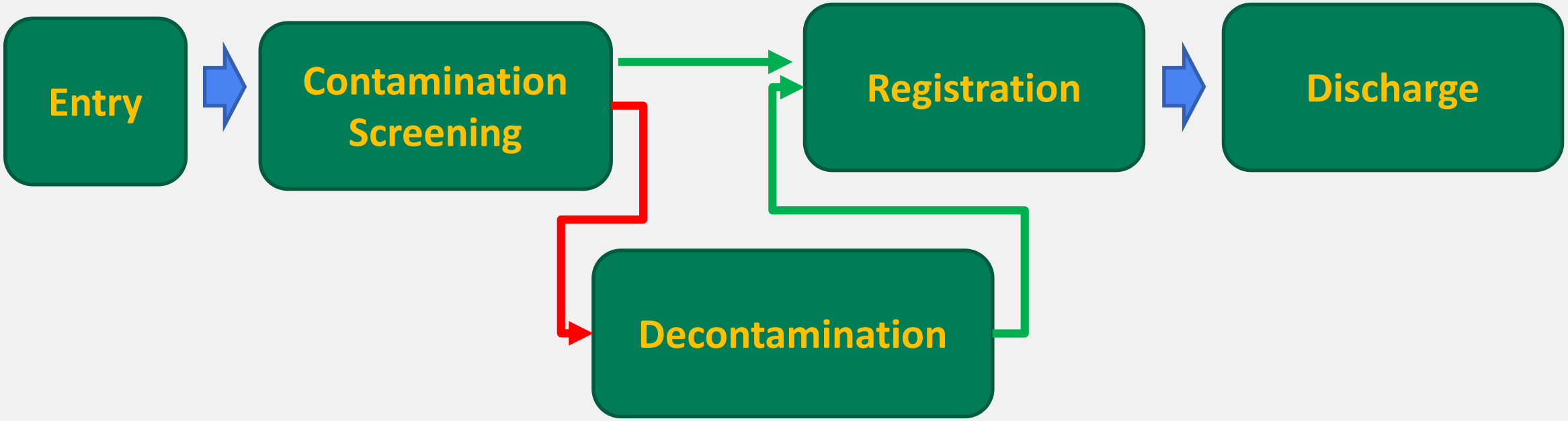
- Coordinate exercise dates, staff, location, resources
- Create and implement population monitoring plan
- Provide training to all staff (with the exception of actors and timekeepers)
- Provide additional staff or volunteers to act as timekeepers
- Have at least 20 individuals run through each station that will be timed

What will provided for you:

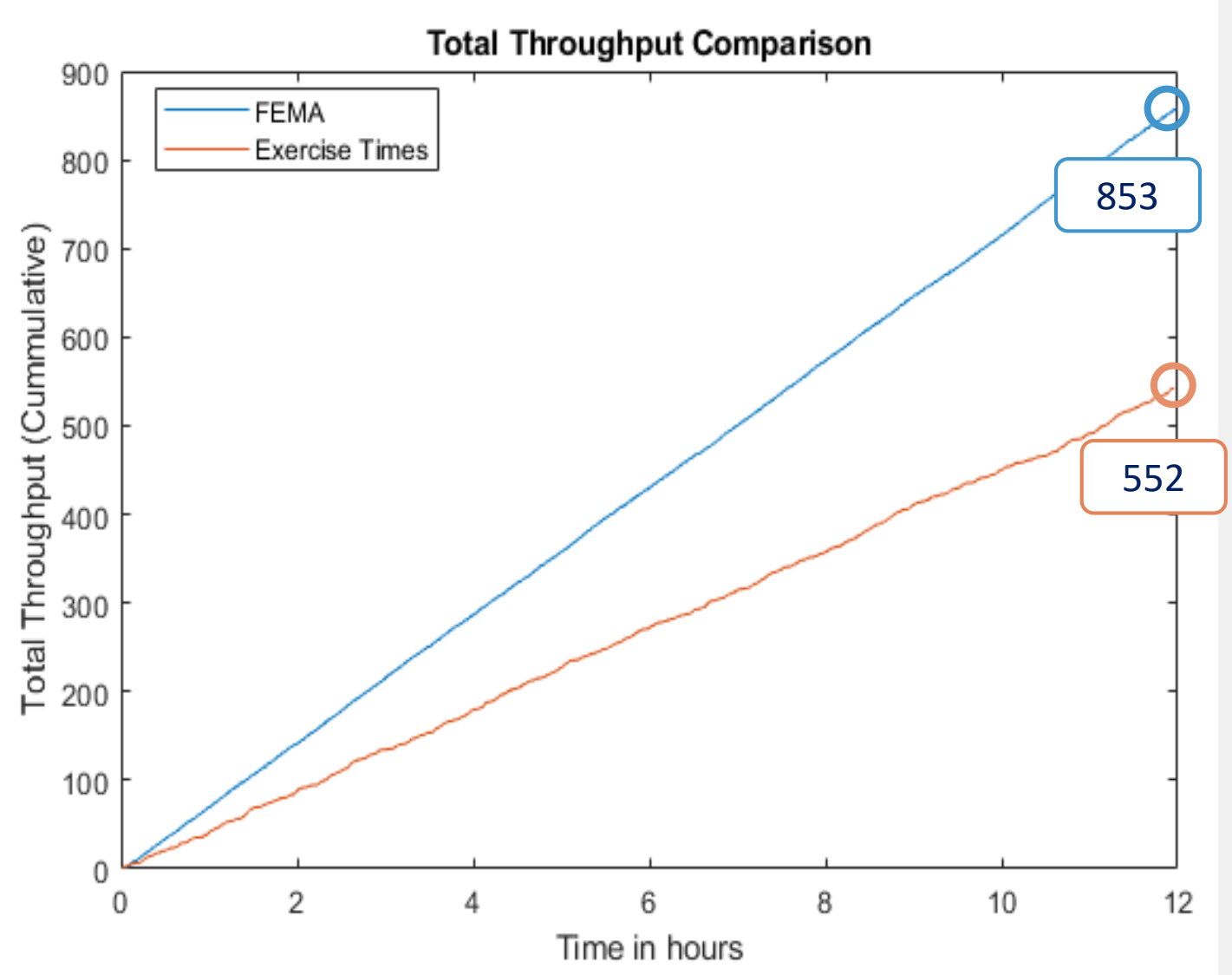
- Timekeeping forms and training
- Actor cards and just-in-time training
- Coordination of collection of timekeeping data
- Data entry of timekeeping data
- Detailed report and summary of exercise timing data
- Calculated hourly throughput based on exercise data
- Additional assistance for population monitoring guidance if desired

COMPARING THROUGHPUT CALCULATIONS

Simplified CRC Flow Diagram



Throughput Estimate Using Modelling and Simulation



- **Assumptions**
  - 2 portal monitors
  - 100 people arriving hourly
  - Simple flow diagram
  - 1% individuals contaminated
  - 4 registration desks
  - 2 showers
  - 12 hour shift

Throughput Estimate using FEMA REP-22 Equation

Recall:

$Throughput_{hourly}$ = 20% EPZ population / 12 hours

$$Throughput_{hourly} = 1/\bar{T} * \#\ of\ Portal\ Monitors$$

$$\bar{T} = Avg\ Monitoring\ Time\ for\ 6\ individuals\ (hours) at\ 1\ portal$$

Let's Assume:

$Throughput_{hourly}$ = 10,000/ 12 hours = 833 ppl/hr

Over 4 CRCs = 208 *ppl/hr*

$$Throughput_{hourly} = 1/\bar{T} * \#\ of\ Portal\ Monitors\ (\mathbf{2})$$

Based on Timing Data Collections:

$$Throughput_{hourly} = \frac{171\ ppl}{hr} * 2\ portals$$

$$Throughput_{hourly} = \mathbf{342\ ppl/hour}$$

Based on FEMA REP Manual (15 seconds):

$$Throughput_{hourly} = \frac{240\ ppl}{hr} * 2\ portals$$

$$Throughput_{hourly} = \mathbf{480\ ppl\ /hour}$$

EPZ – Emergency Planning Zone; ppl – People ; CRC – Community Reception Center; REP – Radiological Emergency Preparedness

Throughput Estimate Comparison for 12 hour Shift

- **Model and Simulation Estimates:**
  - Exercise Data

    12 hour Average: 552 ppl
  - FEMA Manual

    12 hour Average: 853 ppl

- **FEMA REP 22 Equation:**
  - Exercise Data
    - 4104 ppl
  - FEMA Manual
    - 5760 ppl

How much of a difference can this really make?

Method of Calculation	1 CRC	3 CRCs	10 CRCs
REP Assumptions + REP-22 Equation	5760	17280	57600
Exercise Data + Model Simulation	552	1656	5520

More than a factor of **10** difference depending on the method of calculation

Note that this is for one 12 hour shift assuming all CRCs are equally staffed and getting the same population arrival

CRC SimPLER

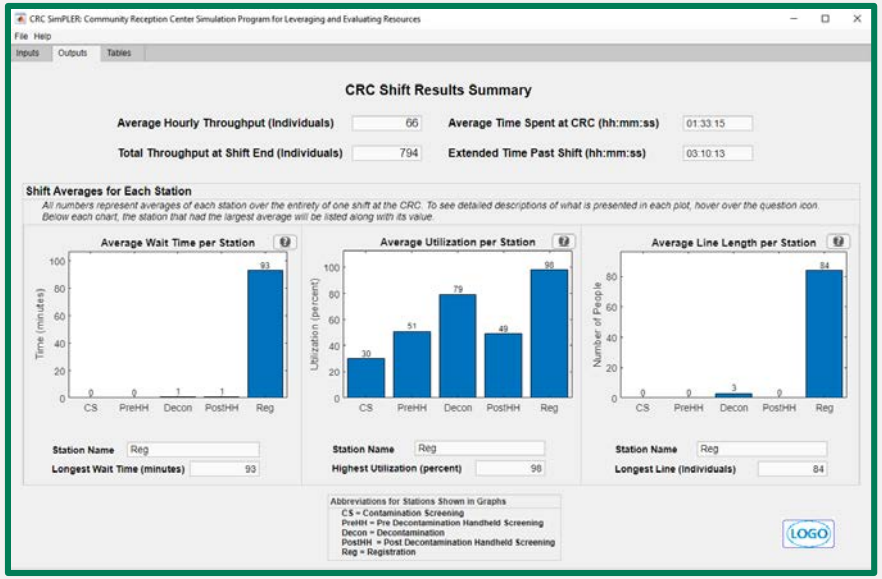
Community Reception Center

Simulation Program for Leveraging and Evaluating Resources

CRC SimPLER Features

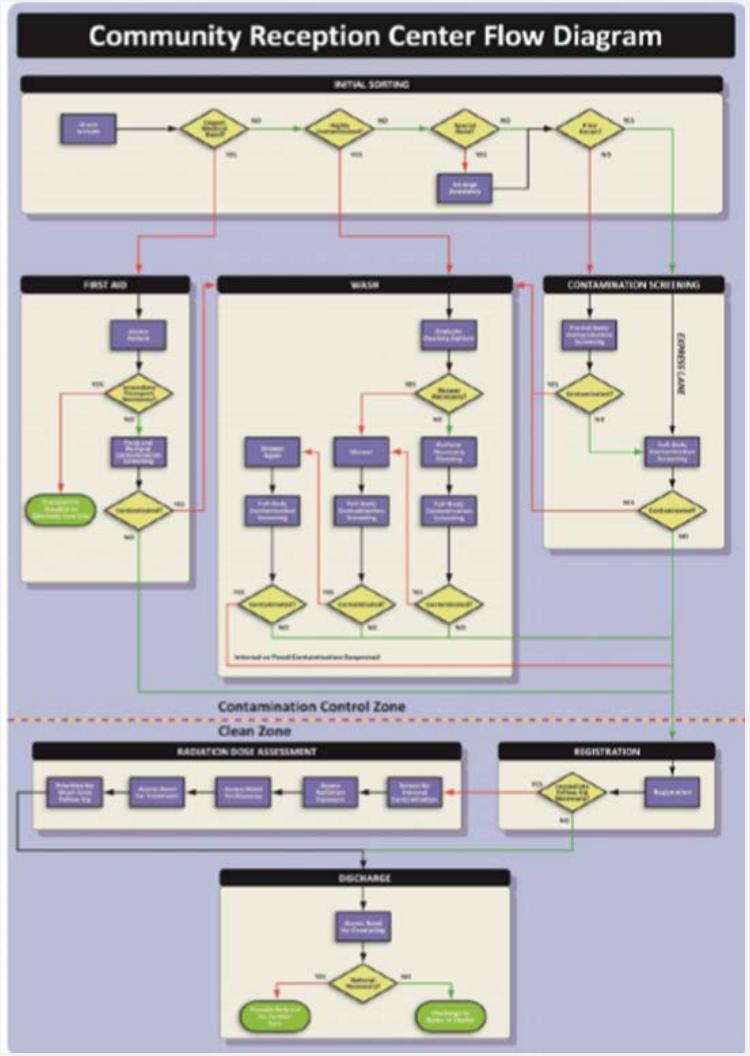
Community Reception Center Simulation Program for Leveraging and Evaluating Resources

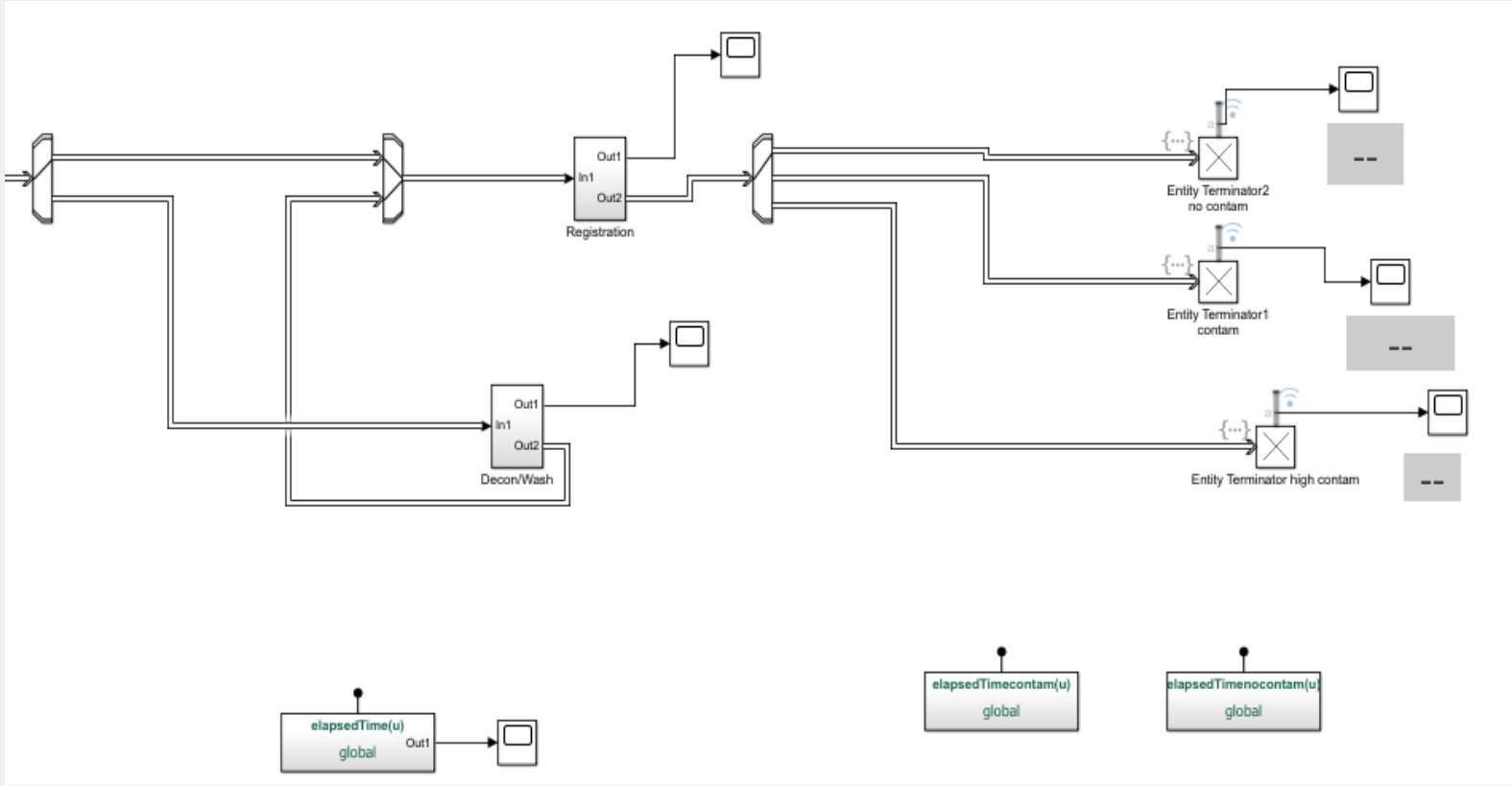
- **Throughput calculator for radiation monitoring and decontamination**
- **Integrates real timing data**
- **Easily used by Public Health and Emergency Management with no end user cost**
  - Graphical outputs
- **Flexible and Scalable**
  - Adjustable CRC capabilities (Basic models to more advanced)
  - Allows for addition of new stations at CRCs
  - Updatable as timing data collected
- **Uses MATLAB ® and Simulink ® Software**



MATLAB and Simulink Release 2017b, The MathWorks, Inc., Natick, Massachusetts, United States.

Modeling and Simulation





DEMO TIME

Get ready for some audience participation!

What is your role in REP?

- Emergency Manager
- Public Health
- Radiation Professional
- Other

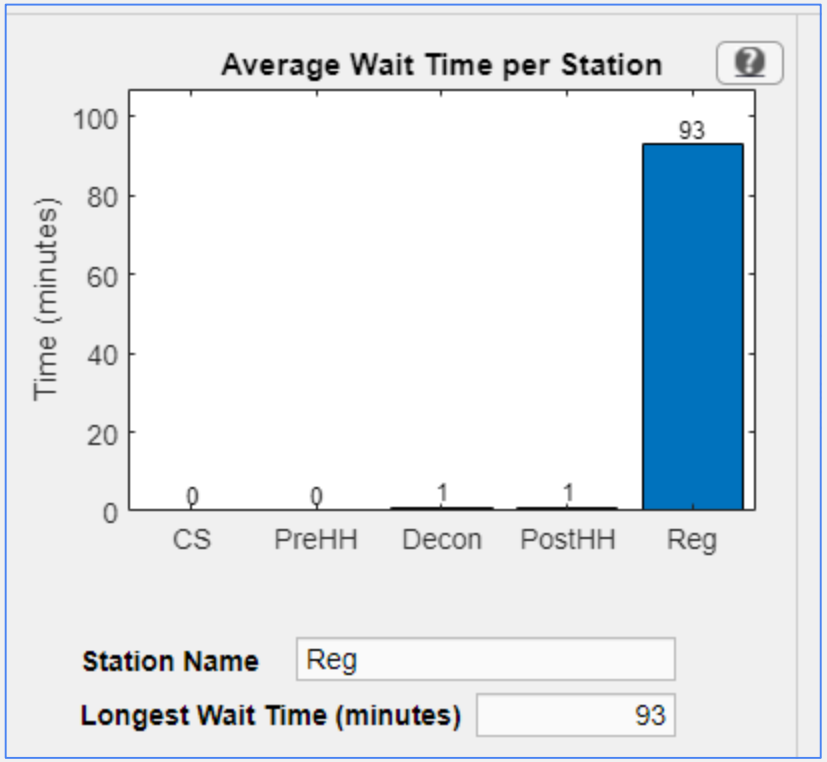
Of the following choices, what do you think Enable Arrival Distribution options will do?

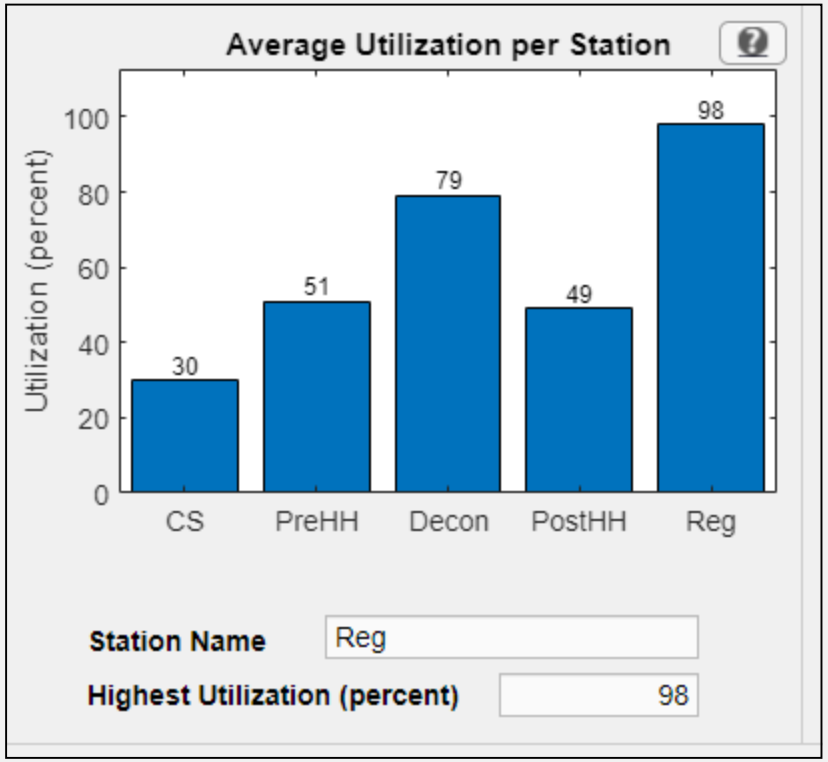
- Have some of the population arrive before the CRC is open
- Give options for the arrival rate to change
- Affect the demographics of the population
- Other

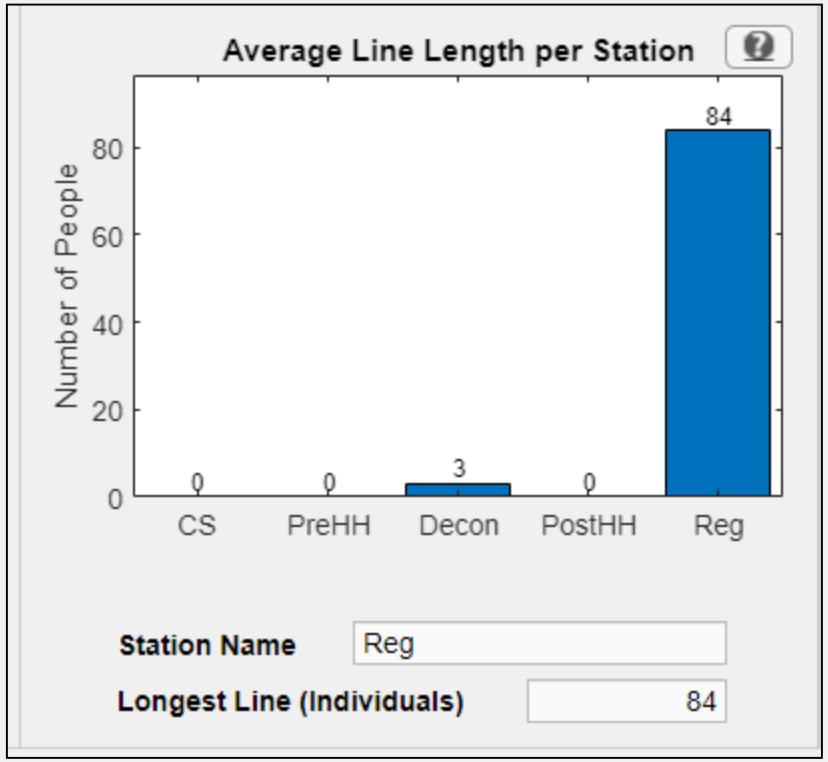
Of the following choices, which other stations would you like to see?

- Vehicle monitoring
- Dose Assessment
- KI Distribution
- Animal monitoring
- Other

Which graph provides you with the strongest justification to add a resource?







Wait

Utilization

Line Length

What information is most useful when providing justification to decision makers?

- Hourly throughput
- Total throughput
- Average Time spent by one person at crc
- Overtime
- Average Wait time
- Average Utilization
- Average Line Length

Next steps

Timing Data Collection at Exercises

- Need host sites for throughput timing at exercises
  - Total throughput estimates
  - Station specific timing data

CRC SimPLER User Testing

- Validation at Exercises
- External testing

Let me know if you are interested in participating!

Contact Lauren Finklea, LNA8@cdc.gov for information

For more information, contact NCEH
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov
Follow us on Twitter @CDCEnvironment

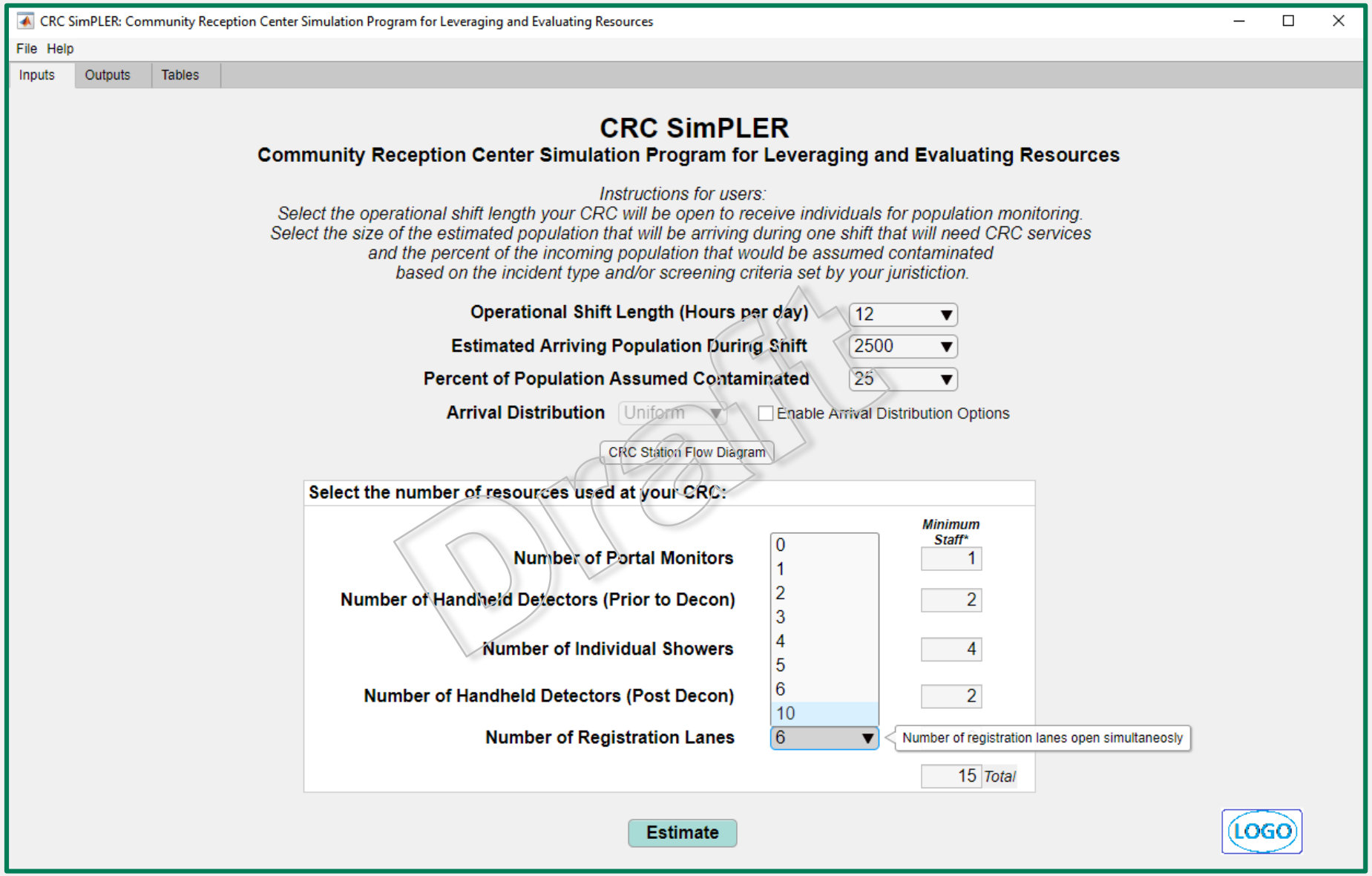
The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

ADDITIONAL SLIDES – WALK THROUGH

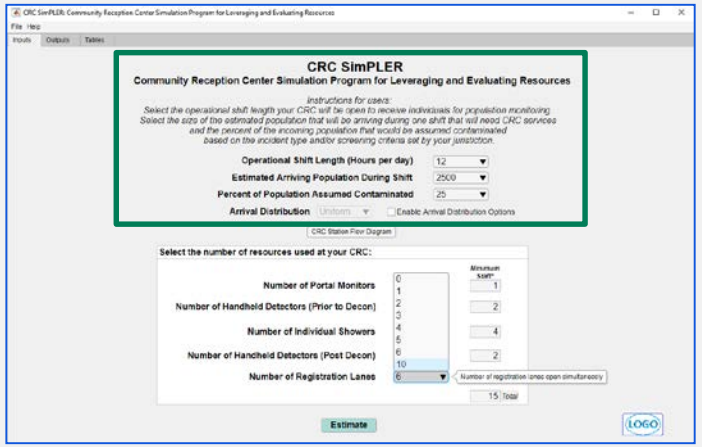
These slides walk through the CRC SimPLER Interface

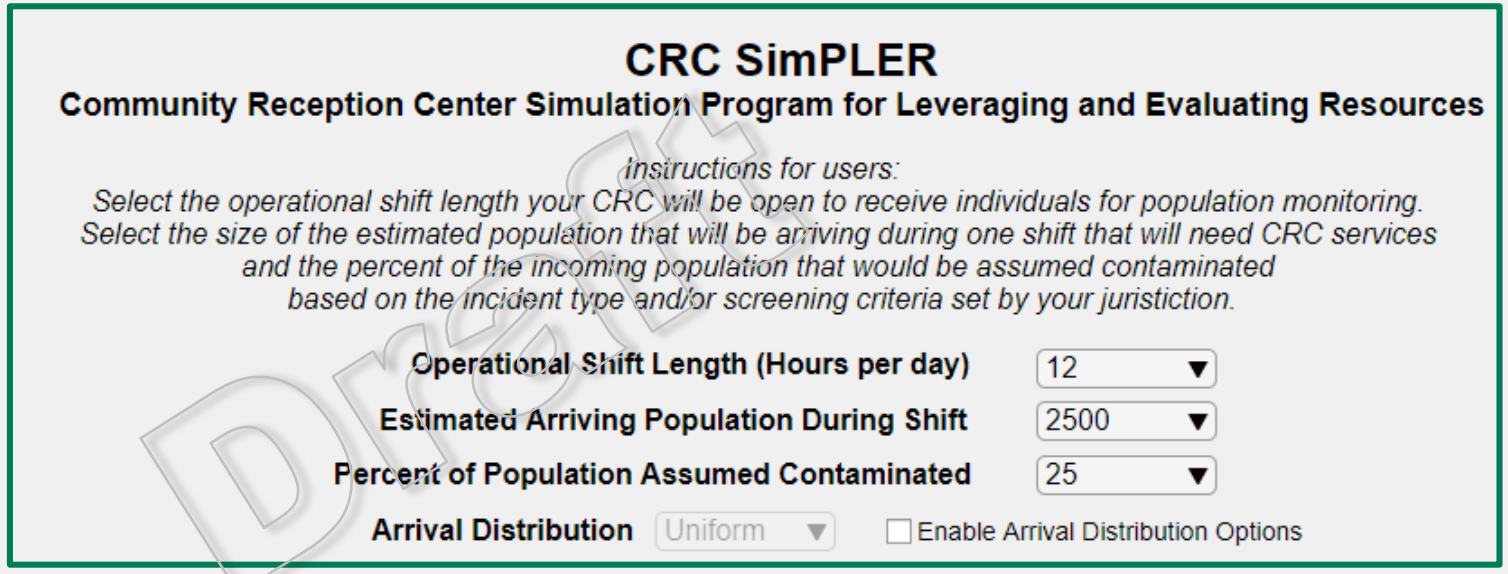
How many people can I screen in 12 hours with my current resources?

Sample Interface



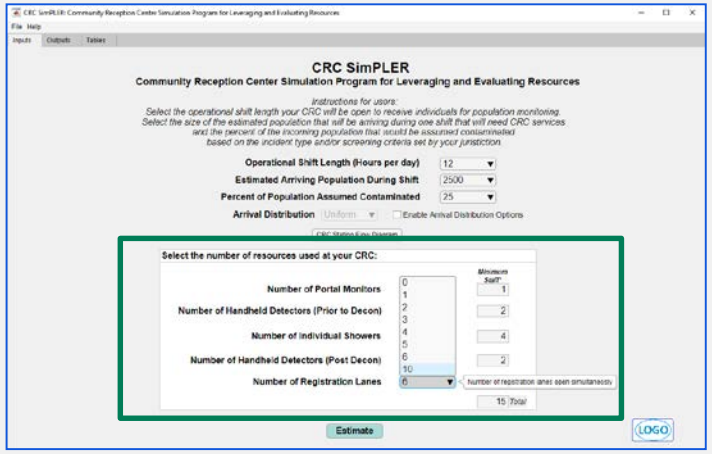
Sample Interface – Closer Look

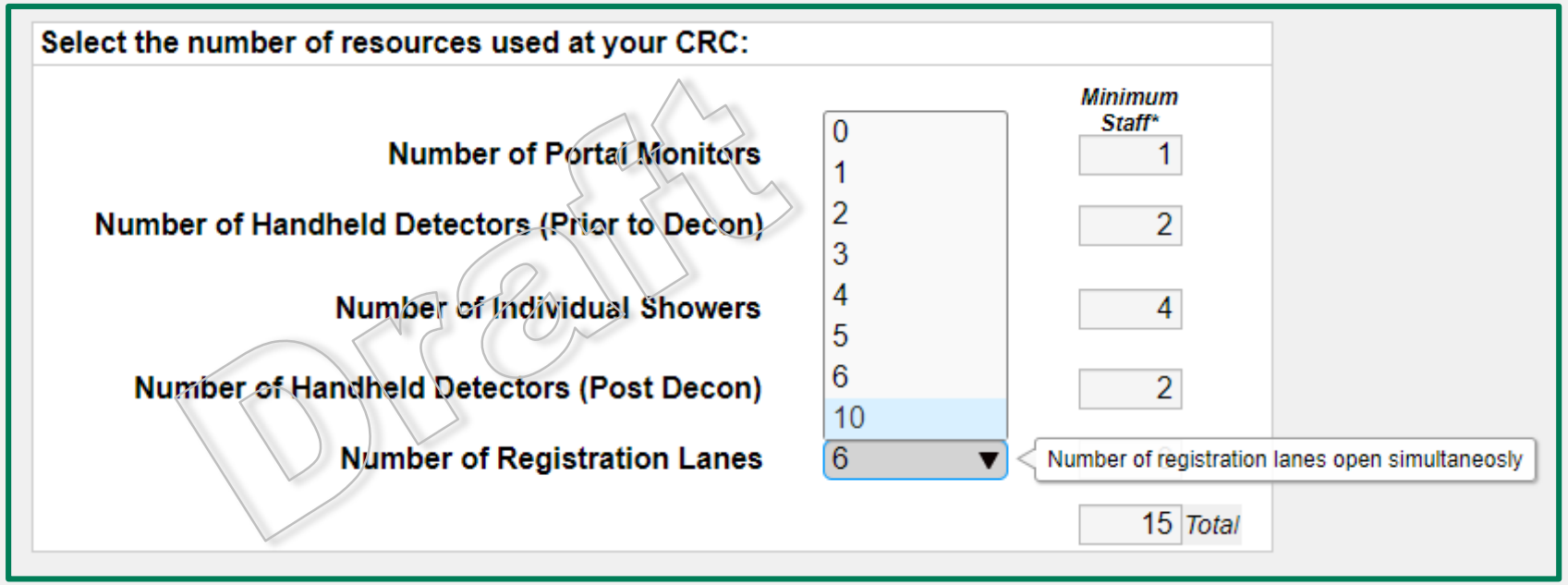




- **Average Hourly Throughput –** Number of individuals being processed each hour
- **Total Throughput at Shift End –** Number of individuals processed by the end of the shift
- **Average Time Spent at CRC -** Amount of time an individual would take to be processed through the CRC
- **Extended Shift Time -** Amount of time past the end of the shift that CRC would need to stay open to finish servicing population

Sample Interface – Closer Look





- ***Minimum Staff** – Minimum number of staff assumed needed to use resources or have lanes open. This number is not tied to throughput estimates as staffing can vary from plan to plan. Staffing number feature was requested in previous meetings and is not final.

Sample Output Summary

CRC SimPLER: Community Reception Center Simulation Program for Leveraging and Evaluating Resources

File Help

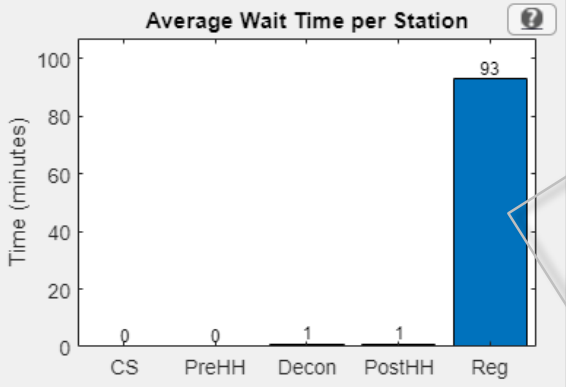
Inputs | Outputs | Tables

CRC Shift Results Summary

Average Hourly Throughput (Individuals)	66	**Average Time Spent at CRC (hh:mm:ss)**	01:33:15
Total Throughput at Shift End (Individuals)	794	**Extended Time Past Shift (hh:mm:ss)**	03:10:13

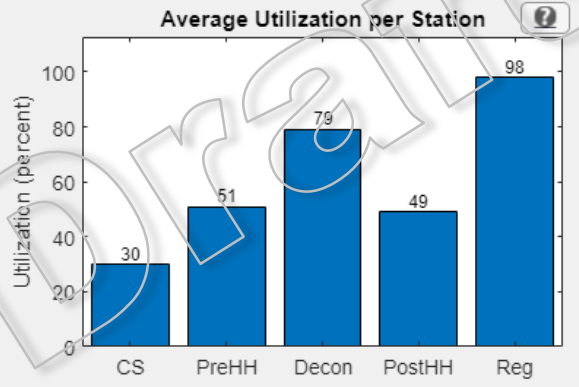
Shift Averages for Each Station

All numbers represent averages of each station over the entirety of one shift at the CRC. To see detailed descriptions of what is presented in each plot, hover over the question icon. Below each chart, the station that had the largest average will be listed along with its value.



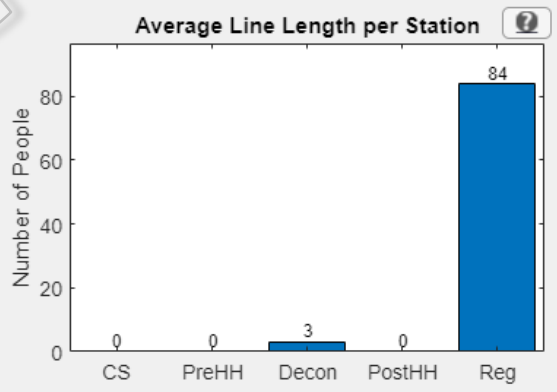
Station Name Reg

Longest Wait Time (minutes) 93



Station Name Reg

Highest Utilization (percent) 98



Station Name Reg

Longest Line (Individuals) 84

Abbreviations for Stations Shown in Graphs

CS = Contamination Screening
PreHH = Pre Decontamination Handheld Screening
Decon = Decontamination
PostHH = Post Decontamination Handheld Screening
Reg = Registration

LOGO

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Sample Output Summary – Closer Look

CRC Shift Results Summary

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- **Average Hourly Throughput –** Number of individuals being processed each hour
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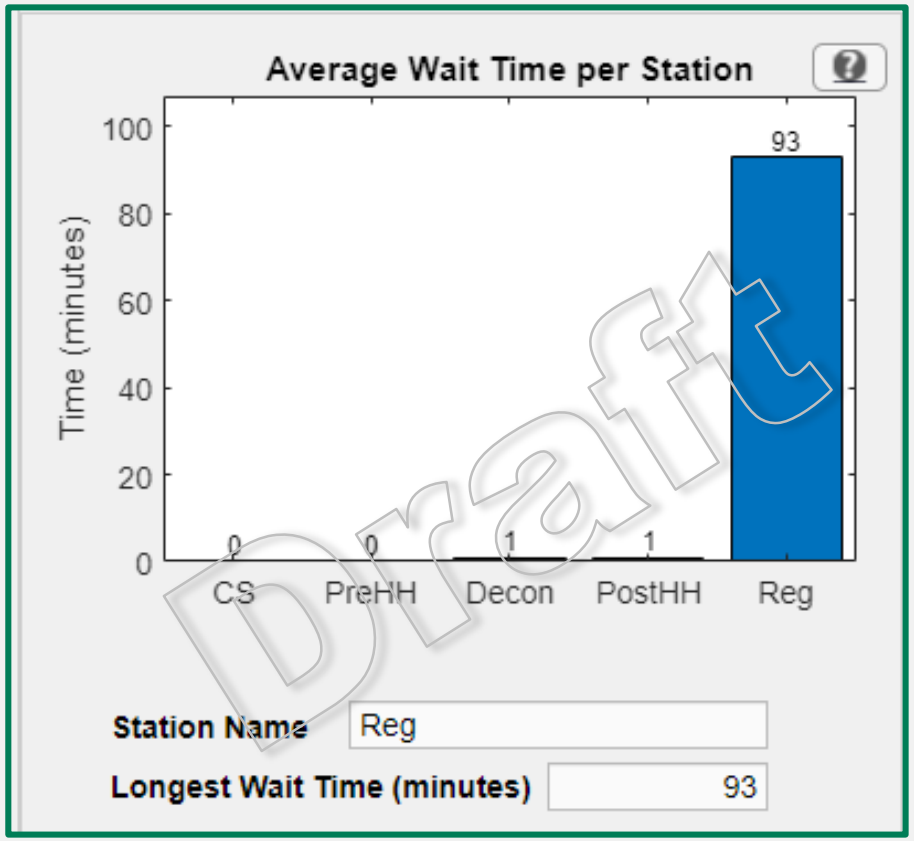
Sample Output Summary – Average Wait Time



- **Average Wait Time per Station–** Amount of time individual is standing in line before being serviced at each station in minutes

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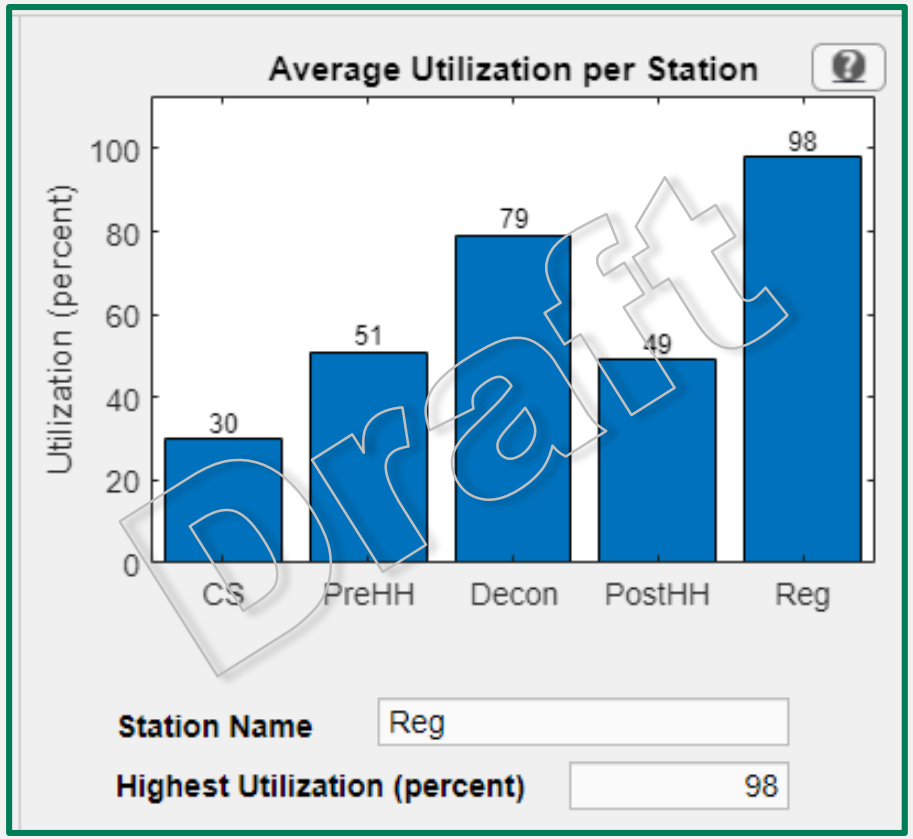
Sample Output Summary – Average Utilization



- **Average Utilization per Station–** Percent of time the station is occupied over course of shift (how busy the station is)

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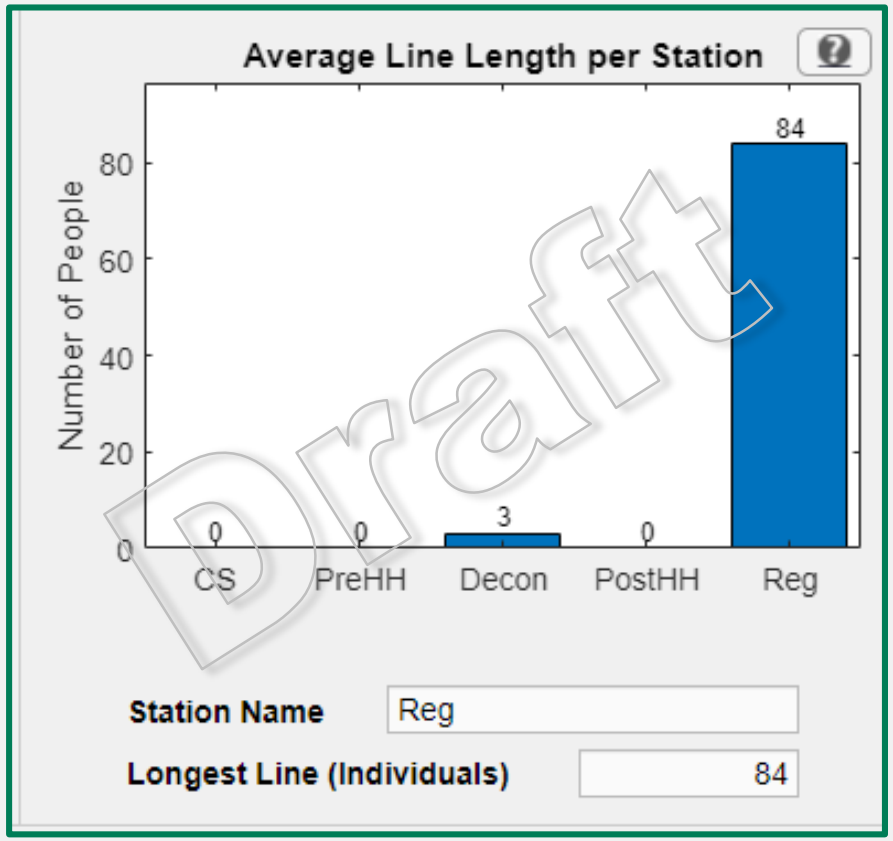
Sample Output Summary – Average Line Length



- **Average Line Length per Station–** Number of individuals waiting in line at each station

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Reg = Registration

Detailed Table of Output Data

Station Name	Average Wait Time (min)	Wait Time STD	Average Utilization (%)	Utilization STD	Average Line Length (people)	Line Length STD
Portal	0	0	30	5	0	0
Handheld Screenin…	0	0	51	3	0	0
Decontamination(S…	1	0	79	2	3	1
Handheld Screenin…	1	0	49	3	0	0
Registration	93	14	98	1	84	15

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“What if” Comparison

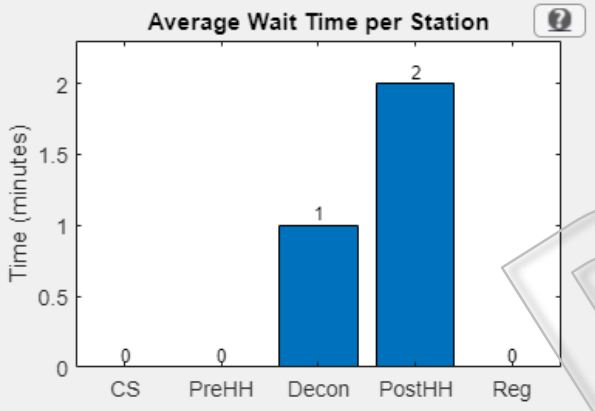
Inputs | Outputs | Tables

CRC Shift Results Summary

Average Hourly Throughput (Individuals)	82	Average Time Spent at CRC (hh:mm:ss)	00:09:52
Total Throughput at Shift End (Individuals)	985	Extended Time Past Shift (hh:mm:ss)	00:24:27

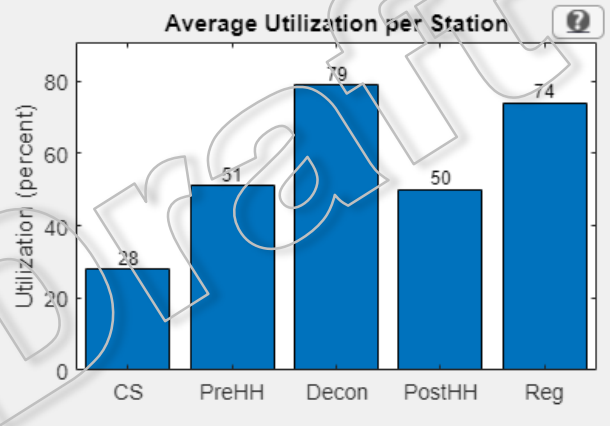
Shift Averages for Each Station

All numbers represent averages of each station over the entirety of one shift at the CRC. To see detailed descriptions of what is presented in each plot, hover over the question icon. Below each chart, the station that had the largest average will be listed along with its value.



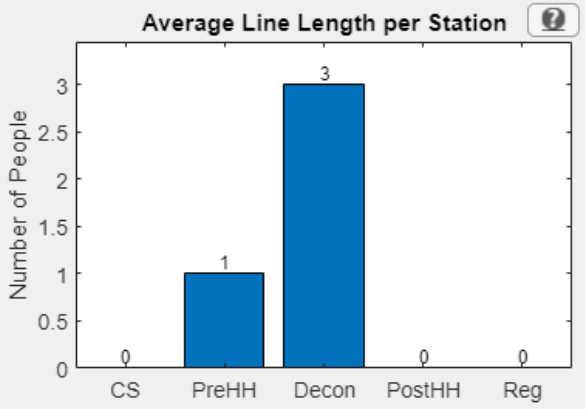
Station Name: PostHH

Longest Wait Time (minutes): 2



Station Name: Decon

Highest Utilization (percent): 79



Station Name: Decon

Longest Line (Individuals): 3

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LOGO

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“What if” Comparison

Original Throughput Summary (6 Registration Lanes)

CRC Shift Results Summary

Average Hourly Throughput (Individuals)	66	Average Time Spent at CRC (hh:mm:ss)	01:33:15
Total Throughput at Shift End (Individuals)	794	Extended Time Past Shift (hh:mm:ss)	03:10:13

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Comparison Throughput Summary (10 Registration Lanes)

CRC Shift Results Summary

Average Hourly Throughput (Individuals)	82	Average Time Spent at CRC (hh:mm:ss)	00:09:52
Total Throughput at Shift End (Individuals)	985	Extended Time Past Shift (hh:mm:ss)	00:24:27

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Increasing Registration Lanes from 6 to 10:

- ✓ Average Hourly Throughput ↑ 24%
- ✓ Total Throughput at Shift End ↑ 24%
- ✓ Average Time Spent at CRC ↓ 89%
- ✓ Extended Shift Time ↓ 86%