The Fourth Industrial Revolution and Occupational Health

Dr Elton Dorkin MBChB MBA
Dr EP Dorkin & Associates
GIBS Part-time Faculty
1. Introduction and Definitions
2. 4IR
3. Artificial Intelligence
4. Applications in other health fields (with OH examples)
5. Implications and Applications in Occupational Health#
   a) HCP/Other risks
   b) Musculoskeletal
6. Conclusions


• Artificial intelligence (AI) and global health: how can AI contribute to health in resource-poor settings? Brian Wahl, Aline Cossy-Gantner, Stefan Germann, Nina R Schwalbe
What exactly is the 4IR?

Prof. Claus Schwab WEF 2016

- Physical
- Biological
- Digital

- Internet of Things
- Artificial Intelligence
- Cyber-physical systems
  - Robots/Cobots
  - Sensors
  - 3D Printing (Additive Manufacturing)
What is AI?

AI is the branch of computer science that deals with the simulation of intelligent behaviour in computers.

Something ‘acts intelligently’\(^1\) when:
(1) what it does is appropriate for its circumstances and its goals;
(2) it is flexible to changing environment and changing goals;
(3) it learns from experience; and
(4) it makes appropriate choices given its perceptual and computational limitations.

---

No universally accepted classification of AI sub-fields relevant to health exist\(^2\), although usually used in combination:

1. Expert systems
2. Machine learning
3. Natural language processing
4. Automated planning and scheduling
5. Image and signal processing
Expert systems

Expert Systems

• Act in place of a human expert, based on existing knowledge e.g. Framingham, PLH calculation, Spirometry, ECG, (Fitness Assessment), birth asphyxia prediction based on a risk score

• Diagnosis and treatment plans
Machine Learning

Machine learning

- Uses existing information to learn, and apply to new situations:
  - Epidemic prediction, modelling and prevention, e.g. using weather and land use patterns to predict Dengue Fever transmission (HEG and disease prediction, rock type, machine type in NIHL and Silicosis, Fitness Assessment, XR Reporting)
  - Guide cancer treatment (with NLP) e.g. IBM Watson
NLP and AI Planning

Natural Language Processing

- Detect and map outbreaks using online and social media sources (Global Health Monitor)
- Support clinical decision making or track health disparities (Somalia), adverse drug reactions

AI Planning and Scheduling

- Immunisation
- Supply chain
- Scheduling, for example: Community Health Worker Visits
- (medical surveillance, machine maintenance)
Signal and Image Processing

Signal and image processing

• Wearables
  – pulse
  – arrhythmia
• Radiology e.g. MBOD
• Dermatology
• Pathology
• OAE
How is the 4IR expected to change OH?

- New (and no) hazards of job displacement and the human-machine interface
  - Psychosocial
  - Physical
  - Biological

- Health surveillance
  - ‘system of systems’

- Risk assessment

- Control
  - VR for training
  - AI Safe
Timeline approach

Timeline 1: Improve efficiency of current work

Timeline 2: Job displacement
- Operations
- Occupational health
Use case: Hearing Conservation (and any other risk) in Mining

HIRA
AI Scheduling: Machine replacement, maintenance, tag-out
Signal and image processing: Machine noise, material types

Control
(VR in training)
Signal and image processing: HPD use, sensors mounted in HPDs

Medical surveillance
Expert systems: Current audiology
AI scheduling
Machine learning
Use case: Clinic Management

- SIGNAL AND IMAGE PROCESSING
- EXPERT SYSTEMS
- NLP
- MACHINE LEARNING
- AI SCHEDULING
Challenges

Expert Systems

- Require a clear definition of the clinical problem
  - Acquiring and updating the knowledge base
  - Accuracy tracking and trust
  - Integration of various AI systems
  - Do all disease domains require expert systems?

Machine Learning, NLP and AI for Planning/Scheduling

- Quality, variety and quantity of datasets for diseases/supply chain of interest
- Different record structures and linguistic content
- Better diagnoses do not equate to more appropriate or quality treatments
- Bandwidth requirements
- Privacy, data ownership, security, consent
- Risk of bias and ‘black box’, exacerbation of inequity
- Clinical efficacy research
Questions and Comments?