Modelling Processes

In the previous video, we explained that process modelling is applicable to wide range of problems in biomedicine and healthcare. But what is a process? And why are we interested in modelling processes? A process is understood as a set of related tasks or activities that are carried out in order to achieve a particular goal. When we cook, for instance, we follow a process, or a recipe that includes several different tasks, such as chopping vegetables or boiling water. There are several reasons for modelling processes. We may want to describe existing processes, so as to gain an insight or prescribe desired processes, so as to communicate how this should be structured. A typical motivation for modelling processes is their subsequent analysis, which enables us to improve existing practices. There is a wide range of process modeling languages. Examples include the Business Process Modelling Notation, UML activity diagrams, the Business Process Execution Language, Petri nets, and others. Some of these languages are diagrammatic focusing on capturing processes and enabling communication and discussion, while others are more formal, backed by mathematical theory for process analysis and execution. The Business Process Modeling Notation, or BPMN, as it is also known, is one of the most widely used languages for modelling processes. Its main constructs are shown here, and they include activities, events, gateways, and flows. Activities can be understood as tasks that are carried out as part of a process. An event is something that happens during the course of a process. A sequence flow is used to show the order in which activities will be performed in a process, while gateways are used to control the divergence and convergence of sequence flows in a process. Let's explain these further with the use of an example. Here you can see a process model for cooking a Greek dish called moussaka. This is a start event, and this is an end event, signifying when the process starts and when it ends. These, here, are examples of activities for making moussaka. The arrows signify sequence flow. So, this guy here tells us that we can start spreading the aubergines over the potatoes, only after we have finished spreading the potatoes on the baking dish. And how about this gateway here? This is an AND-split gateway, which denotes that these three activities are parallel. In other words, they can all start execution once we have preheated the oven to 200 degrees. The AND- join gateway here, denotes that it is only after all three activities have completed their execution that we can start spreading the potatoes on the baking dish. In process modeling, it is very common to decompose the process into sub-processes. Thus allowing us to model at different levels of abstraction. This is also possible in BPMN. So, in the previous example, we can further specify vegetable preparation, with the use of another process model, this one here. The notation used here is very similar to what we saw earlier, with the exception of the XOR gateways, which indicate alternative paths in the process flow. This XOR-split gateway denotes that only one of the paths can be taken, and in this example, this depends on whether we are going for a full-fat or a low-fat version of moussaka. The XOR-join is used for merging the alternative paths. So, once the aubergines have been either baked or drained, we can move on to the next steps in the diagram. Okay, so we've seen an example of a process model for cooking moussaka. But how does this relate to stratified healthcare? Well, the basic modelling constructs that we just saw, such as activities AND- splits and XOR-joints, can be used to describe a wide range of biomedical and health care processes. Care pathways are such an example, describing the key steps in the care of patients with a specific clinical condition. Here's a simplified example of a care pathway for patients with breast cancer. We won't discuss this in detail, but it is worth highlighting that this is a stratified care pathway, as it includes different paths for different patient cohorts. Apart from general purpose process modeling languages, such as BPMN, there are also languages that are tailored to medicine. PROForma, for example, is a formal language especially designed for modelling clinical processes and medical guidelines. In PROForma, we distinguish between different types of tasks, actions, which are typically low-level clinical tasks, plans, which are containers for other tasks and often describing higher level protocols, decisions which denote choice, say, among alternative actions, and enquiries, which are requests for information needed for particular action or decision. Here we can see an example of a process model expressed in PROForma. This example describes a key part of the breast cancer care pathway, commonly referred to as triple assessment. The process begins with a plan for gathering patient history, followed by a decision regarding genetic risk. Next, there is a clinical examination enquiry, followed by an imaging decision. Depending on the decision made, a mammogram or an ultrasound enquiry is made. A biopsy-related decision and enquiry follow. After which, a management decision can be made. PRPForma is not only a diagrammatic language, but also an executable one, which means that process models expressed in PROForma can be enacted by a computer to automate or simulate clinical practice. Simulation is one of the most widely used techniques for analyzing processes. In the next video, we'll discuss such techniques further.