Concept of Operations: Operational Scenarios

Phoenix

Ambulatory Blood Pressure Monitoring System

11 May 2008

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Scenarios

1. Home-based self care
2. Internet-based individual health surveillance
3. Clinical care
4. Self-care followed by clinical care
5. Public health care
6. Research
7. Education
8. Sports training
9. Emergency medical service
10. Combat lifesaving

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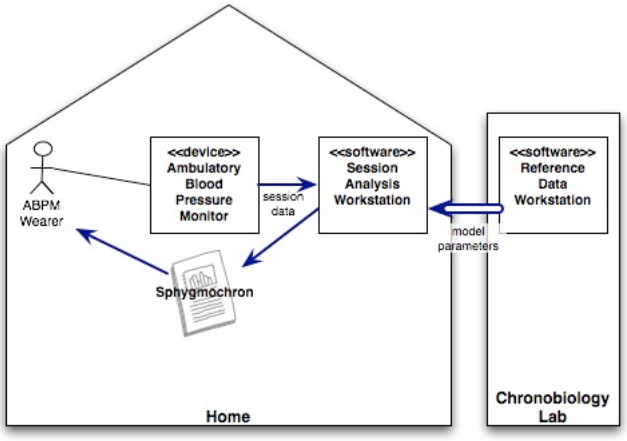
Scenario 1
Home-Based Self-Care



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Scenario 1
Home-Based Self-Care

- Monitoring during activities of daily living (ADL)
  - What a person does for self-care (such as feeding, bathing, dressing, grooming), work, homemaking, leisure
- All monitoring & analysis takes place in wearer's home
- Wearer may download software updates from a resource on the Internet
- No data flows in the opposite direction
  - Data is not exposed to anyone other than wearer

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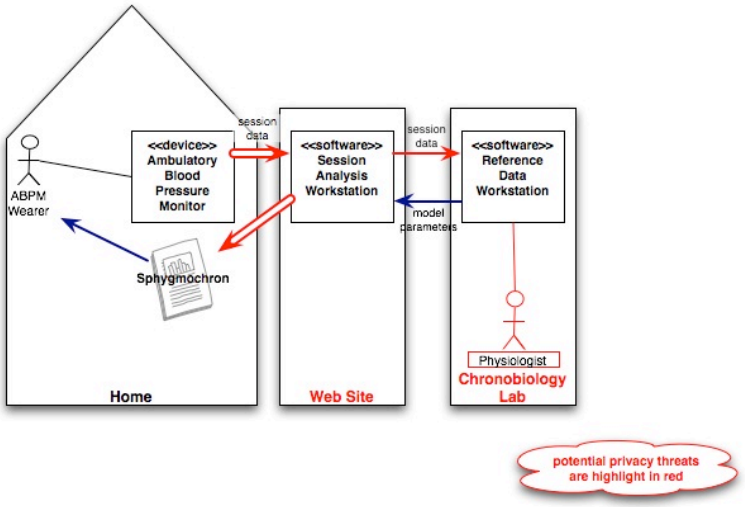
Scenario 2
Internet-Based, Individual Health Surveillance



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Scenario 2
Internet-Based, Individual Health Surveillance

- Similar to the home-based self-care scenario (1)
- Special software on the wearer's computer is not used
- When device is connected to wearer's computer:
  - Device's data presented as a simple file uploadable to Web site that automatically
    - Analyzes the data
    - Generates a report that is then returned to wearer's computer, perhaps as PDF file
- Wearer's data exposed to physiologists who maintain the Web site and use the data to model population profiles, which are then fed back into the analysis software

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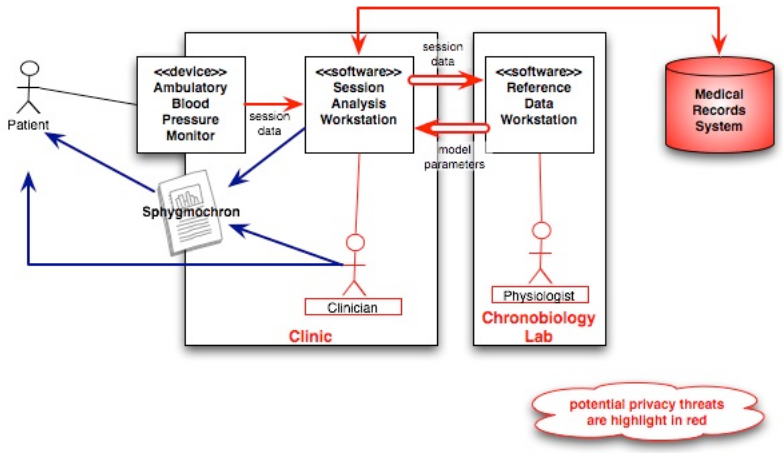
Scenario 3
Clinical Care



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Scenario 3
Clinical Care

- Clinicians use system to monitor patient, diagnose disease
  1. Encounter
  2. Assesses patient and plan treatment
  3. Record encounter in clinical chart
  4. Perform tests
     - During initial appointment, preliminary readings taken
  5. Meet with patient review test results
  6. Revise assessment and plan
  7. Recommendations for follow-up (e.g., Rx, referrals)
     - Device prescribed and given to patient
  8. Patient makes follow-up appointment as needed
     - During follow-up exam, session data collected during the encounter (step 1) or during the test step (4)

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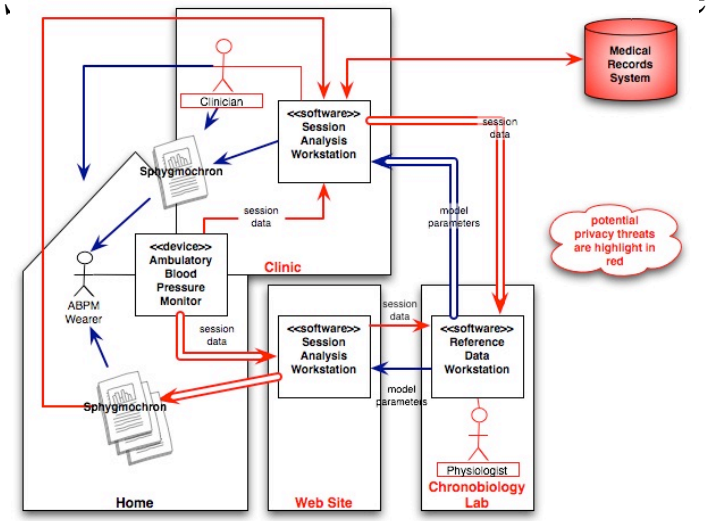
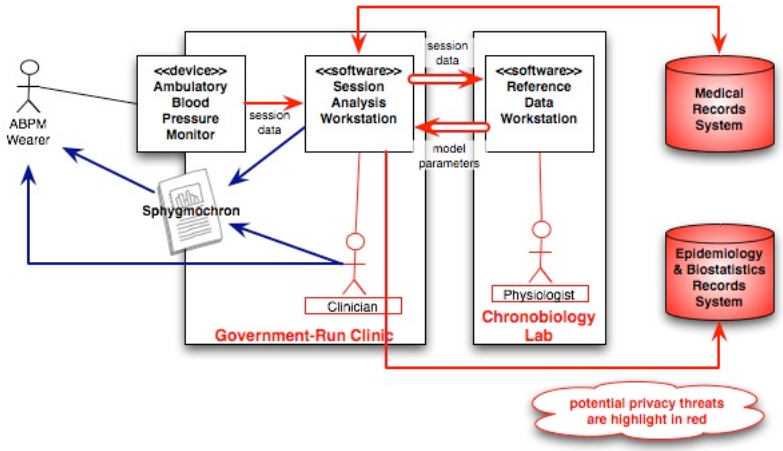
Scenario 4
Self-Care Followed by Clinical Care



Scenario 4
Self-Care Followed by Clinical Care

- Person using the device for self-care (scenario 2)
  1. Detects or perceives an abnormality based on feedback from the system
  2. Takes the matter to a clinic (scenario 3) for follow-up
- Patient brings self-collected data/reports to clinic
  - For consideration with, inclusion into, medical history
- Clinician analyzes series of sessions
  - Some collected during self-care
  - Others under the prescription of the clinician

Scenario 5
Public Health Care



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Scenario 5
Public Health Care

- Health services are frequently major component of public health care
  - Public health-care scenario often flows like the clinical-care scenario (3)
- Public health policy often stresses education in combination with self-care
  - Public health-care scenario might emulate
    - Home-based self-care scenario (1)
    - Internet-based self-surveillance scenario (2), or
    - Combination of self-care and clinical care (4)

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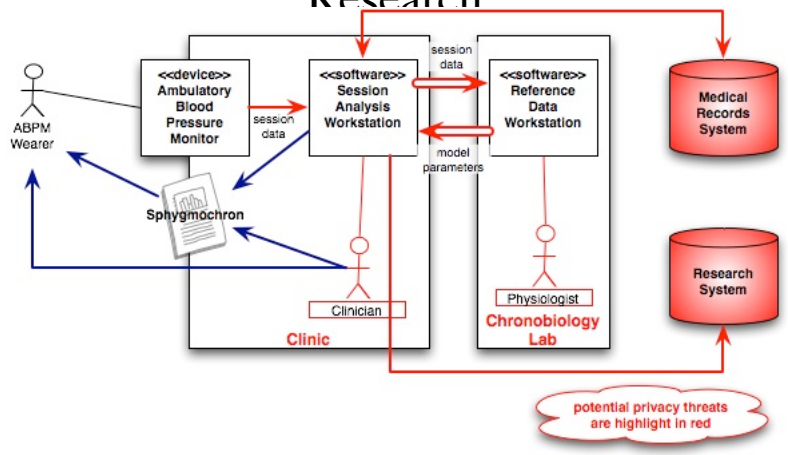
Scenario 6
Research



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Scenario 6
Research

- Process
  1. Research Project Initiation
  2. Candidate Selection
  3. Preparation
  4. Test
  5. Results analysis
- Corporate entities – not just government bodies – may have access to medical data

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Scenario 7
Education
Goals

- Secondary education level
  - Science
  - Mathematics
  - Health
- Academic objectives
  - Relationships between time and biological functions
  - Application of chronobiology to health and health care
  - Skills used in chronobiology
- Public health-care objective (5)
  - Better understanding of school-age population
  - Health education

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Scenario 7
Education
Concerns of the Teacher (Primary Actor)

- Varying learning styles
- Varying learning abilities
- Academic standards
  - History & nature of science
    - Scientific inquiry
    - Scientific enterprise
      - Technology
  - Life science
    - Human organism (physiology)
  - Mathematics
    - Data analysis (9-11)
      - Representation of data
    - Probability (9-11)

The Scientific Method

1. Observation
2. Hypothesis
3. Prediction
4. Test

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Scenario 7
Education

Teacher's Meta Model

- Curriculum
  - Units
  - Lessons
  - Tasks
- Lesson design
  1. Learning outcome
     - what student will be able to DO as result of learning activity
  2. Assessment method, measures
  3. Learning activity
     - Teaching method
     - Resources
- Standards & benchmarks

- Parallel Curriculum
  - Tracks
    - General
    - Gifted
    - Special education
    - Language
  - Model
    1. core or basic curriculum
    2. curriculum of connections
       - expands on the core curriculum's key concepts and principles
    3. curriculum of practice
       - encourages students to function in a discipline with increasing expertise
    4. curriculum of identity
       - helps students see themselves in relation to the discipline

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Scenario 7
Education

Lessons

1. "Seeing Cycles"
   - What is a cycle?
   - What is evidence of the existence of a cycle?
2. "Putting Cycles on the Map"
   - Survey of cycles
3. "What Drives Cycles"
   - What factors are responsible for giving rhythms their distinguishing characteristics?
4. "The Origin of Cycles"
   - Internal rhythms and how they are influenced by environmental rhythms
5. "Keeping in Step with Rhythms"
   - Rhythms in health

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Scenario 7
Education
Lessons

"Seeing Cycles"

- Awareness of cycles and rhythms
  - Physical science
  - Chemistry
  - Biology
- Collecting data
- Graphing data

- Interpreting data -- math concepts
  - Midline
  - Amplitude
  - Period
  - Peak time
  - Sine curves
  - How much data is enough

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Scenario 7
Education
Lessons

"Putting Cycles on the Map"

- Cycles in nature
- Cycles in human individuals
- Cycles in populations
- Periodicity
  - Rhythmic peak
  - Variability

- Circadian (about daily) rhythms
  - Blood pressure
  - Temperature
- Shorter cycles
  - Cell division
- Longer cycles
  - Weekly
  - Monthly
  - Yearly
  - Multi-year

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Scenario 7
Education
Lessons

"What Drives Cycles?"

- Environment influences
  - Change in environment causes change in organism's cycles
    - Period
    - Amplitude
    - Peek time
- Influence is limited
  - Direction of cycle shift
  - Drift in cycle peaks

- Internal sources of rhythms
  - Cycles that persist under constant conditions
  - Variation in free-running cycles
    - Between related species
    - Between individuals
- Environmental synchronization
- Limits of synchronization

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Scenario 7
Education
Lessons

"Discovering the Wheel: The Origin of Cycles"

- How are internal biological rhythms coordinated from within
  - Internal timekeeping
    - Chemicals
    - Cells
    - Tissues and organs
    - Whole-body synchronization with hormones
  - Idea of biological clocks
- Adaption of internal rhythms to the environment for improved survival
  - Internal and external evolution
    - Anticipation
    - Efficiency
    - Competition
    - Navigation
  - Development of rhythms in individuals
- Constancy versus rhythmicity

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Scenario 7
Education
Lessons

"Keeping in Step with Rhythms"

- Practical applications
- Finding the rhythm range
  - Variation among individuals
  - Variation with time
  - Time of day versus time of organism
  - Finding differences
- Detecting disease
  - Normal ranges
  - Rhythm characteristics

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Scenario 7
Education
Observations

- Curriculum developer must balance techniques
  - Learn by lecture
  - Learn by experiment
- Some subjects insufficiently researched for secondary education
  - Treating disease
  - Ecology

- Role of ABPM
  - Subject is chronobiology
    - Not blood pressure monitoring technology
    - ABPM is a resource -- only
  - Opportunities for ABPM vary by track
    - May be inappropriate for entire tracks
  - Learning by experiment will provide more opportunities for ABPM
- Vocabulary varies with user group
  - Avoid jargon

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Scenario 8
Sports Training

- Similar to self-care scenario (1)
- Wearer's activity is much more strenuous than activity of daily living
  - Measurements are more extreme
  - Environment of system is more severe
- Can progress to sports medicine
  - Specialized variant of clinical care (3, 4)

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Scenario 9
Emergency Medical Service

- Emergency medical technician plays role of ABPM Administrator
- EMT brings system to wearer
  - Including any sensing element
- Wearer in state of
  - Physical trauma
  - Extreme stress
- NOT IN SCOPE OF PHOENIX PROJECT
  - Technology might be useful but …
  - Scenario typically lasts less then couple hours
  - Need at least three days of data for chronomedical analysis

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Scenario 10
Combat Lifesaving

- Cross-over of multiple scenarios
  - Sports training (8)
  - Emergency medical service (9)
- Wearer is typically
  - Young adult
  - Extremely fit
- Device
  - Incorporated into uniform
  - Worn continuously
- Combat medic plays role of ABPM Administrator
- Wearer's activity extremely strenuous
  - Measurements extreme
  - System environment severe
- System must not impede wearer
- Wearer more interested in blood flow, heart rate than in blood pressure
- Data carried into clinical care scenario (3)
- Research potential — relevant chronomedical predictors?
  - Stress disorders (e.g., PTSD)
  - Combat stress reaction

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