eHealth and Digital Medicine in the Virtual Hospital of the Future

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What is “OP 2000”? 

• Surgical Research Unit at RRK-Charité / MDC
• RRK / MDC combine basic- with clinical-research
• Operating Room of the Future
• Combined application of laser / computer / telecom / video technologies
  - navigation & robotics
  - stereoscopic remote video transmission
  - tele-manipulation & tele-presence
  - tele-teaching & tele-training
  - virtual reality & simulation

precise & optimised tumour diagnosis and therapy

www.rrk-berlin.de/op2000
eHealth and Telemedicine today

USER INTERFACE

INFORMATION
- Internet / Interactive TV
- mobile / stationary

SENSOR DATA
- Body Area Networks
- Biochips, Nanotechnology

SERVICE
- Connectivity for Healthc. Services
- Services for the Citizens
- Health-care at Home
- Mobility
- Management of Trauma, Emergency & Disaster
- Health Early Warning for Env.Risk
- e-Health Education

COMMUNICATION NETWORK
- Satcom
- Wireless / Wired Local Access

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Background of VEMH

• Telemedicine aims at equal access to medical resources for everyone at any time and anywhere (*uHealth*)
• Digital divide: ICT amplifies disparity in quality of life

⇒ **Need for real integration**
   of ICT platforms and telemedical services (*eHealth*)
⇒ **from aid towards multi-lateral cooperations**
The VEMH Consortium constitutes an original partnership between Euro-Mediterranean Health care professionals and industries for the delivery of telemedical services for global health care.
„Non-digital“ Medicine
The modern Medicine is Image Guided and requires an adequate fully digitized Environment for optimized usage in Clinical Routine
direct perception

⇓

video perception
Telemedicine: Required Bandwidth for Multimedia Communication

- **Images:**
  - 1 CT-scan: 4 MB
  - 1 CT-diagnosis (40 scans): 160 MB
  - 1 X ray (e.g. thorax): 30 MB

- **Image sequences (uncompressed):**
  - High quality video: 270 Mbit/s
  - Stereoscopic Transmission: 540 Mbit/s
  - HDTV: 1080 Mbit/s
  - Stereoscopic HDTV: 2160 Mbit/s
WinVicos

Wavelet-based interactive Video communication system

- Sophisticated medical telecommunication software
- Advantages of intelligent wavelet transform compression
- For archiving and transmission of medical images
- Meets the *heterogeneous* requirements
  (scalable resolution and transmission rate)
“Digital” Medicine:
Virtual-, Augmented-, Mixed-Reality, and Haptic
“Digital” real-time Medicine
VEMH: Networks for interactive Telemedicine
Bridging the Digital Divide

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VEMH: from Telemedicine towards Telepresence

Status quo of Telemedicine

• patient data transfer
• patient administration & management
• patient monitoring
• consultation

⇒ interaction with patient’s data per se

Medical Telepresence

• live interaction - telemanipulation & telerobotics
• haptic telesensation
• telementoring & teleteaching

⇒ site-independent access to best medical expertise
VEMH: the Tool for Global Health

Simultaneous and synchronized access from local and remote

– collaborative access of patient data
– collaborative manipulation
– collaborative control
Digital Surgery in VEMH

Computational tools:
- force feedback instruments
- simulations of tissue interactions
- collision detection
- collision response
- visual display
- haptic display
Robotics in the VEMH: a step forward in evolution of operative medicine?

advantages
- three dimensional vision
- improved dexterity
- decreased tremor
- increased surgical comfort
- telesurgical capability

disadvantages
- high costs
- special training
- longer operating time
- rapidly changing equipment
- loss of haptic sensation
VEMH:
Design of future Operating Theatre

- operational efficiency and workflow
- systems integration and standards
- telecollaboration
- surgical robots (dexterity enhancement)
- intraoperative diagnosis and imaging (molecular imaging)
- surgical informatics (eugnostics)
- creation of common standards for digital operating environment
VEMH - Future Medical Developments
VEMH - Getting evidence into medical practice

- Innovative methods for disseminating evidence into practice
- Translation of evidence into knowledge for practising physicians
VEMH - Technology of Interacting

Source: MedSMART 2003
VEMH and the Digital Patient
Physician-Patient Interaction Model
VEMH - Integration of Means

Simulators
Displays
Virtual Reality
Advanced Telecomms
Medical Command Centres

Source: MedSMART 2003
VEMH - Advanced Therapies

Tissue engineering
nanotubes
new drug design
molecular injection

Cell Therapy

Gene Therapy
VEMH – the Nanomedicine?

**classic**

diagnosis and treatment of disease symptoms

**future**

preventive and personalized medicine:
- molecular diagnosis
- molecular imaging
- molecular therapy
GRID for VEMH

flexible, secure and consistent resource sharing & problem solving architecture among dynamic collections of individuals, institutions and resources
Image-Guided Medicine in VEMH?

Avatars… Micromanipulators…. Molecular Probes…. 
Future Medical Developments in the VEMH

Computerisation
Molecularisation
Miniaturisation

- Microsystem-Implants (passive, sensory, active, neural, telemetric)
- In-vitro Diagnostics (DNA- and Protein-Chip, Lab-on-Chip, Microfluidics, Point-of-Care, Cellular Diagnostics)
- Drug Delivery (Micro-Vaporisers, -Dosing, -Injection)
VEMH:
Bridging the Medical Digital Divide of the World

• Training centers and use of new medical devices from distance
• Remote treatment of patients
• Integration of medical competence
• Application centers for new treatments
• Centers of distributed medical intelligency
The Doc in the Virtual Hospital of the Future?