

Simple Health Clinic – Scheduled HCCM

Problem description

This case study extends the [Simple Health Clinic \(SHC\) model](#). In that case study walk-up patients waited for treatment by a doctor. In this case study an additional doctor is present in the clinic, one that sees patients with scheduled appointments. The second doctor can also treat walk up patients if they are free.

Objectives

The goal of this simulation study is to analyse the average time patients spend:

1. waiting for treatment; and
2. in the clinic;

and the average length of the patient queue (which informs waiting room size). This analysis will include a comparison of the walk-up vs scheduled patients.

Output

Table 1 Output data for the Health Clinic problem

Time Walk-up Patients spend waiting for treatment	Time from Walkup-Patient arrival in clinic to Doctor sees patient
Time Scheduled Patients spend waiting for treatment	Time from Scheduled Patient arrival in clinic to Doctor sees patient
Total time spend in clinic by Walk-up Patients	Time from Walk-up Patient arrives in clinic to Outside
Total time spend in clinic by Scheduled Patients	Time from Scheduled Patient arrives in clinic to Outside
Number of Walk-up Patients in waiting room	The number of Walk-up Patients waiting before Doctor sees patient
Number of Scheduled Patients in waiting room	The number of Scheduled Patients waiting before Doctor sees patient

Input

Table 2 Input data for the Health Clinic problem

Interarrival Times Walk-up Patients	The time between arrival of Walk-up Patients with its distribution
Appointment Times Scheduled Patients	The time Scheduled Patients arrive at the clinic
Treatment Time Walk-up Doctor	The time the Walk-up Patient spends at Walk-up Doctor sees patient with its distribution
Treatment Time Appointment Doctor	The time the Scheduled Patient spends at Appointment Doctor sees patient with its distribution
Waiting room capacity	The maximum number of patients in the waiting room

Entity list

Table 3 Entity list for the Health Clinic problem

No.	Entity	Active/ Passive	Attributes	Unit	Value
1	Treatment Room 1	Passive			
2	Treatment Room 2	Passive			
3	Waiting Room	Passive	WalkUpPatient_Waiting ScheduledPatient_Waiting	Number Number	Max (WalkUpPatient_Waiting + ScheduledPatient_Waiting) = ...
4	Walk-up Patient	Active	WalkUpPatient_Waiting_Time WalkUpPatient_Total_Time	min min	
5	Scheduled Patient	Active	ScheduledPatient_Waiting_Time ScheduledPatient_Total_Time	min min	
6	Walk-up Doctor	Active	WalkUp_Doctor_Shift WalkUpDoctor_Available	Binary- number Binary- number	No shift= 0 Shift = 1 Idle = 0 Busy = 1
7	Appointment Doctor	Active	Appointment_Doctor_Shift AppointmentDoctor_Available	Binary- number Binary- number	No shift= 0 Shift = 1 Idle = 0 Busy = 1

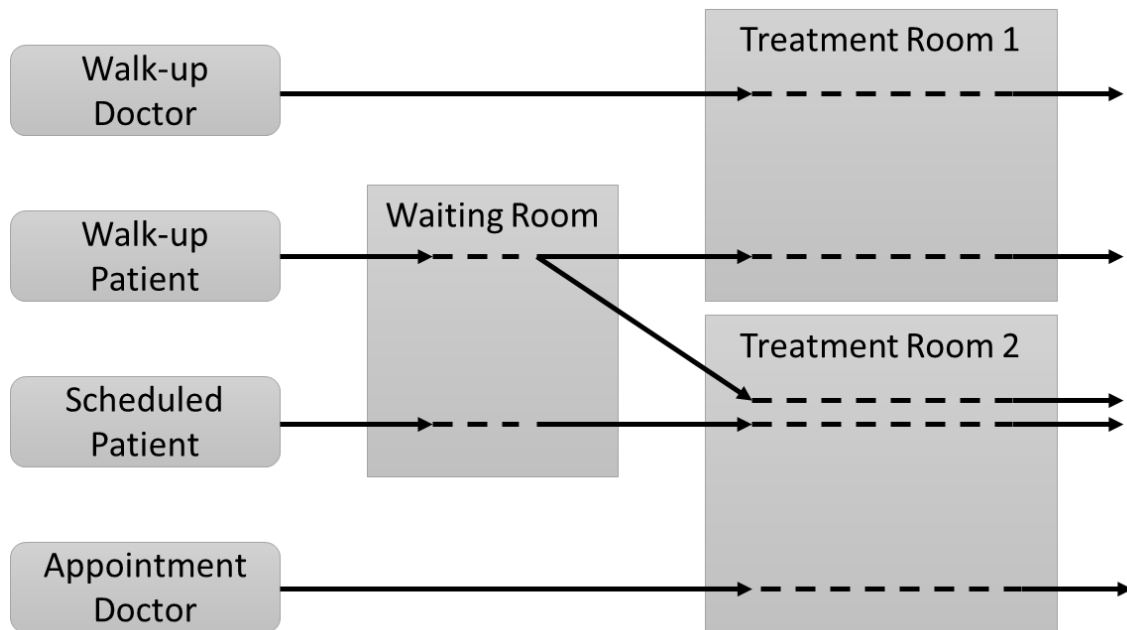


Figure 1 Structural view of the Health Clinic

Active entities individual behavior

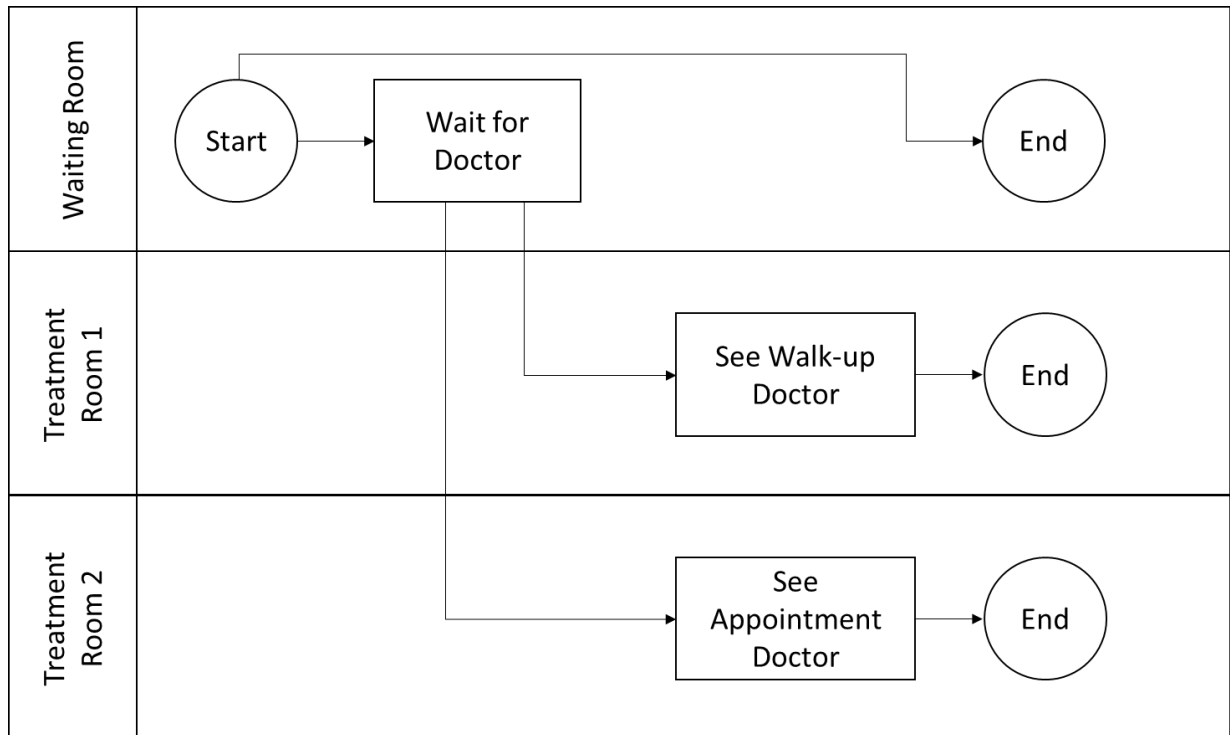


Figure 2 Behavioral view Walk-up Patient

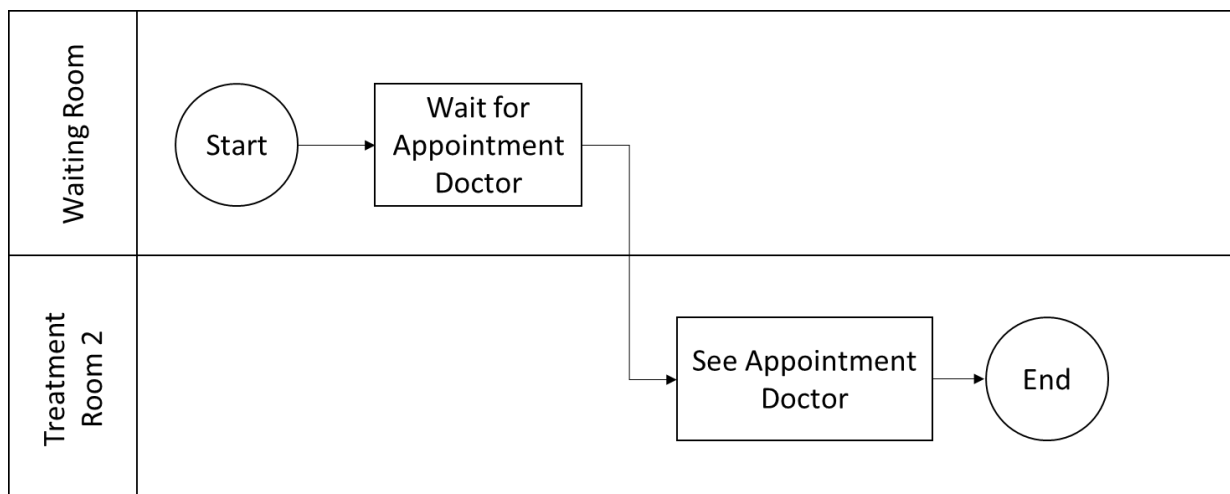


Figure 3 Behavioral view Scheduled Patient

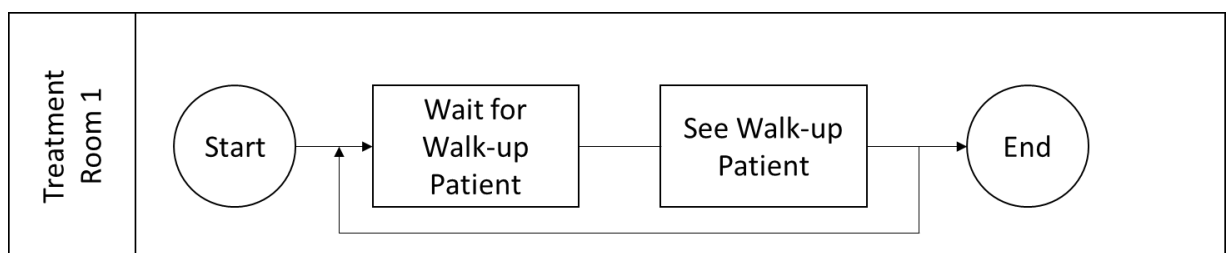


Figure 4 Behavioral view Walk-up Doctor

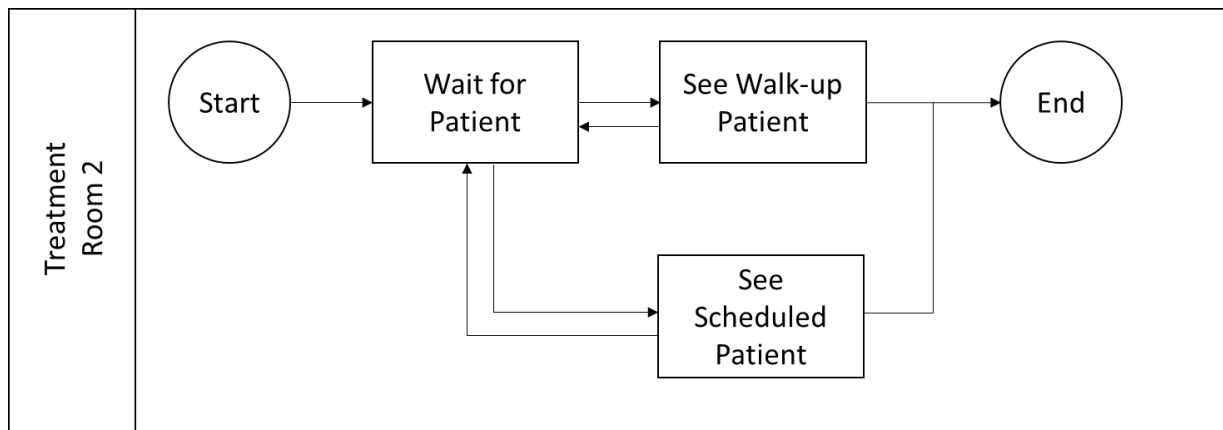


Figure 5 Behavioral view Appointment Doctor

Activities definition

Walk-up Patient waiting	
Activity Type	Control Activity
Participating entities	Walk-up Patient, WaitingRoom
Code	A01
Start type	Request
End type	Request
Start state changes	A01_Start_Time = time WalkUp_Patient_Waiting += 1 WalkUp_Patient_State = "Wait"
End state changes	WalkUp_Patient_Waiting_Time = time- A01_Start_Time WalkUp_Patient_Waiting -= 1 WalkUp_Patient_State = ""
Attributes	
Start Request	WalkUpPatient enters WaitingRoom
End Request	WalkUp Patient enters TreatmentRoom1 WalkUp Patient enters TreatmentRoom2
A01_Start_Time	Time activity starts
Control units	Patient Control

Scheduled Patient waiting	
Activity Type	Control Activity
Participating entities	ScheduledPatient, WaitingRoom
Code	A02
Start type	Scheduled
End type	Request
Start state changes	A02_Start_Time = time Scheduled_Patient_Waiting += 1 Scheduled_Patient_State = "Wait"
End state changes	Scheduled_Patient_Waiting_Time = time- A02_Start_Time Scheduled_Patient_Waiting -= 1 Scheduled_Patient_State = ""
Attributes	
Start Scheduled	Appointment Times
End Request	ScheduledPatient enters TreatmentRoom2
A02_Start_Time	Time activity starts
Control units	Patient Control

WalkUpDoctor at TreatmentRoom1	
Participating entities	Walk-up Doctor, Treatment Room 1
Code	A03
Start type	Scheduled Request
End type	Scheduled
Start state changes	WalkUpDoctor_Available = 1 WalkUpDoctor_State = "Idle"
End state changes	WalkUpDoctor_Available = 0 WalkUpDoctor_State = ""
Attributes	
Start Scheduled	WalkUpDoctor enters TreatmentRoom1
End Scheduled	WalkUpDoctor leaves TreatmentRoom1
Control units	Employee Control

Appointment Doctor at Treatment Room 2	
Participating entities	Appointment Doctor, Treatment Room 2
Code	A04
Start type	Scheduled Request
End type	Scheduled
Start state changes	AppointmentDoctor_Available = 1 AppointmentDoctor_State = "Idle"
End state changes	AppointmentDoctor_Available = 0 AppointmentDoctor_State = ""
Attributes	
Start Scheduled	AppointmentDoctor enters TreatmentRoom2
End Scheduled	AppointmentDoctor leaves TreatmentRoom2
Control units	Employee Control

Walk-up Doctor treats Walk-up Patient	
Activity Type	Control Activity
Participating entities	Walk-up Patient, Walk-up Doctor, Treatment Room 1
Code	A05
Start type	Request
End type	Scheduled
Start state changes	A05_Start_Time = time WalkUpPatient_State = "Treat" WalkUpDoctor_Available = 0 WalkUpDoctor_State = "Working"
End state changes	WalkUp_Patient_Total_Time = WalkUp_Patient_Waiting_Time + time- A05_Start_Time WalkUpPatient_State = "" WalkUpDoctor_Available = 1 WalkUpDoctor_State = "Idle"
Attributes	
Start Request	Walk-up Doctor Start Treatment Walk-Up Patient
End Scheduled	Walk-up Doctor End Treatment
Scheduled Time	Treatment Time
A05_Start_Time	Time activity starts
Control units	Patient Control

Appointment Doctor treats Walk-up patient	
Activity Type	Control Activity
Participating entities	Walk-up Patient, Appointment Doctor, Treatment Room 2
Code	A06
Start type	Request
End type	Scheduled
Start state changes	A06_Start_Time = time WalkUpPatient_State = "Treat" AppointmentDoctor_Available = 0 AppointmentDoctor_State = "Working"
End state changes	WalkUp_Patient_Total_Time = WalkUp_Patient_Waiting_Time + time- A06_Start_Time WalkUpPatient_State = "" AppointmentDoctor_Available = 1 AppointmentDoctor_State = "Idle"
Attributes	
Start Request	Appointment Doctor Start Treatment Walk-up Patient
End Scheduled	Appointment Doctor End Treatment
Scheduled Time	Treatment Time
A06_Start_Time	Time activity starts
Control units	Patient Control

Appointment Doctor treats Scheduled patient	
Activity Type	Control Activity
Participating entities	Scheduled Patient, Appointment Doctor, Treatment Room 2
Code	A07
Start type	Request
End type	Scheduled
Start state changes	A07_Start_Time = time ScheduledPatient_State = "Treat" AppointmentDoctor_Available = 0 AppointmentDoctor_State = "Working"
End state changes	Scheduled_Patient_Total_Time = Scheduled_Patient_Waiting_Time + time- A07_Start_Time ScheduledPatient_State = "" AppointmentDoctor_Available = 1 AppointmentDoctor_State = "Idle"
Attributes	
Start Request	Appointment Doctor Start Treatment Scheduled Patient
End Scheduled	Appointment Doctor End
Scheduled Time	Treatment Time
A07_Start_Time	Time activity starts
Control units	Patient Control

Control Units Definition

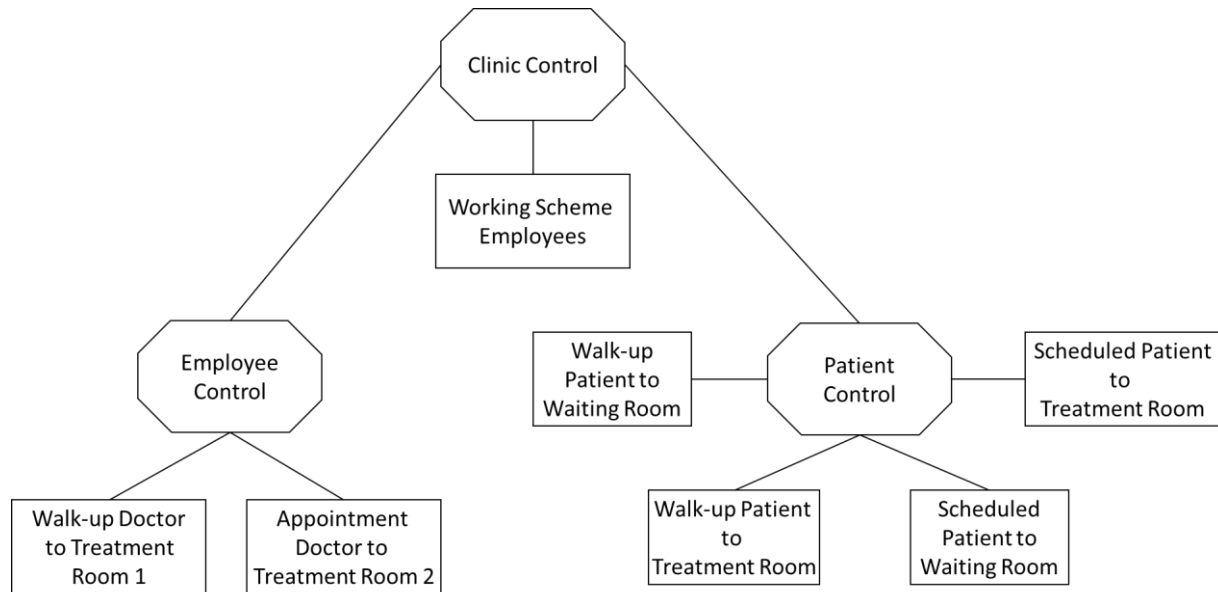


Figure 6 Control view for the Health Clinic - Scheduled problem

Control Units Definition		
Name	Entities	Attributes
Clinic Control	Walk-up Doctor Appointment Doctor	WalkUp_Doctor_Shift Appointment_Doctor_Shift
Employee Control	Walk-up Doctor Appointment Doctor Treatment Room 1 Treatment Room 2	WalkUpDoctor_Available AppointmentDoctor_Available WalkUpDoctor_State AppointmentDoctor_State
Patient Control	Walk-up Patient Scheduled Patient Waiting Room Treatment Room 1 Treatment Room 2	WalkUp_Patient_Waiting_Time WalkUp_Patient_Total_Time Scheduled_Patient_Waiting_Time Scheduled_Patient_Total_Time WalkUpPatient_Waiting ScheduledPatient_Waiting

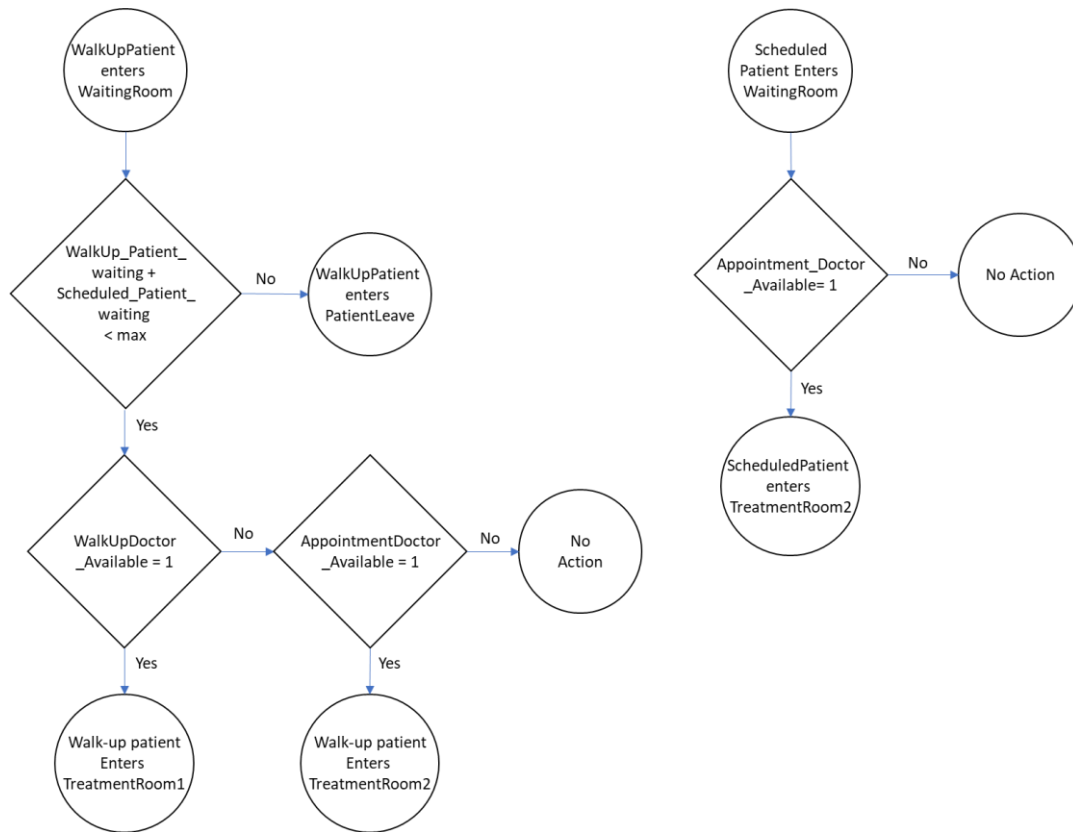


Figure 7 Control policies for Patient Control

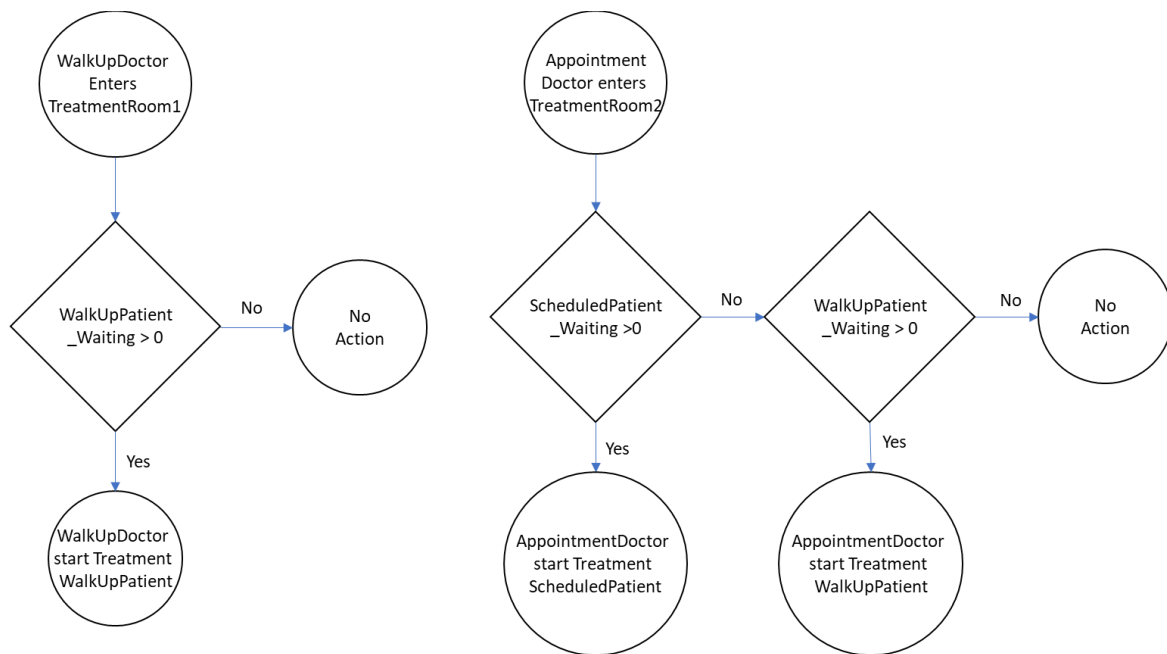


Figure 8 Control Policies for Employee Control (1)

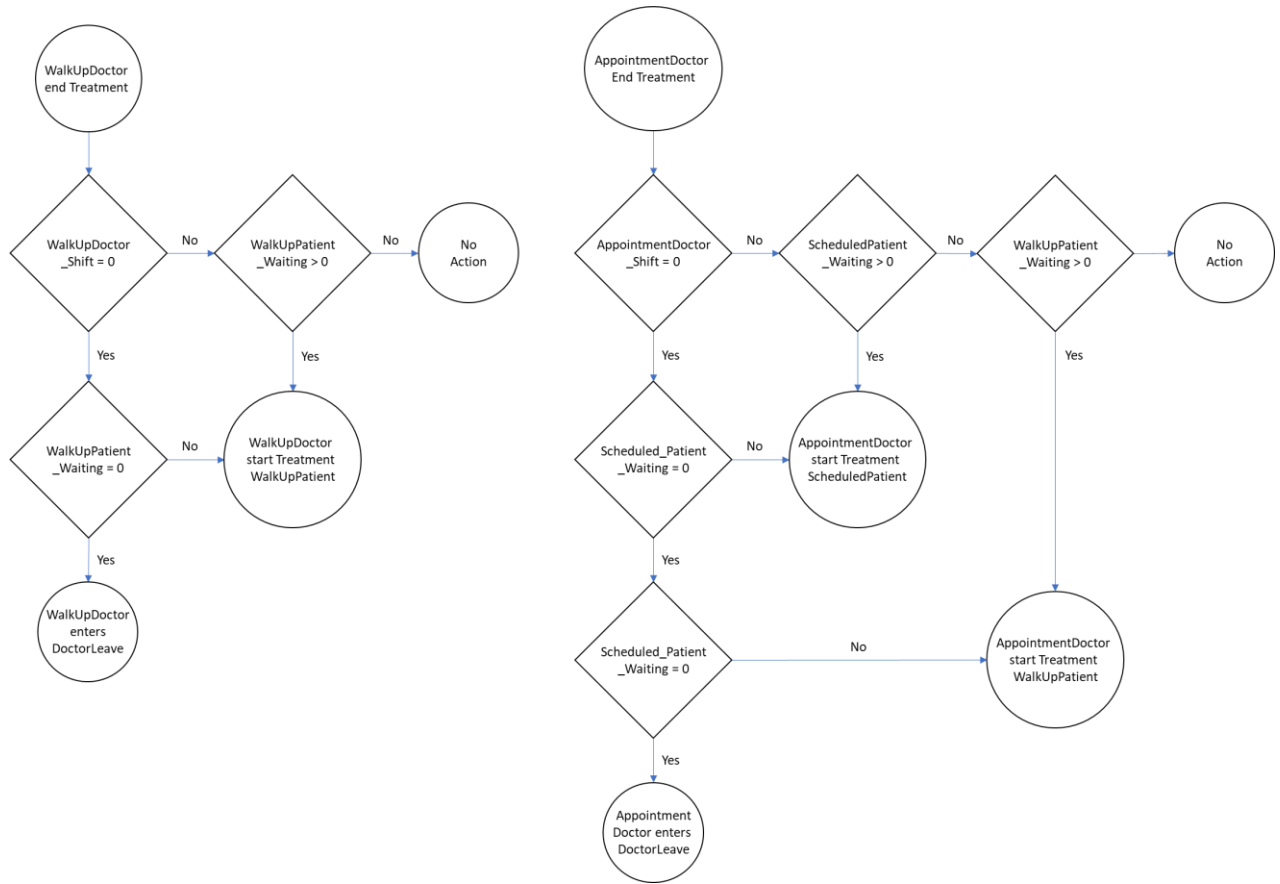


Figure 9 Control policies for Employee Control (2)