

Decontamination centers provide sterilization services for reusable surgical instruments that have a vital impact on patient safety. They are required to sort, disinfect, package, and sterilize surgical instruments before their return to operating rooms and other hospital clinics. This assignment is about creating a simplified model of a decontamination center and analysing some scenarios for improving the system.

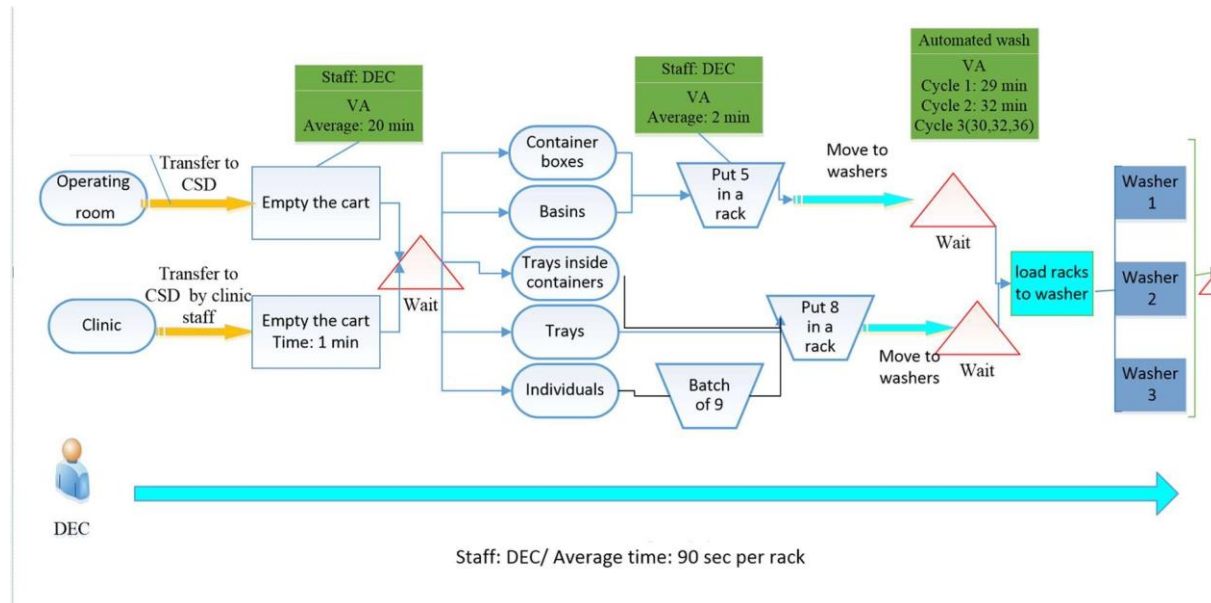
Entity types

There are different types of surgical instruments.

- Container: a box that contains a tray of the instrument inside it.
- Basin: a bowl shape plate used in operating rooms.
- Tray: a tray containing some instruments
- Individual: instruments which are treated individually (not inside a box or tray).

Processes:

There are two separate departments in a decontamination center. The first area is called the decontamination area where infected instruments arrive. These instruments arrive in a cart together and should be separated and placed in washing machines (also called disinfectors). Three washing machines have another door that opens in the second department called the sterilization area. These two departments are only linked by the doors of washing machines to avoid contamination between dirty and clean instruments. In the decontamination area:



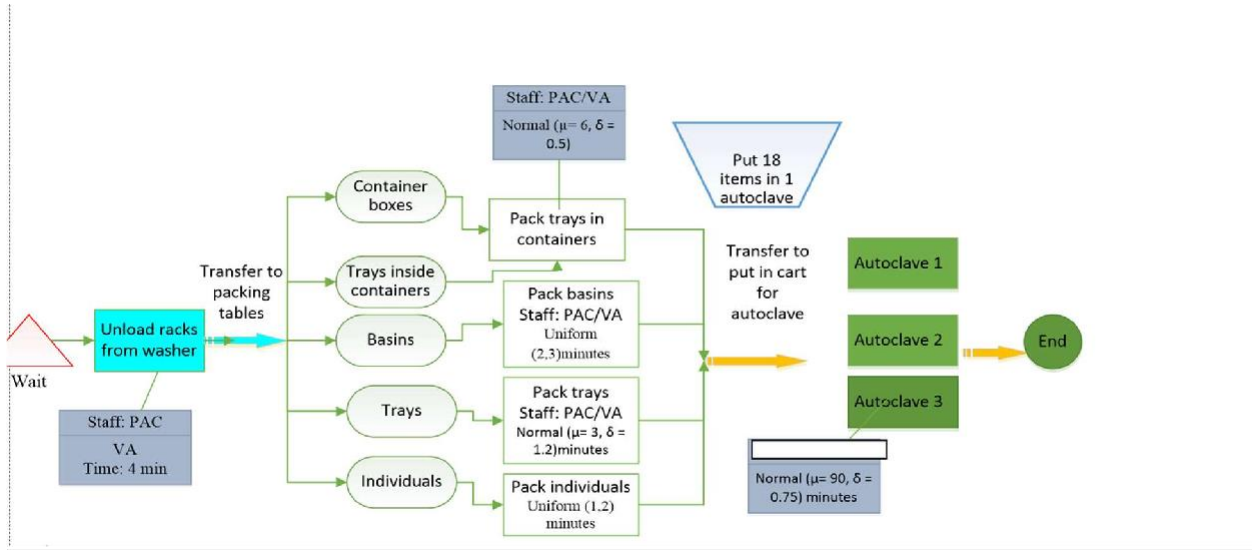
Instruments arrive from **operation rooms** and **clinics** based on this schedule:

Day	Simulation time	Time of day	Basin	Container	Tray	Individual
Day 1	1	8-9	0	0	10	28
	2	9-10	4	6	7	7
	3	10-11	8	13	14	14
	4	11-12	7	11	13	13
	5	12-13	4	6	7	7
	6	13-14	4	6	27	63
	7	14-15	3	5	5	5
	8	15-16	5	8	9	9
	9	16-17	4	6	7	7
	10	17-18	0	0	0	0
	11	18-19	0	0	20	56
	12	19-20			8	15
	13	20-21			8	15
	14	21-22			8	15
Day 2	18	8-9	0	0	7	23
	19	9-10	7	10	21	28
	20	10-11	4	6	12	16
	21	11-12	8	11	24	32
	22	12-13	5	7	15	20
	23	13-14	6	8	32	70
	24	14-15	4	6	12	16
	25	15-16	5	7	15	20
	26	16-17	6	8	18	24
	27	17-18	4	6	12	16
	28	18-19	2	3	20	54
	29	19-20			8	15
	30	20-21			8	15
	31	21-22			8	15
Day 3	34	8-9	0	0	10	10
	35	9-10	1	2	2	3
	36	10-11	3	5	5	10
	37	11-12	7	11	13	24
	38	12-13	2	3	4	7
	39	13-14	5	8	30	36
	40	14-15	5	8	9	17
	41	15-16	5	8	9	17
	42	16-17	1	2	2	3
	43	17-18	3	5	5	10
	44	18-19	2	3	25	26
	45	19-20			8	15
	46	20-21			8	15
	47	21-22			8	15
Day 4	51	8-9	0	0	15	23

	52	9-10	2	4	6	6
	53	10-11	5	9	14	15
	54	11-12	6	11	17	18
	55	12-13	5	9	14	15
	56	13-14	7	13	49	66
	57	14-15	5	9	14	15
	58	15-16	5	9	14	15
	59	16-17	5	9	14	15
	60	17-18	3	5	8	9
	61	18-19	2	4	35	51
	62	19-20			8	15
	63	20-21			8	15
	64	21-22			8	15
Day 5	68	8-9	0	0	9	6
	69	9-10	5	8	10	27
	70	10-11	5	8	10	27
	71	11-12	6	10	12	32
	72	12-13	3	5	6	16
	73	13-14	5	8	29	39
	74	14-15	5	8	10	27
	75	15-16	4	6	8	22
	76	16-17	5	8	10	27
	77	17-18	3	5	6	16
	78	18-19	0	0	19	12
	79	19-20			8	15
	80	20-21			8	15
	81	21-22			8	15

Arrivals at 8 am, 1 pm and 6 pm are from the clinic and other times are from operating rooms. The first process is to empty the arrived cart. The time of this process is TRIA (18,20,25) minutes and the resource is one of the decontamination (DEC) staff. In this process, instruments are out of the cart and are put in a basket named rack to be transferred to the washing machine. If the entity type is the container, it should be opened, and the container box is separated from the tray inside it. Basin and container boxes are put in racks with the capacity of max 5 instruments. Individuals are put in a tray with a capacity of 9 individuals. Trays (including the original tray, the tray of 9 individuals, and the tray inside the container) will be put in a rack with a capacity of 8. Putting instruments in a rack has TRIA (1.5,2,3) minutes. Then the racks should be transferred through washing machines takes TRIA (1, 1.2, 1.5) minutes. When instruments are in the machine their washing cycle is performed automatically. The cycle of Basin: 29 minutes. The cycle of Container box = 32 minutes. The cycle of trays: TRIA (30,32,36).

Sterilization department:



In the sterilization area, instruments should be unloaded from the second door of the washing machine. Unloading takes TRIA (3.5,4,4.5) minutes and is performed by packing staff (PAC). Packing means putting instruments in a package. Also, the container box and its tray should be put together again (you can use the Match module here). Packing process times are identified in the picture. The next process is to put instruments in an autoclave to sterilize them under high temperatures. There are three autoclave machines and the time of process in the machine is identified in the picture. The processes end here. Information about the process is as follows:

Resource schedule:

There are 6 staff in decontamination and 5 staff in packing. The table below shows the schedule of staff according to their pause and lunch/dinner time.

Acronyme	Pause #1	Meal	Pause # 2	Work shift
Dec 1 = PAC 1	9h30-9h45	11h30-12h15	14h15-14h30	8 to 16
Dec 2 = PAC 2	9h45- 10h	12h-12h45	14h15-14h30	8 to 16
Dec 3= PAC 3	10h-10h15	12h-12h45	14h30-14h45	8 to 16
Dec 4		14h30- 15h15	18h45-19h	12 to 20
Dec 5 = PAC 4		15h15- 16h00	18h45-19h15	12 to 20
Dec 6 = PAC 5		18h00-18h45	22h00-22h30	16 to 24

In Arena you can use these table for setting your staff schedule:

dec 1 = pack 1		dec 2 = pack 2		dec 3 = pack 3		Dec 4		Dec 5 = pack 4		Dec 6 = pack 5						
0	4	7:00-8:00	0	4	7h00-8h00	0	4	7h00-8h00	0	20	7h00-12h00	0	20	7h00-12h00	0	36
1	6	8:00-9:30	1	7		1	8		1	10		1	13		1	8
0	1	9:30-9:45	0	1	9h45- 10h	0	1	10h-10h15	0	3	14h30- 15h15	0	3	15h15- 16h00	0	3
1	7	9:45-11:30	1	8		1	7		1	14		1	11		1	13
0	3	11:30-12:15	0	3	12h-12h45	0	3	12h-12h45	0	2	18h45-19h	0	2	18h45-19h15	0	2
1	8	12:15-14:15	1	6		1	7		1	3		1	3		1	6
0	1	14:15-14:30	0	1	14h15-14h30	0	1	14h30-14h45	0	16		0	16			
1	6	14:30-16:00	1	6		1	5									
0	32	after 16	0	32		0	32									

	Name	Type	Time Units	Scale Factor	File Name	Duration
1	DEC 1 schedule	Capacity	Quarterhours	1.0		9 rows

Run setup

Systems works 17 hours per day = From 7 am to 12 am.

Run the model for 85 hours = 5 days

Calculate the number of replications and use it.

Key Importance Factors

Processing time, total time or treatment time:

Total time from the time an instrument arrives at the center to the time it is stored in the storage
(Value added time + Wait time + Transfer time)

Work in process or WIP

Number of instruments that stay in the system at night, to be treated the day after

Queue time

The time that an instrument or a group of instruments wait before a person or machine is available. Consider Queue for washing machine, packing process, and autoclave.

Scenarios:

1- Adding robot

To reduce the time of treatment, WIP and for avoiding ergonomic problems of staff, it is planned to add one or two automotive-guided vehicles (AGV robots) to the system. If an AGV is used in the decontamination area, it will be used to transfer racks to the washing machines which machine which is 14 meters and will also load the rack in the washing machine. Apply this change in

the system and calculate the KPIs and compare the results. Calculate the number of times that the robot is used for transfer and the meters of distances that are saved.

2- One other change in the system

Suggest another scenario for change and calculate the KPIs and compare. These scenarios can be adding staff to DEC group or PAC group, changing the arrival time of instruments from the clinic, renewing washing machines to reduce the washing cycle and other possible changes. Compare the KPIs and suggest your recommendations.

Use process analyzer, where applicable, to compare more than one change. For example, adding 1 or more staff in one department, or comparing 3 scenarios.

3- Sensitivity analysis

For the scenario of adding a robot, increase the arrival rate by 50% and analyse the results before adding and after adding for each scenario (basic and robot added).

You can use the tutorial links provided in Moodle in week 10.

Create a PowerPoint to explain your work. Start with a short introduction, put a picture of your model and explain it, explain your results, and provide a final conclusion and recommendations. Submit all your doe files, including your PowerPoint, your output analyzer, your process analyzer and any other additional files you had.