IARIA

InfoSys 2024 & InfoWare 2024

Theme:

Advanced Technologies for Health

Moderator

Prof. Dr. Rory Lewis, University of Colorado - Colorado Springs, USA

Panelists

Prof. Dr. Dirceu Cavendish, Kyushu Institute of Technology, USA

Prof. Dr. Maura Mengoni, Polytechnic University of Marche, Italy

Prof. Dr. Takayuki Nakano, Kyoto Prefectural University of Medicine, Japan

Lect. Dr. Amina Souag, Canterbury Christ Church University, UK

Dr./CEO Sarfraz Khokhar, Rasimo Systems, Raleigh, USA

- **(Generative) AI applications in hospital; a point of view as a Physician**
  - **Indeed there is something to overcome, but it is hopeful.**

  Expectations; **helping patients**

  e.g. Develop novel treatments, agents, tests, or monitoring, …

  Make patients understand their disease deeply, Reducing healthcare cost

  helping healthcare workers

  e.g. Streaming (clerical) work

  Empower their medical knowledge and experience rapidly

  Challenges; Not (entirely) sure how AI is drawing conclusions, Protect patient's privacy

  Wrong answers ("Hallucination") will survive if users doesn't have knowledge in the

  field

Takayuki Nakano
Kyoto Prefectural
University of Medicine

- **What is like the CURRENT relationship between healthcare workers and (generative) AI?**
  - **A reliable JUNIOR**
- **What is like the FUTURE relationship between healthcare workers and (generative) AI?**
  - **In my opinion; AI will be able to replace most of physician`s or pharmacist`s work**

    (e.g. Diagnosis, Prescription, …) **and they will degenerate into a messenger for AI achivements**

Takayuki Nakano

- **Is healthcare workers or patients able to coexist with (generative) AI and its product in hospital?**
  - **Maybe YES**

  Neither may not accept the reasonable suggestion made by AI if they are not familiar to AI.

  It is important to recognize what AI is able to do and not, both in specialists and ordinally person.

  We are already familiar to one Japanese anime and it shows the ideal relationship, DRAEMON!

- **Personalized medicine** involves the identification of therapeutic regimes that are safe and effective for specific individuals.

- *A data-driven* approach that relies on **artificial intelligence** and **(big) multi-modal data** from an individual to make patient-tailored decisions.

- There is an **avalanche** of biomedical data generation and **a parallel expansion in computational capabilities to analyze and make sense of these data.**

  - **What are some examples of data sources used in personalized medicine?**
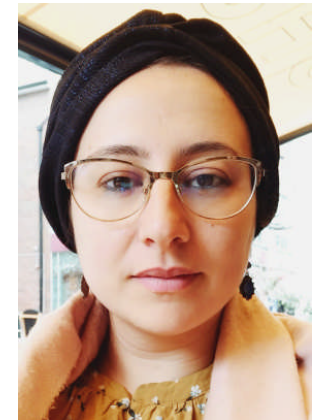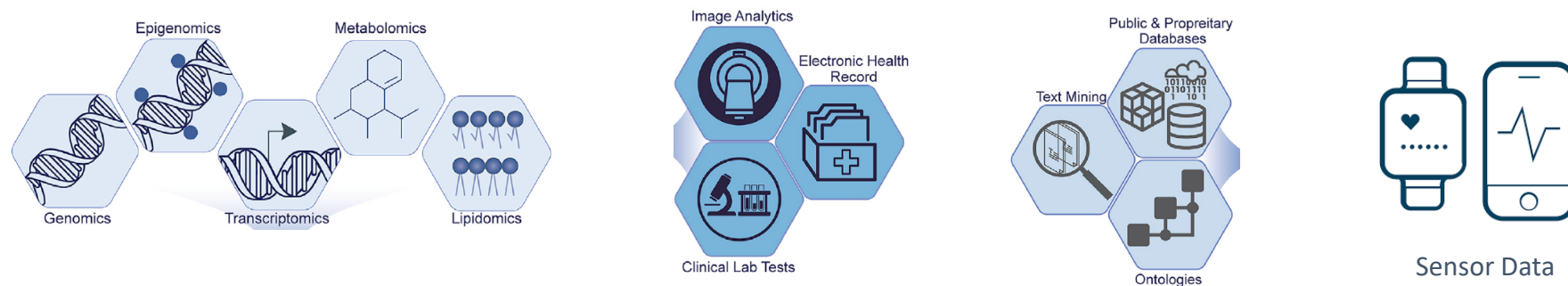
**Amina Souag
Canterbury Christ
Church University**

  - **What role does (Big) Data/AI play in personalized medicine, and why is it considered crucial?**

    - Identifying Patterns and Trends.
    - Predictive Modeling.
    - Enhanced Patient Engagement.
    - Drug Discovery and Development.
    - Precision Imaging and Diagnostics.
    - Remote Patient Monitoring.
    - Etc …

5

- **What challenges might arise in the implementation of personalized medicine, particularly concerning data privacy and ethics?**

  - **Data Security and Privacy:** sensitive patient data + comply with privacy regulations.
  - **Data Bias and Representation:** underrepresentation of certain demographic groups or populations => disparities in healthcare outcomes + limit the effectiveness of personalized medicine approaches.
  - **Interpretation and Clinical Validity:** Translating complex genomic and molecular data/AL models into actionable clinical insights => **explainable AI.**
  - **Resource Allocation and Access:** investment in infrastructure, technology, workforce training, and research initiatives. Limited resources may exacerbate inequities in the delivery of personalized medicine, particularly for underserved populations or regions with limited healthcare infrastructure.

Amina Souag
Canterbury Christ
Church University

How can the technological advancements of our time and future trends improve people's health and care?

❖ **What is health?**

*«Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity» (*World Health Organisation [WHO], 1948: 100)

→ Attention to **human factors** (emotions, cognitive and physical ergonomics) in terms of

objective measure and **use** in technology **(adaptive interaction, usability, accessibility, personalization)**
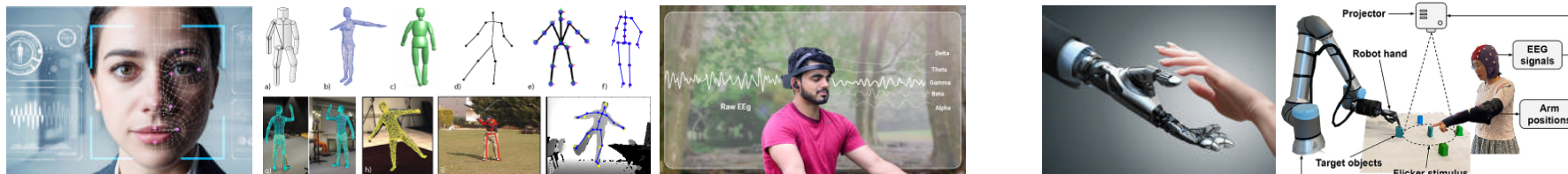
Maura Mengoni
Polytechnic
University of
Marche, Italy

❖ **Could it be limiting to discuss health only in the context of care**, or can we extend its study to other sectors to ensure safer and healthier **living environments**?
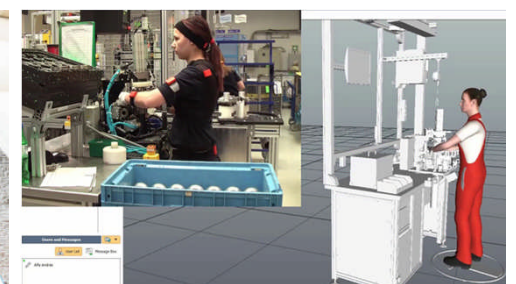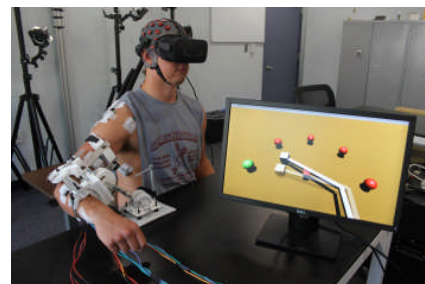
→ Extention from medicine to **rehabiliation** **automotive** **home automation** **factory**

❖ **Which are the current technological trends that offer promising prospects for revolutionizing the healthcare sector?**

Artificial Intelligence and Machine Learning

Telemedicine and remote monitoring

Internet of Medical Things (IoMT)

Virtual Reality and Augmented Reality and Metaverse / Multiverse

Genomics and personalized medicine

Blockchain technologies

Maura Mengoni
Polytechnic
University of
Marche, Italy

❖ **Is it merely a matter of identifying technologies and dedicating ourselves to their research and development, or do we need to bring about methodological changes in their selection, design, and implementation?**
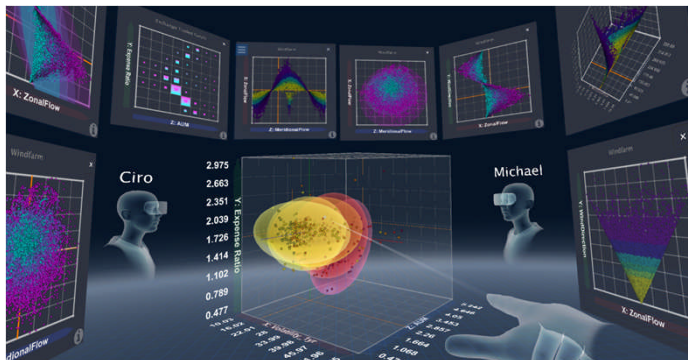
Methods for **technologies clustering, selection and customization** by applying multidimensional Quality Functional Deployment matrices to map human needs, technology requirements and specifications, production and quality assessment requirements.

Design methods → **Role of scientists/technologists** in a world where AI seems to replace human beings.

Shift from a technological approach to a more **holistic and human-centered perspective**.

Focus on **empathy, creativity, and ethical decision-making** issues in technology development for healthcare.

8

➢ AI is not just ML. Let's don't forget other disciplines: Expert Systems

➢ Integration of AI with state of the art digital health technologies

➢ Develop comprehensive, multidisciplinary AI-based solution for noncommunicable diseases (metabolic health)*
  - ➢ 74% of global deaths comes from noncommunicable diseases
  - ➢ 1B people living with obesity
  - ➢ 0.8 B people living with diabetes
  - ➢ 2B people suffering from NAFLD/NASH (Liver Metabolic disease)
  - ➢ 18M dying every year from cardiovascular conditions

➢ Effective AI-based solutions to shape lifestyle, ease psychosocial conditions, enhanced patient–HCP communication, improved patient outcome, minimize therapeutic inertia, better adherence to treatment, and better insight for personal medication.
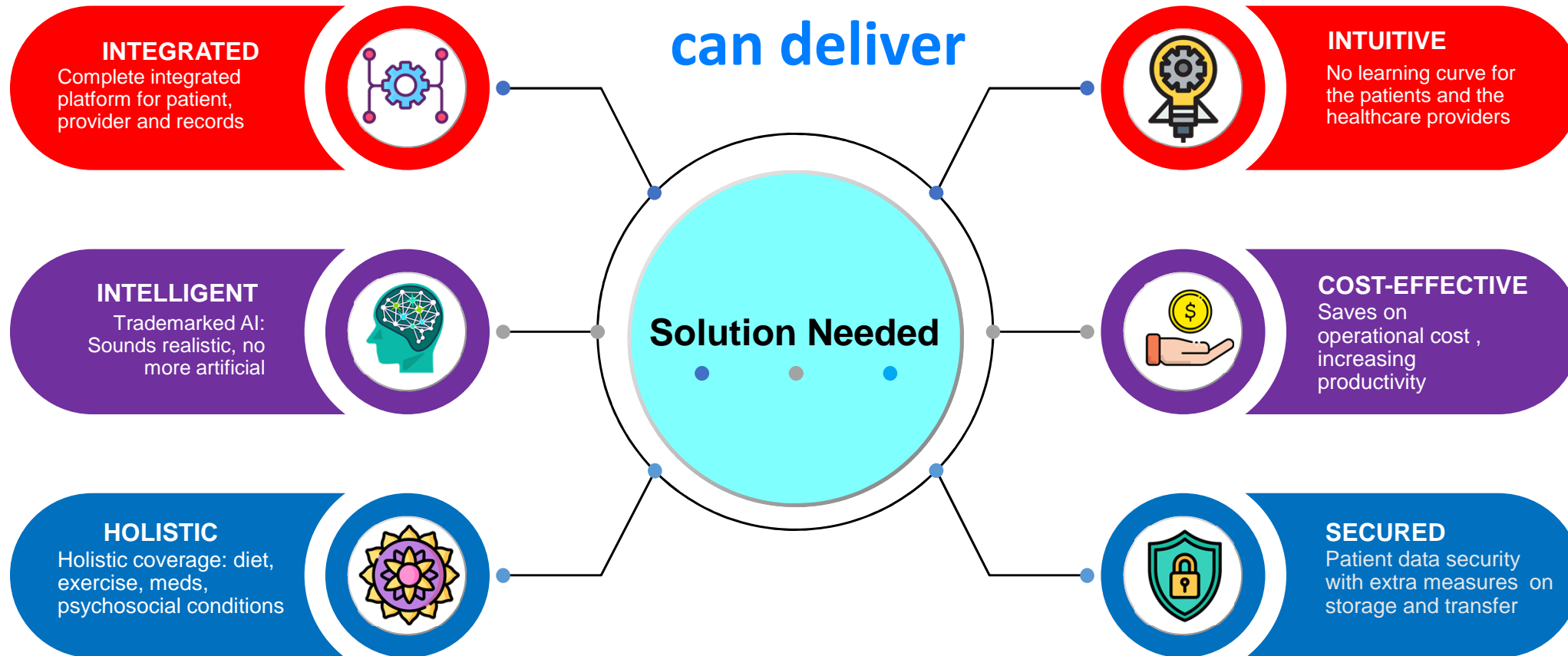

Sarfraz Khokhar
Rasimo System,
Raleigh, NC, USA

*Sources   WHO   UpToDate®   PMID 32061595   PMID 32061595   WHO

Characteristics of the solution in need ML and Expert System can deliver

Solution Needed

INTEGRATED
Complete integrated platform for patient, provider and records

INTELLIGENT
Trademarked AI: Sounds realistic, no more artificial

HOLISTIC
Holistic coverage: diet, exercise, meds, psychosocial conditions

INTUITIVE
No learning curve for the patients and the healthcare providers

COST-EFFECTIVE
Saves on operational cost, increasing productivity

SECURED
Patient data security with extra measures on storage and transfer

Sarfraz Khokhar
Rasimo System,
Raleigh, NC, USA

10

Medical Systems Components
- Small edge device: implants (e.g. pacemakers), sensors (e.g. cgm)
  - Short range communication: battery/security
- Command and control device: smartphone
- Cloud infrastructure
  - Data gathering and analysis
  - System security control
- Hospital infrastructure
  - ICU/MRI/etc
  - Hospital Management System

Dirceu Cavendish
Kyushu Institute of Technology

Medical components vulnerabilities/threats
- Edge devices;
  - implants: lack of encryption/authentication – injection of malicious commands
  - sensors: lack of FW authentication, lack of encryption/integrity check – data tampering/MITM attacks
- Smartphones
  - OS vulnerabilities (CVSS)
  - Apps vulnerabilities: lack of authentication/attestation verification – unauthorized data harvesting;
- Cloud infrastructure/resources
  - Resources outages - DoS
  - Heavy dependency on PKIs/certificates
- Hospital infrastructure
  - Legacy equipment: Obsolete OS, hardcoded credentials, no encryption/authentication – code injection, ransomware
  - Hospital Management System: Strong Identity and Access Management (IAM); PHI role based access control

1
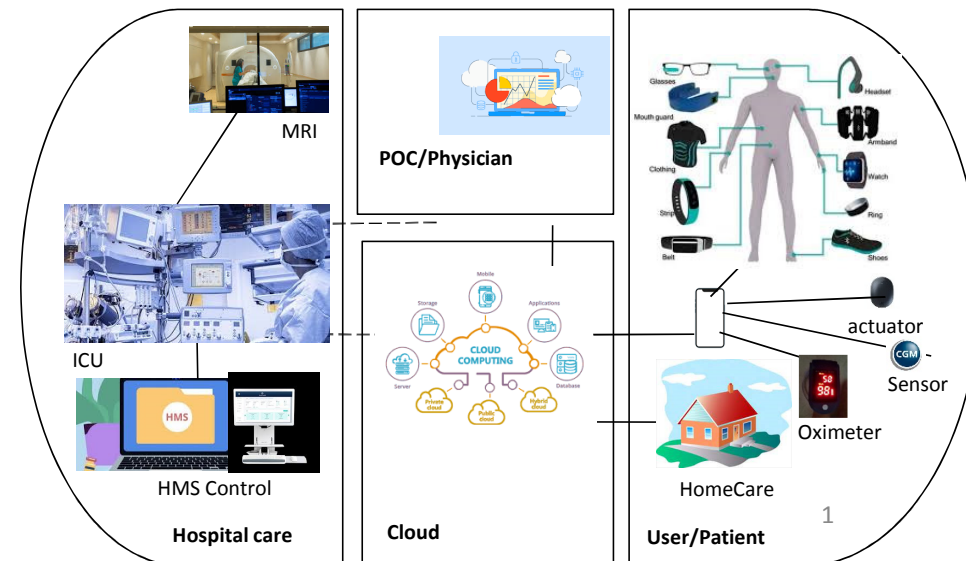
Embedded/SW Secure requirements
■ Firmware tampering verification
■ Firmware/software compatibility (Versioning)
■ Configuration/calibration verification
■ OS security patching

Components Authentication and Authorization
■ Short range authentication: secure BLE (IoT whitelisting)
■ System Multifactor authentication
■ Explicit resource authorizations via security tokens
■ Cloud Hardware Security Module (HSM): management of security credentials
■ System multicomponent authentication: distributed ledgers

Dirceu Cavendish **IoTRC**
Kyushu Institute of Technology

Safety   **Security**

Risks
Harzards   Threats

Security/Safety/Privacy Tradeoff Scenarios
■ Safety/Privacy: Deny PHI access to healthcare professionals
■ Safety/Security: Stop Therapy on security threat detection
■ Security/Privacy: Block patient data access on security threat

PHI leakage

Privacy

2