

Appendix 1: table of codes

Demographic Data
Sex
female
male
IT affinity
nursing staff
respiratory therapist
physician
Work experience on ICU
nursing staff
respiratory therapist
physician
Perceived Barriers to Implementation
No time for training
Digital infrastructure lacks functionality
Many external nurses - much time for training with new system
Communication problems
Clinical decision support systems (CDSS)
difficult to understand technology
no clear benefit perceived
technology not reliable
fear to lose clinical skills
satisfied with existing solution
Remote patient monitoring (RPM)
clinical skills better than monitoring
trust in colleagues more than RPM
less direct contact with patients
not thinking about problem solution
skepticism
increased workload
already satisfied with available system
no clear benefit perceived
less distance, more stress
no trust in new monitoring solutions
Current patient monitoring (PM)
Environmental Factors

architecture of ICU
long distances
Usability PM
Task-specific
Central Monitor
usability
task-specific
technical
more monitors needed
Monitoring other patients from bedside PM
useful
patient identification difficult
Trendanalysis
<i>Purpose</i>
special questions
overview
<i>Usage</i>
daily
seldom
Only additionally to Patient Data Management System (PDMS)
no use
using trends in PDMS
better visualization
more contact to PDMS than PM
Resp. Monitoring
respiratory weaning
spO2 is not sufficient for respiratory monitoring
usage of PM and respiratory device
Alarm Management
<i>Responsibilities</i>
<i>Problems</i>
mental issues
alarm fatigue
stress
communication problems
too many alarms
reasons
technical reasons

patient-related
poor alarm hygiene
lack of training (false alarm limits)
lack of resources
<i>Alarm thresholds</i>
check ECG alarm retrospective
active change of thresholds
frequency
regularly
once per shift
seldom
reason
user-oriented
patient or situation oriented
change of therapy
<i>Routine PM</i>
daily usage
Technical
<i>Measurement inaccuracies</i>
ECG measurement error
spO2 not possible for shock patients
artifacts in the respiratory curve
CO2 measurement error-prone
<i>Auditive alarms</i>
alarm prioritization (importance)
<i>Hardware</i>
entanglement of cables negative
respiratory rate through ECG not possible
touchscreen
touchscreen useful
remote controller
useful
battery empty
monitor
monitor reflects
<i>Visualization</i>
<i>Other medical hardware for visualization</i>
respirator

<i>Design</i>
good
used to this design
color
font
uniform
good overview
<i>Graphic visualization</i>
optimum scale problem
number alone is sufficient
graphic vs numeric visualization
graph important for clinical assessment
validity of measurement
respiratory rate curve for respiratory assessment
loops for respiratory assessment
faster and better visualization of trends
Compatibility with other hardware
small monitor for transports
PDMS
ventilator
System settings
<i>Individual setting options</i>
visualization
display: parameter
curve display / amplitude
<i>Good basic settings</i>
<i>Advanced functions difficult to set</i>
individual adaptation to the specialist field not well
settings take too much time
<i>Parameters (see also Future: concrete wishes)</i>
frequently used parameters
important parameters are missing (subject-specific)
Intuitiveness and simplicity
Future PM
Social Factors
education of staff
enhance team communication
more helpers for nurses

Usability PMS
Usability and intuitiveness
modular system with complex functions more hidden
more functionality for more training time
usability more important
usability important for emergency
usability requirements individually different
individually different number of functions
less training, more functions
Technical
better transmission of data, interoperability of devices
alarm management
different alarm tones for different parameters
wireless
wireless useful
for transports
enhance mobility of patients
comfort for patient
less artifacts
wireless for patient bedding
visualization
relevant parameters get bigger in size
all parameters in one monitor
visualisation at bedside important
non-invasive
required parameters for general monitoring
etCO2 validated
modular system with all available parameters
BIS
non-invasive cardiac index
depth of breath
no need for more parameters
etCO2 for non-intubated patients
Task-specific
Remote Control
less patient contact
respiratory device
remote control of PM

useful when alarm cry
less workload
Remote PM
usability remote PM
<i>Task-specific</i>
patient-oriented
for noise reduction at bed-side
increase of patient safety
monitoring non-ICU patients for fast track
weaning
critically ill
known patients
staff and resources
wireless PM for ward rounds
for less alarm fatigue
forwarding alarm to doctor
direct information about alarm reason
filtering alarms through nurse
when preparing the medication
responsible for more than one ward
remote PM from home
remote PM from on-call room
transports
for intervention with radioactive substances, radiation
CT Transport
neighboring patient room
rural areas
staff shortage
for education
tablets for handing over
will use
not needed
<i>Technical</i>
Alarm management RPM
voice alarm
vibration alarm
audio alarm
only for vital alarms

visual alarm
video monitoring
visualization
graphical
design
color codes for alarms
RPM and PDMS in one system
parameter for remote PM
hardware
projection through beamer
size of hardware
small sized tablet
to have free hands
easy to transport
remote PM on body
middle sized tablet
big sized tablet
if stationary
better overview
smartphone better
tablets / smartphone in ICU
tablets in danger of theft
useful
not useful
no space to carry additional devices
<i>Clinical decision support systems (CDSS)</i>
Usability
<i>task-specific</i>
alarm automatic threshold query
sepsis risk assessment
CDSS only for doctors
automatic trend analysis
scores
intelligent alarm management
CDSS learns from false alarms
CDSS automatically adjusts alarm limits
CDSS suggests solutions to solve alarm
alarm prioritization

alarm filter
less interdisciplinary communication
pattern recognition of alarms
individualization of alarms
report of alarms
closed loop system in ICU