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TeleCare Monitoring with Decision Support for Health Risk Stratification

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Background

- Telecare - delivery of healthcare at a distance centred around patient's needs
- Rapidly developing as a cost-effective model for health service delivery in the context of aging populations and the increasing cost of health care delivery
- A major challenge facing designers of telecare systems today is providing decision support to enhance the health carer's review of remotely acquired monitoring data.
- More critical as telecare systems become more widely adopted with a need to screen large volumes of electronically monitored patient data efficiently.

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The TeleMedCare System

- Initially developed at the University of NSW, Biomedical Systems Laboratory and subsequently commercialised by TeleMedCare, Sydney
- Complete monitoring and care management system
  - Clinical measurement monitoring
  - Questionnaire delivery
  - Medications management
  - Managed health education
  - Falls detection/prevention
  - Personal Alarm
- Carer access via secure Web site (PCP, Pharmacist, Ambulatory/Community Care staff) for monitoring clinical information and controlling unit remotely

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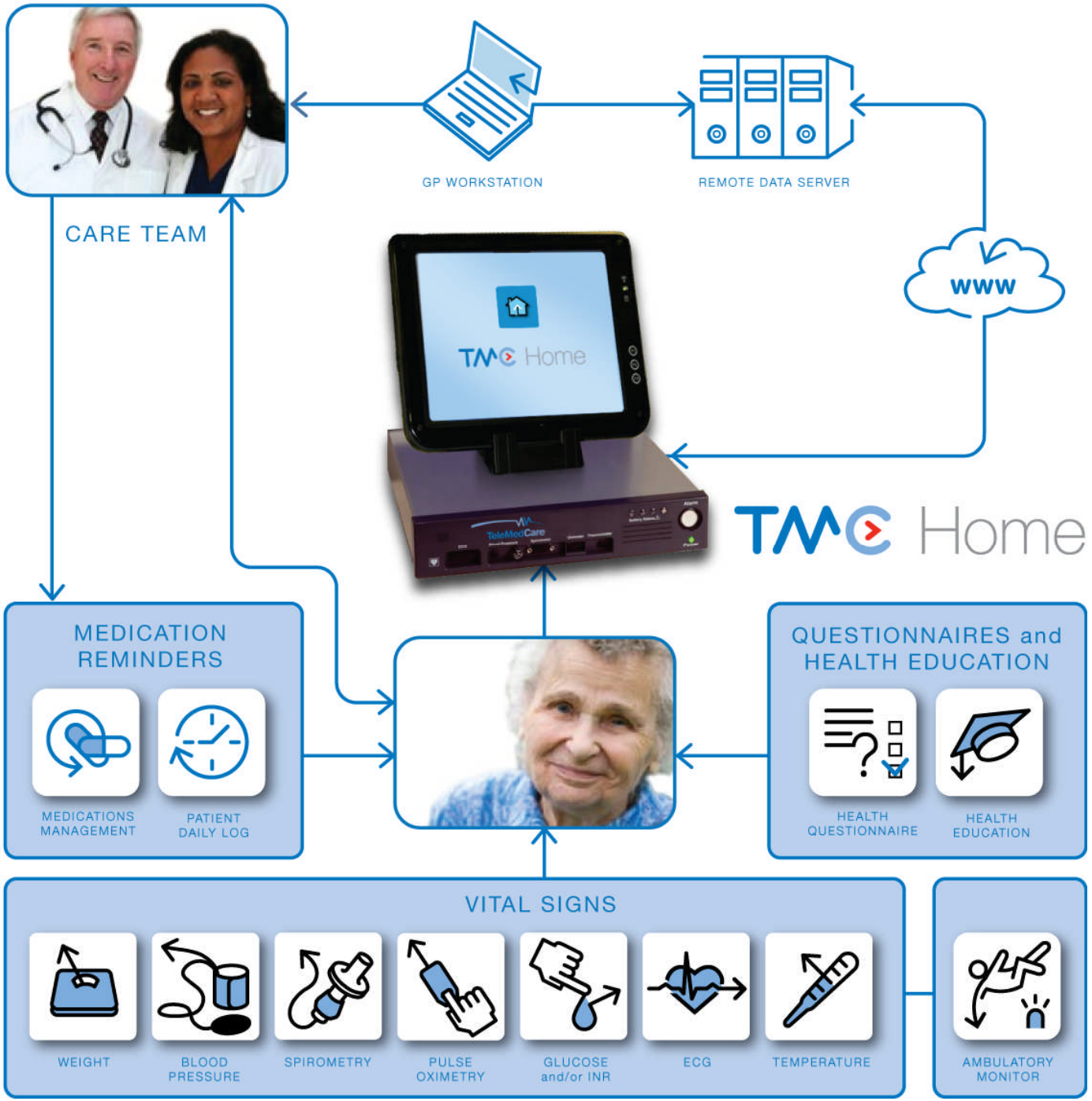
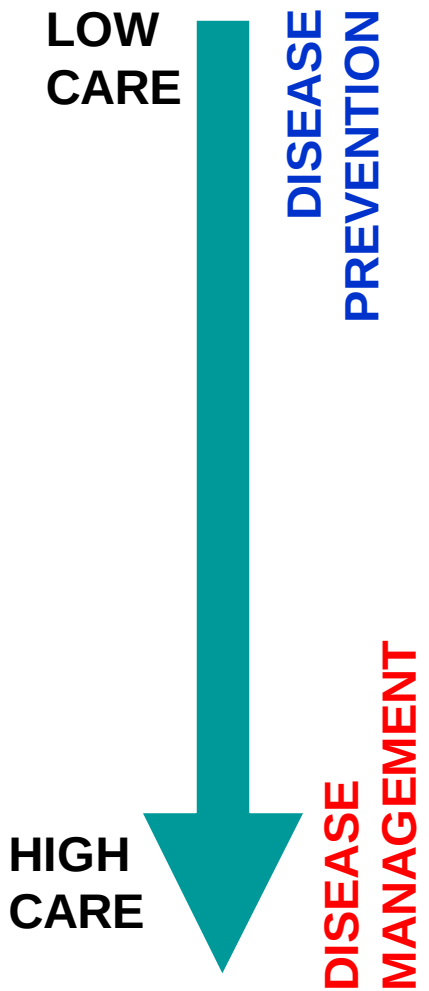

CARE TEAM
GP WORKSTATION
REMOTE DATA SERVER
www
TMC Home
TMC Home
MEDICATION REMINDERS
MEDICATIONS MANAGEMENT
PATIENT DAILY LOG
QUESTIONNAIRES and HEALTH EDUCATION
HEALTH QUESTIONNAIRE
HEALTH EDUCATION
VITAL SIGNS
WEIGHT
BLOOD PRESSURE
SPIROMETRY
PULSE OXIMETRY
GLUCOSE and/or INR
ECG
TEMPERATURE
AMBULATORY MONITOR

Telehealth Products and Services
should span the primary care sector!



- Web based lifestyle management
- Energy and activity monitor
  - Overweight, obesity & diabetes Management
- Health and fitness management
- Occupational Health and wellness
- Bluetooth Tele HUB + devices
  - Falls monitor, weight scales, BP monitor +++
- GP desktop applications
- Community nursing and community hospitals
- Multiuser clinical monitoring
  - Hostels, Independent living units, pharmacies
- Transitional care and early discharge
- Home telecare – chronic disease management
- Applications for Residential Care Facilities
  - Medications management & clinical monitoring

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TeleCare Benefits

- Promotes self-care
  - Empowers the patient and powerful motivator of behavioural change
- Improvement in efficiencies of health care service delivery
  - Better resource management (eg. automation of routine tasks)
- Improvement in the communication and sharing of clinical information that is unconstrained by distance.
  - Better case management
  - More equitable distribution of resources: rural and remote applications
- **Better quality clinical information**
  - **Making better clinical decisions**

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Chronic Disease Management

- Telecare has an important role to play in chronic disease management as it offers the ability to:
  - Identify earlier a deterioration in health status
  - Monitor the effect and response to a specific therapy
  - Confirm convalescence after treatment of a disease exacerbation
  - Monitor the effect of maintenance therapy
  - Identify the requirement for, and monitoring of preventative therapies

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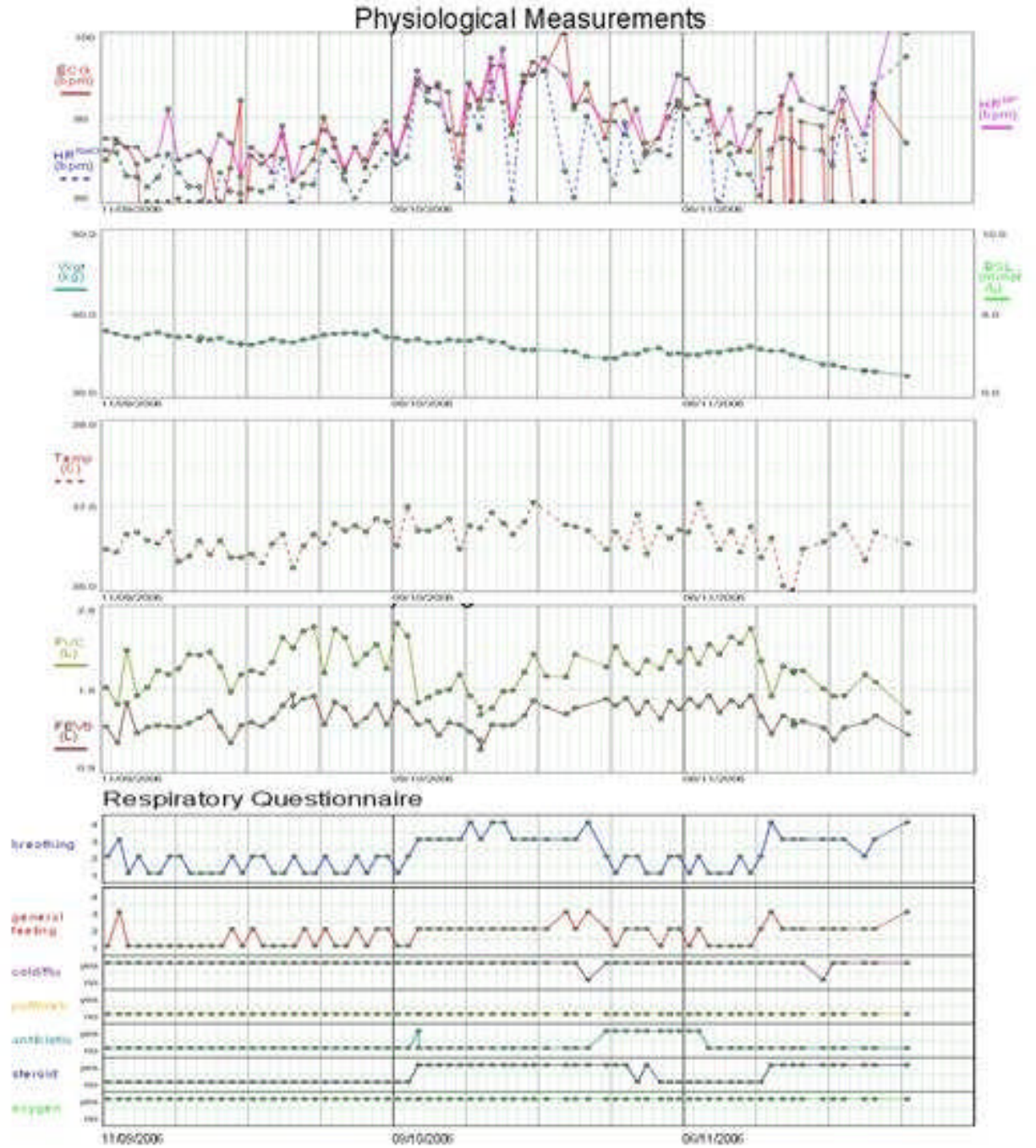

Physiological Measurements
Respiratory Questionnaire
breathing
general feeling
cold/flu
antibiotic
steroid
11/09/2006
09/10/2006
09/11/2006

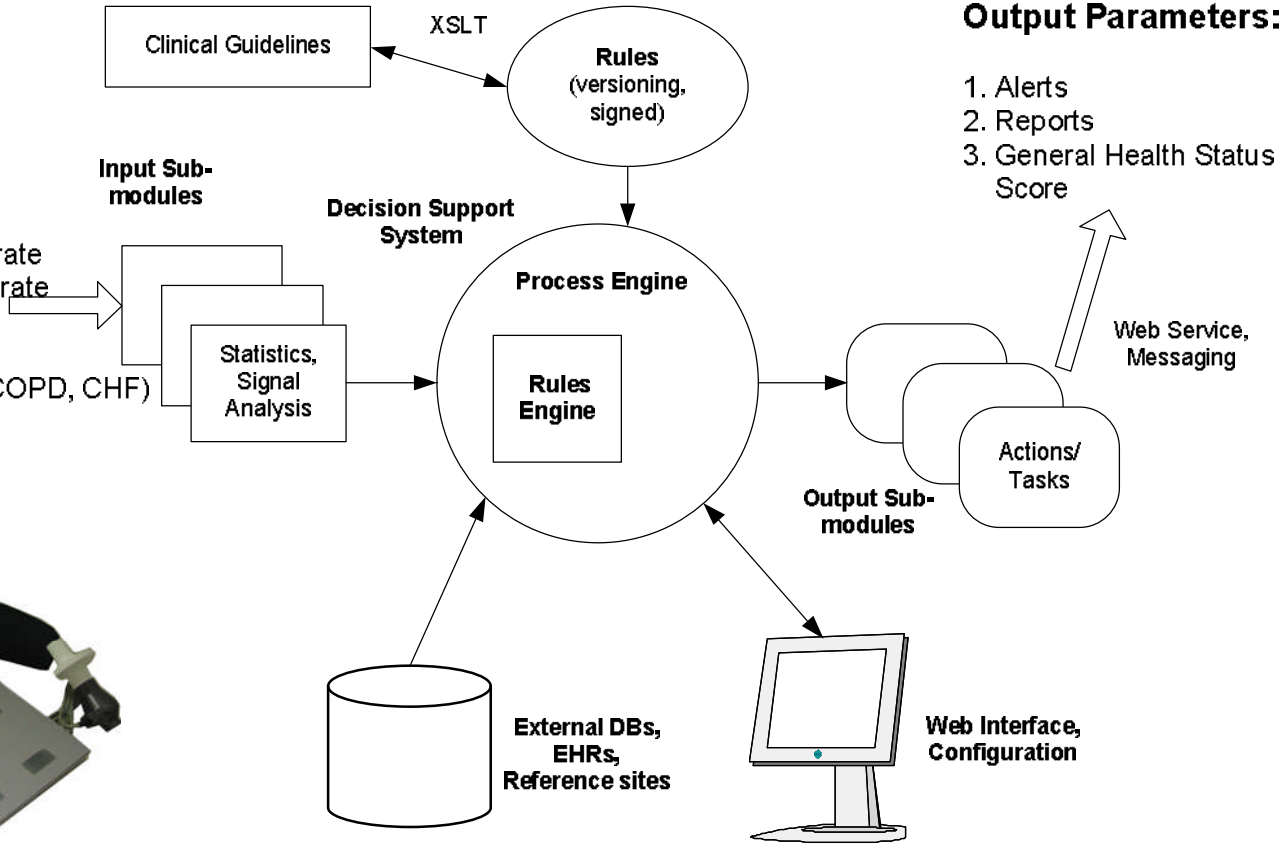
Clinical Analysis

- Patients with exacerbations of chronic disease often have changes in their physiological state way before they realize they are unwell or report problems to their health carers.
- A lot of information is automatically and remotely available that gives the clinician confidence that a particular clinical data pattern is indicative of health deterioration.
  - Enough data is available to develop an understanding of what is 'normal' for the patient
  - Multiple changes across measurements can be correlated for the same period
  - Pattern changes cannot be explained by another reason (eg. changes to medications)
  - Useful knowing beforehand the particular pattern of changes occurring when the patient's health deteriorates

Decision Support Architecture

Input parameters:

1. Single Parameter
   - body temperature
   - weight
   - blood glucose
2. Extracted Waveform Parameters
   - single channel ECG: heart rate
   - blood pressure: systolic, diastolic, heart rate
   - pulse oximetry: oxygen saturation, heart rate
   - forced spirometry: fev1, fev6, fvc
   - relaxed spirometry: ic, vt, ve, rr, ti2tot
3. Questionnaire Results (COOP/WONCA, COPD, CHF)
4. Medications
5. Clinical History



Output Parameters:

1. Alerts
2. Reports
3. General Health Status Score

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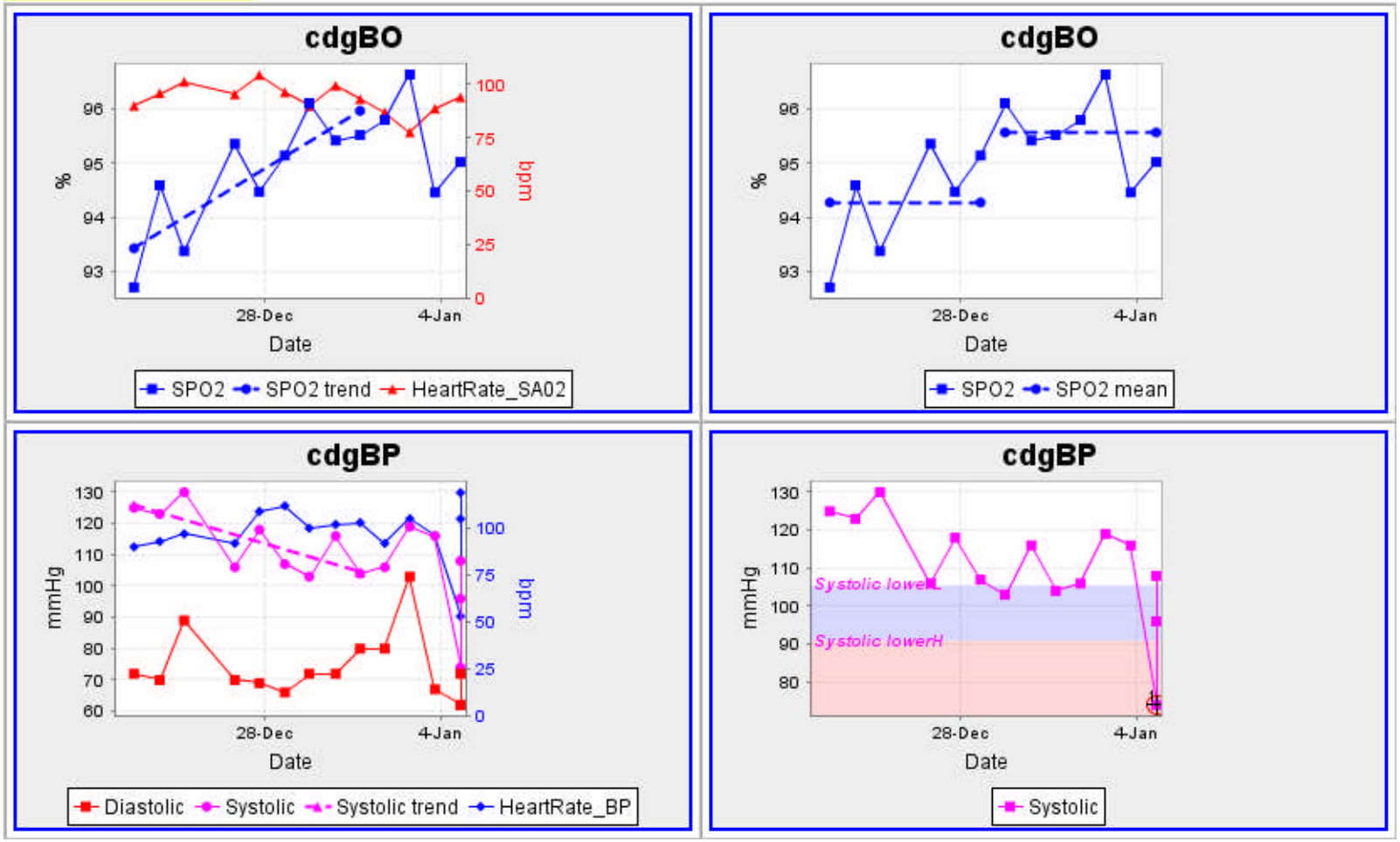
Decision Support



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Status Determination

- Interpretation of the combination of trends, thresholds and average shifts in the data to reach a conclusion about the underlying health status of each patient on a daily basis
- Each clinical measurement and questionnaire result is weighted differently according to the type of change in the data and to the relatively importance of the result to the final overall health status
- Final DSS output score stratifies patient results into high, medium, and low health status categories, to assist health carers when determining review priorities and resource allocation for intervention when required.

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Patient Risk Stratification using Decision Support

ID	Family Name	Given Name	Trend	Status
54	COPD754555	HCWSID17		
64	COPD	HCWSID27		
74	COPD	HCWSID37		
69	COPD	HCWSID32		
61	COPD	HCWSID24		
112	CHF	HCWSID75		
59	COPD782540	HCWSID22		
113	CHF	HCWSID76		
55	COPD392599	HCWSID18		
5	CHF071232	HCWSID5		
72	COPD	HCWSID35		
60	COPD823586	HCWSID23		
65	COPD	HCWSID28		
73	COPD	HCWSID36		
56	COPD256758	HCWSID19		
58	COPD792540	HCWSID21		
66	COPD	HCWSID29		
4	CHF765475	HCWSID4		
114	CHF	HCWSID77		
2	COPDX113115	HCWSID2		
62	COPD	HCWSID25		
63	COPD	HCWSID26		
57	COPD226471	HCWSID20		
68	COPD	HCWSID31		

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Research Areas

- Further refining signal analysis techniques:
  - Factoring indicators of signal quality as a measure of result reliability to the DSS.
  - Identifying indicators of health deterioration at the signal level
- Developing knowledge base for rule interpretation of a specific clinical domain.
  - Factoring in current clinical context, known risk factors, clinical history and medications (SNOMED-CT classification)
- Employing statistical and machine learning techniques to effectively train against recorded clinical outcomes for a specific patient or clinical domain
- Electronic clinical guideline development – guiding clinical management according to evidence best practice.

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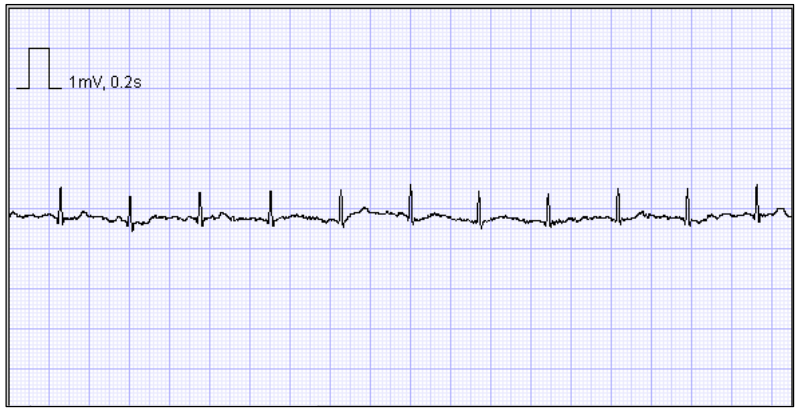
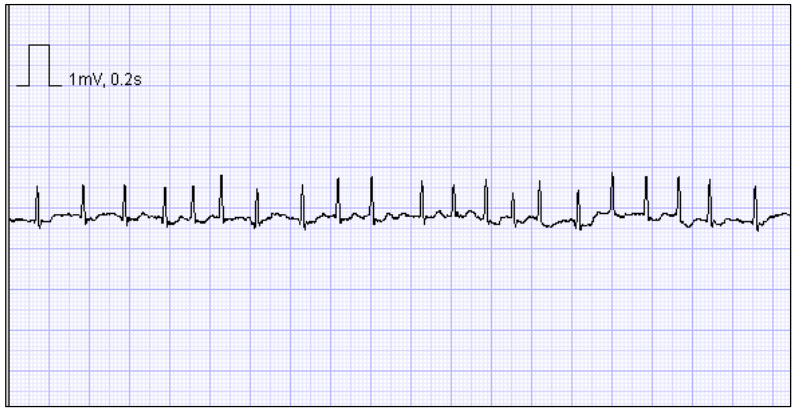
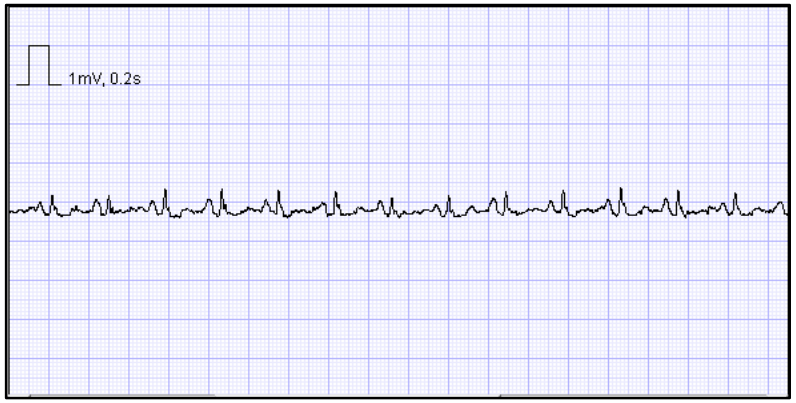
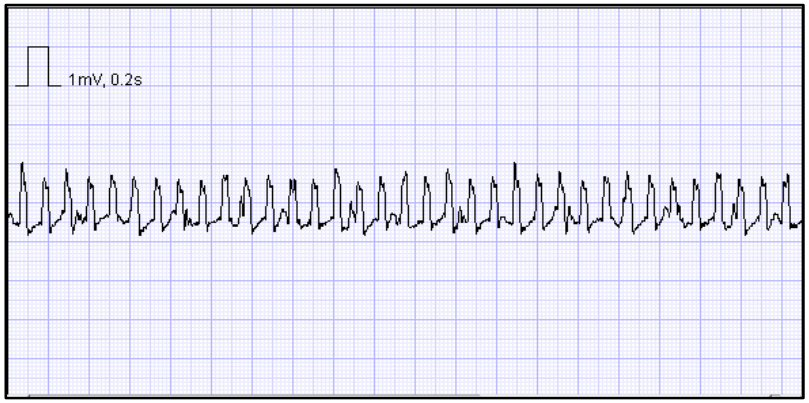
Decision Support – Signal Analysis Level









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Implementation in practice

- Telecare services need to be embedded into an overall health care delivery framework to support existing deficiencies identified in current clinical practice.
- Considerations:
  - Choosing the appropriate telecare service
  - Education and training – staff and patients
  - Appropriate resource allocation
  - Dedicated staff for regular review of remote monitoring results
  - Protocol for notification and intervention based on results
  - Clinical support services for acting on telecare results
  - Readily accessible clinical consultation as required
  - Access to installation and technical support
- We work closely with the clinical services team to support all of the above activities.

Conclusion

- DSS framework facilitates the future integration and management of a wide range of decision support services in a secure, scalable and efficient manner.
- Beta-testing has been undertaken as part of the Austin deployment with preliminary positive agreement between clinician decisions and DSS.
- Ongoing research activity with significant potential for enhancement of features and evidence-based decision support will require a co-ordinated research approach.

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