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Use Cases: What Are They? How to Develop Them And Methods to Test Them

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Objectives

- Define and describe a Use Case in the healthcare information technology field
- State the importance of a collaborative approach in the development of Use Cases
- Define the various types of testing and discuss their importance (unit, functional, integration, regression, performance, user acceptance)

“Use Case” Defined

- Behaviorally related sequence of steps (a scenario), both automated and manual for the purpose of completing a single business task.
- Use Cases describe the system functions from the perspective of end users
- Technique to better understand and document a system’s requirements

Source: Whitten, Bentley & Dittman (2000). Systems Analysis and Design Methods (5th ed.). McGraw-Hill Irwin. Boston.

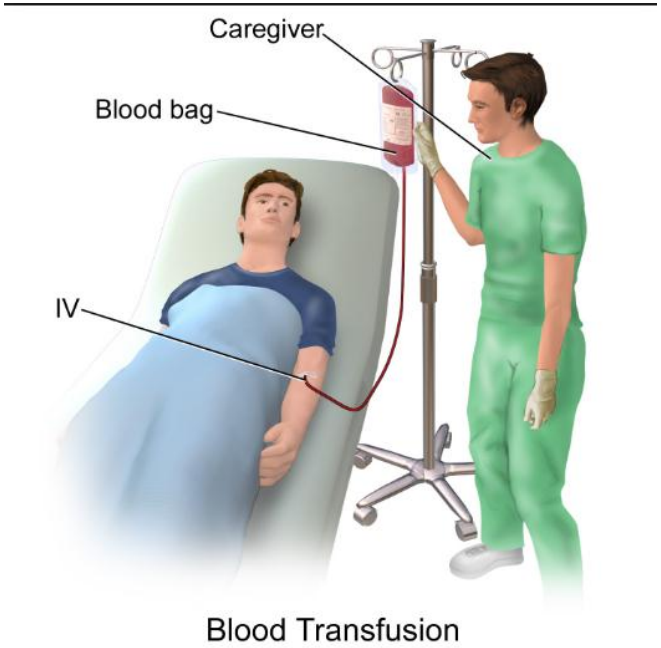
System (Functional) Requirements

- A functional requirement is a function or feature that must be included in an information system to satisfy the business need and be acceptable to the end users
- Can be put into 3 categories:
  - Must have
  - Would like to have
  - Bells and whistles

Example Requirements - An Infection Control System shall:

- Identify culture results indicating that a particular antibiotic would be resistant in a patient in real time.
  - Include patient unit, room number, name, account number and organism.
- Identify drug-bug mismatches and opportunities to streamline or discontinue antimicrobial therapy
- Automate creation of National Healthcare Safety Network reports that are formatted for export to Microsoft Excel and/or upload to NHSN

Examples in Healthcare



Blood Transfusion

More Examples: ONC's Interoperability Task Force 6/23 - five broadly applicable use cases for health IT

1. **Transitions of Care:** Automated query from ER physician in one state to the patient's PCP EHR record where the patient is regularly seen and have it imported directly to the ER physician's EHR.
2. **Shared Care Plans:** All health professionals sharing care for a cancer patient have access to care plan developed by the oncologist.
3. **Patient-Initiated Data:** A diabetic patient's caregiver gathers notes and lab results from her PCP and Endocrinologist and submits the patient's glucometer readings to both doctors.
4. **Clinical Information Transparency for Patients/PCP:** Hospital discharge of high-risk patient to post-acute care with appropriate involvement of PCP. The patient is able to access and review their health information, view costs for medications and pharmacies; in addition to payer coverage.
5. **Quality Improvement:** Allow persons in quality management and health care organizations (such as ACOs) the ability to interchange and review clinical quality data for a patient or a population.

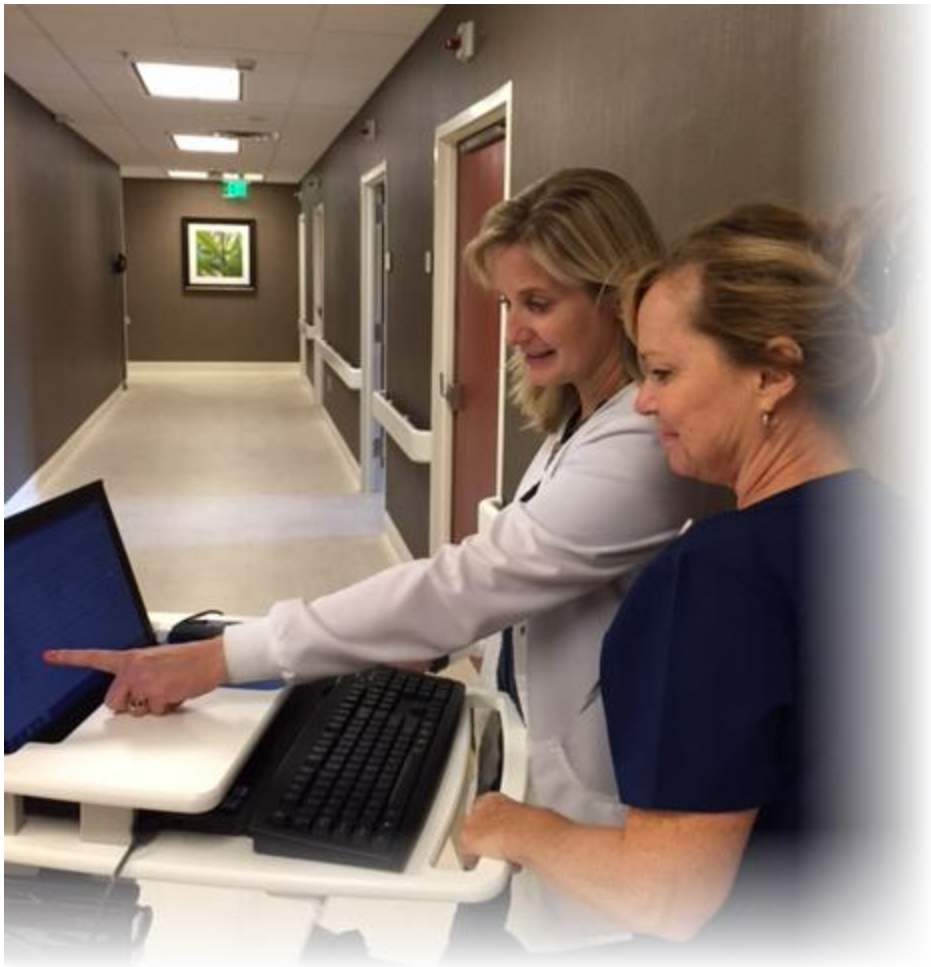
Benefits of Use Cases

- Provides the perspective of the desired system functionality from the end user's viewpoint
- Ensures end user involvement
- Creates an effective tool for validating requirements
- Supplies an effective communication tool for all parties involved in analysis, development and testing

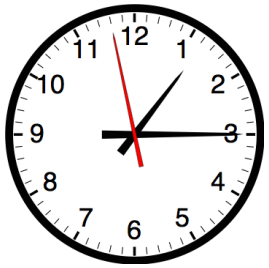
Actors and Their Roles for $400

- Terminology for Use Cases can be confusing.
- **Actors** – anything that needs to interact with the system to exchange information during the course of the scenario
- An actor initiates the Use Case for the purpose of completing a task
- An “actor” represents a role fulfilled by an end user interacting with the system – not an individual person
- In Use Cases we create, who is our primary actor?

The Nurse!



Time as an Actor



- Remember - An actor initiates the Use Case for the purpose of completing a task
- Time can be a trigger to initiate a task
- Examples:
  - A billing system for a credit card company may automatically generate bills at midnight on the 5th day of the month
  - A lab system may automatically generate a list of morning labs for the phlebotomist daily at 5am
- "Temporal Event" – is a system event that is triggered by time. An actor of a temporal event is time.

Naming Use Cases

- Use Cases are typically named using the name of the event or input preceded by an action verb
- Examples
  - Submit blood transfusion order
  - Administer blood transfusion using bar code scanner
  - Generate list of morning labs to be drawn by phlebotomist

Documenting the Use Case

- Step by step description starting with the actor initiating the use case and going through to the end of the event
- Include:
  - Use Case name
  - Actors
  - Any references (requirements)
  - Course of events – each step spelled out individually
  - Alternate course of events – if applicable
  - Pre-condition
  - Post condition

Use Case Example

- Use Case name: Administer blood transfusion using bar code scanner
  - Actor: Nurse
  - Any references (requirements): See requirements document
  - Course of events – each step spelled out individually:
  - Alternate course of events (if applicable): May include steps if barcode technology not working or steps if patient experiences reaction
  - Pre-condition: Patient's condition warrants administration of PRBCs
  - Post condition: Blood administered, patient stable, H & H drawn for follow-up

Step by step course of events

- Actor – triggers initiation of use case: Nurse sends message to blood bank to deliver PRBCs back to nursing unit
- Blood bank receives message, delivers blood to nursing unit
- Nurse takes blood to patient's bedside with another RN
- Nurse scans patient armband, nurses badge and unit of PRBC, etc.....

Use Case Documentation

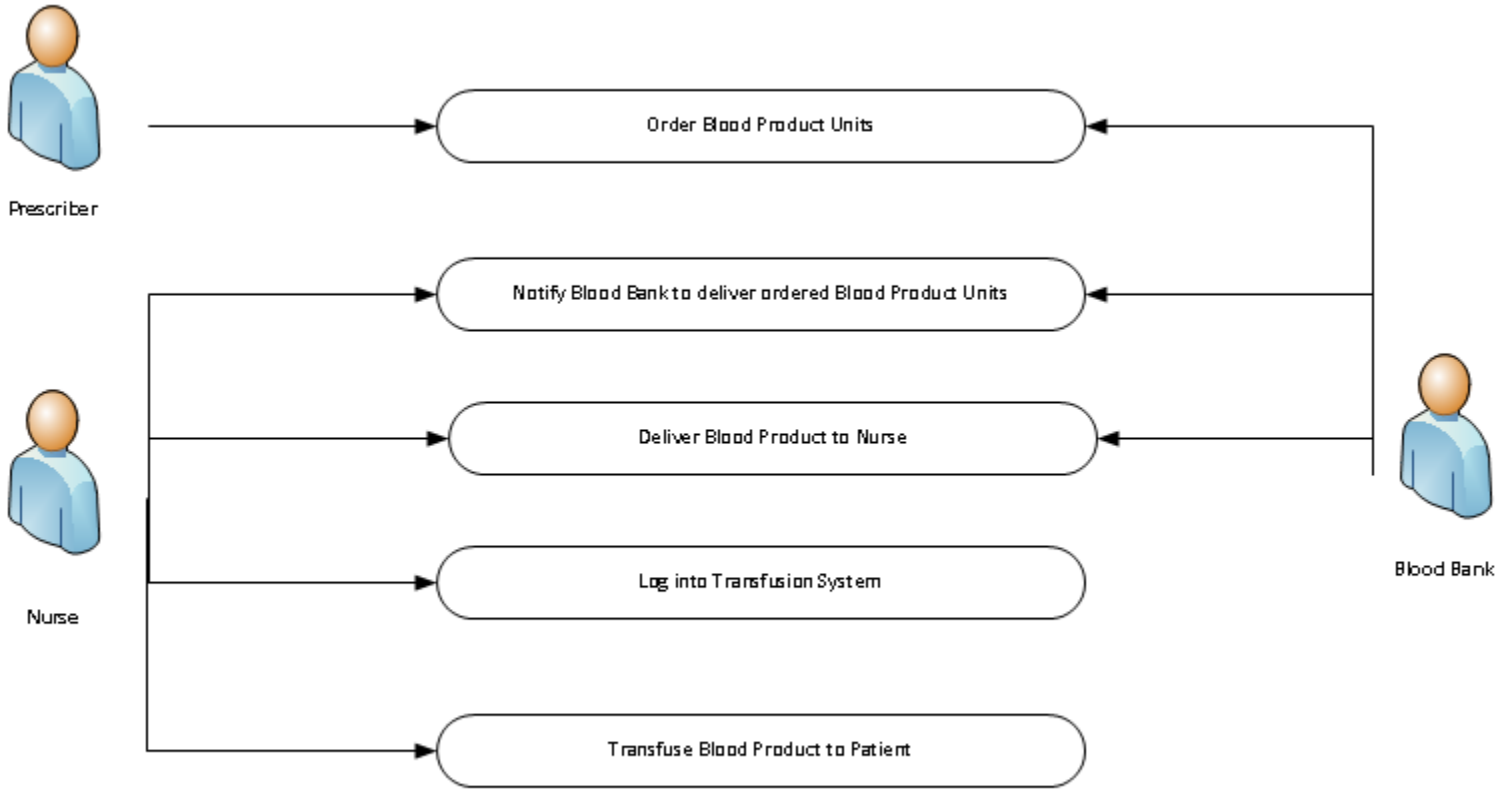
Use Case Name:	**ID:**	**Priority:** (*Relative significance to the overall system)*
Actor:		
Description: • *Briefly describes the process conveying the purpose*		
Trigger: (*What* triggers this task? *What tells you to perform this task?)* **Type:** External ☒ Internal ☐		
Preconditions: (*The state in which the system must be in prior to the use case beginning)*		
Normal Course: • *Describes the major steps that are performed to execute the response to the events, the inputs used for the steps and the outputs produced by the steps* • *The "happy path" where everything flows normally in the system* (**Any branching off of a step follows the alternative course path)*		**Information for Steps** • *List the information used as inputs (put into the system) or output (results from a step)* • *Input use arrow pointing to the left* ← • *Output arrow pointing to the right* →

Use Case Documentation (cont'd)

Alternative Course: • *Includes branches in logic that would lead to successful conclusion of the use case* • *Clearly state which step from the normal course that would follow the alternative course*	
Post Conditions: • *Define the final products of this use case* • *Are used to define the pre-conditions in the next use case in the larger process*	
Exceptions: • *Not normal branches in logic but unusual occurrences or errors that could potentially be encountered and would lead to an unsuccessful result* • *Include where the exception would occur off of the normal occurrence path*	
Summary	

Source: Whitten, Bentley & Dittman (2000). Systems Analysis and Design Methods (5th ed.). McGraw-Hill Irwin. Boston.

Use Case Diagram



Use Case Templates
(available on the web)

- TechnoSolutions: http://www.technosolutions.com/use_case_template.html
- TechWhirl: http://techwhirl.com/use-case-template/
- Bridging the Gap: http://www.bridging-the-gap.com/what-is-a-use-case/
- Product Management Insights: http://pmblog.accompa.com/2009/10/08/use-case-template-example-requirements-management-basics/

Testing

- A Use Case is a great collaborative tool for developers and end users to work through a system design and build
- Testing throughout the design and build is as important (if not more) as developing a strong use case
- Terminology around testing can also be complex

Phases of Testing

- Unit Testing
- Functional Testing
- Integration Testing
- Regression Testing
- Performance Testing
- User Acceptance Testing
- Production Validation Testing

Use Case Scenario – Specimen Collection Verification Testing

- Specimen collection verification using bar code technology

Clinical Integration Testing

The testing of a barcode system involves multiple components and setup, and can lead to a high volume of testable clinical scenarios. Patient identification, specimen collection, transfusion verification, and medication administration are some of the applications for barcode clinical workflows. Each clinical workflow involves multiple functional components, including the barcode application, printing capabilities, scanning capabilities, and often a mobile computer platform to run the clinical application, attached to a scanner, and enabling the generation of barcoded media. Additionally, there is the infrastructure of the hospital information system to allow order entry as well as an ancillary system (depending on the function: pharmacy, lab, or blood bank) to assist in the management of orders, medications, specimens, and blood units. Here is a sample testing scenario:

1. Physician logs into the hospital information system.
2. Physician selects the test patient.
3. Physician enters a lab order to collect a CBC + Diff.
4. Nurse logs into the barcode specimen collection application.
5. Nurse scans the patient ID.
6. Nurse verifies that CBC + Diff order is present in specimen collection application.
7. Nurse prints a label for CBC + Diff order and affixes to tube.
8. Nurse draws a sample in tube.
9. Nurse scans a label barcode to indicate that specimen was collected.
10. Physician validates in the hospital information system that the order is updated to "specimen collected" status, and that date/time associated with order is date/time of specimen collection.
11. Nurse sends tube to the lab.
12. Lab scans label barcode to indicate that the specimen was received.
13. Lab performs tests with analyzer on the specimen. Results are documented in the lab system.
14. Prescriber validates in hospital information system that the order is updated to "resulted," and that all results documented in lab system are visible under results view for patient.

Source: Carlson, S. (2015). Testing in the Healthcare Informatics Environment. In Sengstack & Boicey Mastering Informatics: A Healthcare Handbook for Success. STTI. Indianapolis, IN

Unit Testing

- Initial testing of an individual software component
- Performed while a component is being developed and before it is turned over to the test team
- Typically performed by the developer who creates the component
- Includes testing of different low-level logical pathways within component

Unit Testing - Example

- Unit test of status update to EHR
- Create positive test case that unit xyz has been transfused to patient. Validate in EHR that patient shows they have received unit XYZ
- Create negative test case that unit xyz was not successfully transfused. Validate in EHR that patient did not receive unit XYZ

Function Testing

- Testing of system by the test team to ensure that system meets the functional requirements
- Functional requirements and use cases need to be defined and documented
- Test scripts written to evaluate if the system meets the functional requirements
- Each requirement is mapped to a test script

Function Testing - Example

- Requirement = The system shall notify the end user of an incompatibility of blood type between patient and unit to be administered
- Create a test patient in system with ABO blood type A
- Create unit to be transfused with ABO blood type B
- Attempt to select unit for transfusion. Validate that system displays alert about ABO type mismatch

Integration Testing

- "The development of common scenarios that will exercise the integrated components of the clinical system"
- Goal is to ensure that the individual components of the system work together to support the business process
- Can leverage common use cases for this testing

Source: Garton & McCulloch (2012). Fundamentals of technology project management (2nd ed.) MC Press Online, LLC. Boise, ID.

Integration Testing - Example

- Physician orders PRBCs to be transfused to patient
- Transfusion medicine department verifies crossmatch and issues units
- RN uses barcoding system to identify patient and issued units
- RN takes vitals and transfuses units to patient
- Vital signs and transfusion report are sent to EHR to document process

User Acceptance Testing

- End users perform testing of the system and identify problems or issues they see with the functional aspects of the system, or the business process flow
- Testing is often similar to how the end users envision using the system once it is deployed

User Acceptance Testing - Example

- Can be similar to the Integration testing scenarios/use cases, except executed by the end user
- Can be done by the end users alone, or with another member of the project team who acts as an observer and records significant issues, observations by the end user about the system

Performance Testing

- Technical testing, which involves creating a user load on the system to validate the components can withstand anticipated volumes of usage
- Involves testing the application itself, the underlying database, and any other system components, and how they perform together as a whole

Source: Garton & McCulloch (2012). Fundamentals of technology project management (2nd ed.) MC Press Online, LLC. Boise, ID.

Performance Testing - Example

- Create a script that simulates the Integration test scenario of ordering units, issuing units, and then documenting vital signs and the transfusion
- Run this script with 50 concurrent incidences and monitor memory usage and response time of the system
- Another example is flushing all of the toilets at the same time in a football stadium

Regression Testing

- A standardized set of test scripts which is used to verify that no functionality that was previously working is now failing as a result of a change that was introduced
- Performed after a change has been made to the system along with testing of the change itself

Source: Garton & McCulloch (2012). Fundamentals of technology project management (2nd ed.) MC Press Online, LLC. Boise, ID.

Regression Testing - Example

- After a change is made to the interface that sends the issued units from the Transfusion Medicine system to the Barcoding system, regression testing would consist of testing additional functions of the interface, including issuing different types of units, and canceling the issuing of units.

Production Validation Testing

- Production Validation testing is performed when testing a change that has passed testing in a Test environment and has now been placed into the Production environment
- Usually means running a similar test case to what was tested in the Test environment, but may only mean running a subset of the tests

Production Validation Testing - Example

- When moving the new Transfusion System to Production, many test cases have been run in the Test environment
- In Production, would execute some representative scenarios and functionality tests, including issuing a new unit and then transfusing the unit (on a test patient), and performing a transfusion with and without vital signs

Tying it all Together

- Use cases help document a scenario of system use from the end user perspective
- Use cases (documented well) reduce the chances that your IT team builds something that won't work or won't be accepted
- Testing what is built in a system needs to happen on a number of levels to ensure the system is working as intended
- Conducting all types of testing are required to maintain a strong system

Question

- One of the most important benefits of a Use Case is:
  1. It supports the concept of “if it’s not documented, it’s not done”
  2. It ensures the end user’s perspective is included in the design of a system
  3. It requires rigorous testing
  4. Actors can configure functional requirements

Question

- Functional requirements that provide the foundation for a Use Case can be categorized into 3 categories. Which one does not belong:
  1. Would like to have
  2. Actor supported
  3. Bells and whistles
  4. Must have

Question

- Conducting testing to ensure that the individual components of the system work together to support the business process (from A to Z) would be called:

1. Performance testing
2. Regression testing
3. Integration testing
4. Unit testing

More Questions:

- Does your organization use Use Cases? Can you share an example?
- If your organization does not use Use Cases – can you think of a current project that could benefit from the development of one?
- Does your organization perform User Acceptance testing prior to implementation in production? How is this done?

Thank you!

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