

What is eHealth Network doing towards AI in Health?

Professor Henrique Martins

12 de abril 2019
COCIR General Assembly



SPMS_{EPE}
Serviços Partilhados do Ministério da Saúde

Why?





7 reasons to go fast into AI and Artificial Life

01

It is possible to radically **change** the way of doing medicine / health

02

This **change** will occur whether we like it or not, but this inevitability is not equal to passivity or lack of ability to give it a certain meaning (**Transformation**)

03

If it is possible to give "meaning" to the DT, then there is room for "agency" action, ie the **Leaders have to know** what they **want for the Digital Transformation** of Health

04

If we want to lead the DT we **have to know the purpose we intend** to: Transform to "what". Without knowing this, we may know how to use the digital tools, but we do not know the " what for"



7 reasons to go fast into AI and Artificial Life



What is the **intent** to be Digital Transformed?

a. something that you want and plan to do; an aim

In: Cambridge Dictionary Online





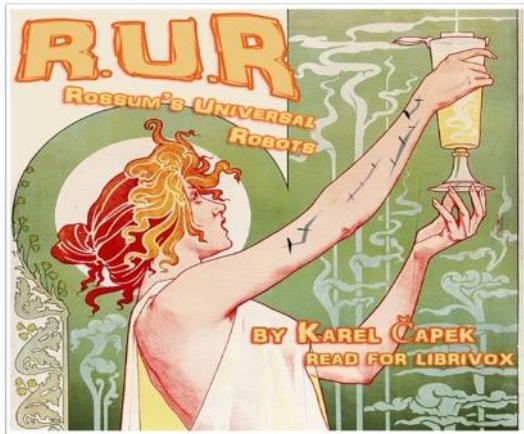
7 reasons to go fast into AI and Artificial Life

06

Open data, big data, Artificial Intelligence, Increased Intelligence (**Hybrid Human-Machine**)

07

ALIFE - Artificial Life comes in whether we want to use or not health/medicine to make "Robots" more human , or simply "robotize" medicine and health without influencing that path;



Rossumovi Univerzální Roboti - 1920 Karel Čapek, Robot / Robota (Robota, which, in his language and in other Slavic languages, can mean work performed compulsorily, or slave)

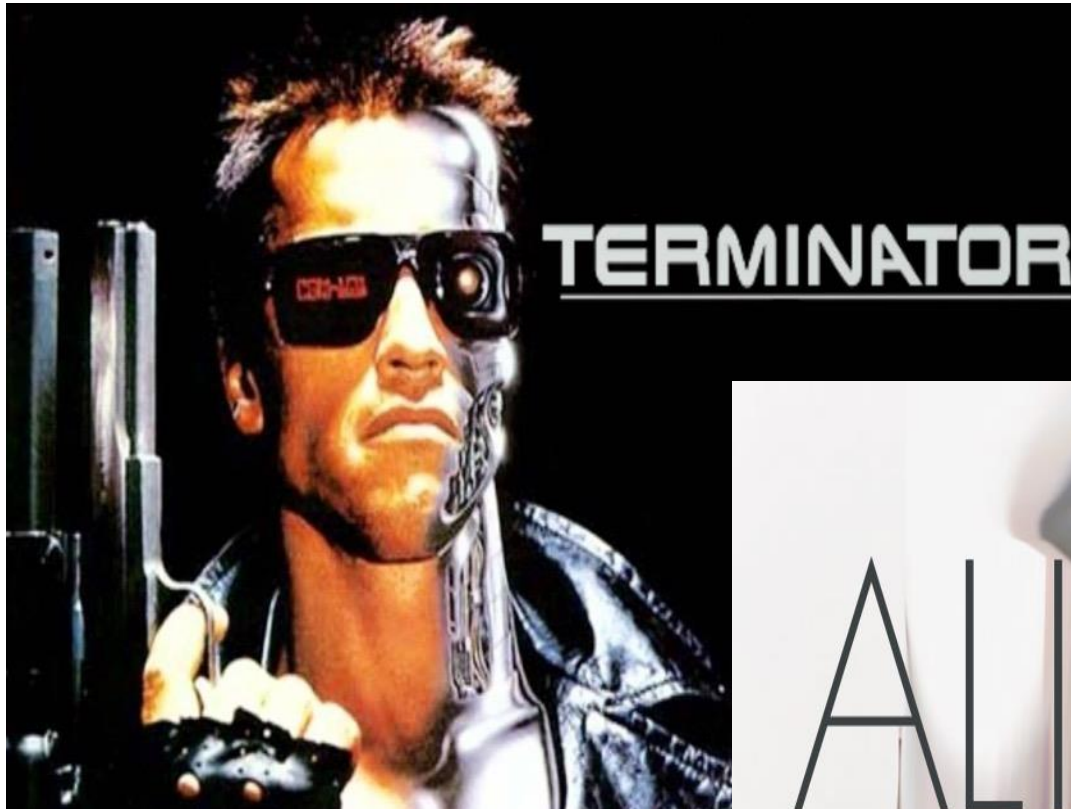






“GOOD” AI vs “BAD” AI

ALIFE: ARTIFICIAL LIFE



4.4 Comparison of Evolutionary Search Methods

The best individuals obtained in the evolutionary experiments using the three different versions of the search algorithm (Section 3) were qualitatively similar. Yet, quantitative analysis of each algorithm’s performance reveals that the success rate of producing high-quality individuals is very different for each of them.

Compared to the basal, simple fitness function, the progressive fitness approach was observed to produce on average higher quality of individuals (Figure 10), in both the cases of evolving aquatic and terrestrial larvae first. A likely explanation is that the progressive fitness function relaxes the requirement of both developmental phases having to produce moving individuals from the very beginning. At the same time, metamorphosis is easier to evolve if modifications that occur in the

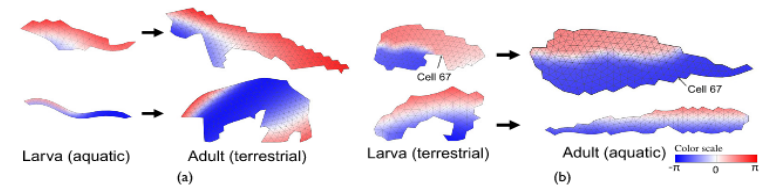


Figure 9. Controller comparison for the larval and adult stages of individuals shown in Figures 3 and 6. Colors represent evolved phase shifts of cellular contractions and expansions.





EUROPEAN CONTEXT



Digital Single Market



eGovernment Plan 2016-2020



Multiannual Work Programme 2018-2021



EC Communication 25.4.2018 on enabling the digital transformation of health and care in the DSM; empowering citizens and building a healthier society



EC Communication 25.4.2018 on Artificial Intelligence for Europe



Commission Recommendation of 6.2.2019 on a European Electronic Health Record Exchange format



DIGITAL SINGLE MARKET



e-commerce
parcel delivery
geo-blocking
copyright
VAT



Access

telecoms and media
online platforms
security and personal data



Environment

data economy
standards
skills and e-government



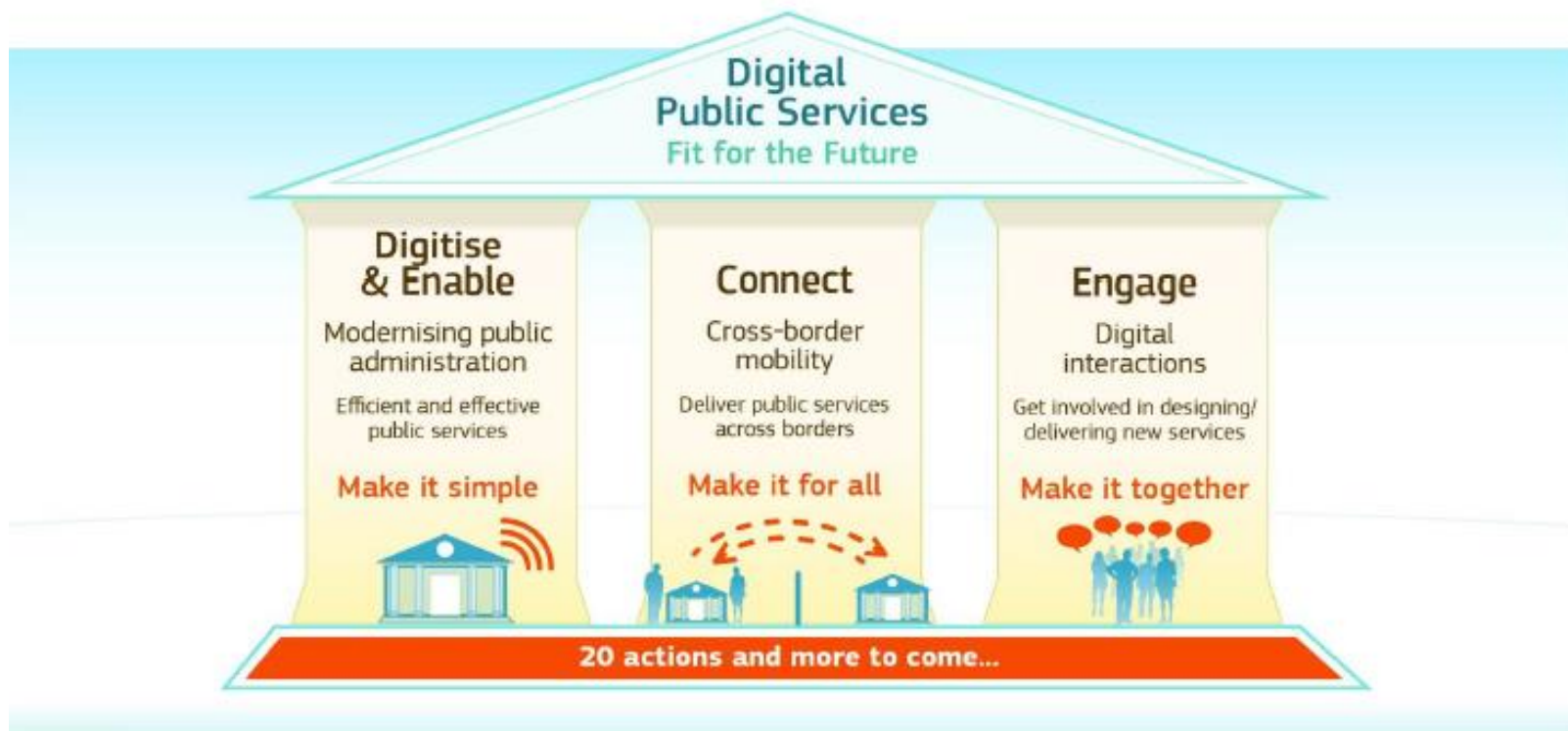
Economy and Society

Creating a #DigitalSingleMarket



eGov ACTION PLAN 2016-2020

eGovernment Action Plan 2016-2020 Accelerating the digital transformation of Government





MULTIANNUAL WORK PROGRAMME 2018-2021



- A1 mHealth and apps reliability**
- A2 Patient access and use of data**
- A3 Digital Health literacy of patients**
- A4 Telehealth**



- B1 Awareness raising of using Big Data in Healthcare**
- B2 Develop a common vision of innovative use of data on healthcare**
- B3 Governance and methodologies for Big Data**



- C1 Stimulating and supporting the adoption of CBeHIS**
- C2 New use cases and sustainability for eHDSI**
- C3 Legal Challenges**
- C4 European Reference Network eHealth Services**



- D1 Interoperability**
- D2 eSkills for Professionals**
- D3 Data Protection and Data Security**
- D4 Evaluation of eHealth**



EC COMMUNICATION 25.04.2018

The Communication contains a package of legislative & non-legislative proposals with the aim of supporting Member States action on eHealth to:

1

Access and Sharing of Electronic Health Records for citizens

2

Connected health data to advance research, prevention and personalised health and care

3

Digital tools to foster citizen empowerment and person-centred care



EC ELECTRONIC HEALTH RECORD EXCHANGE FORMAT (EHRXF)

This Recommendation sets out a **framework for the development of a European electronic health record exchange format** in order to **achieve secure, interoperable, cross-border access to, and exchange of, electronic health data** in the Union.

The framework includes:

- (a) a set of principles that should govern access to and exchange of electronic health records across borders in the Union;**
- (b) a set of common technical specifications for the cross-border exchange of data in certain health information domains, which should constitute the baseline for a European electronic health record exchange format;**
- (c) a process to take forward the further elaboration of a European electronic health record exchange format. It also encourages Member States to ensure secure access to electronic health record systems at national level**



EC COMMUNICATION IN AI

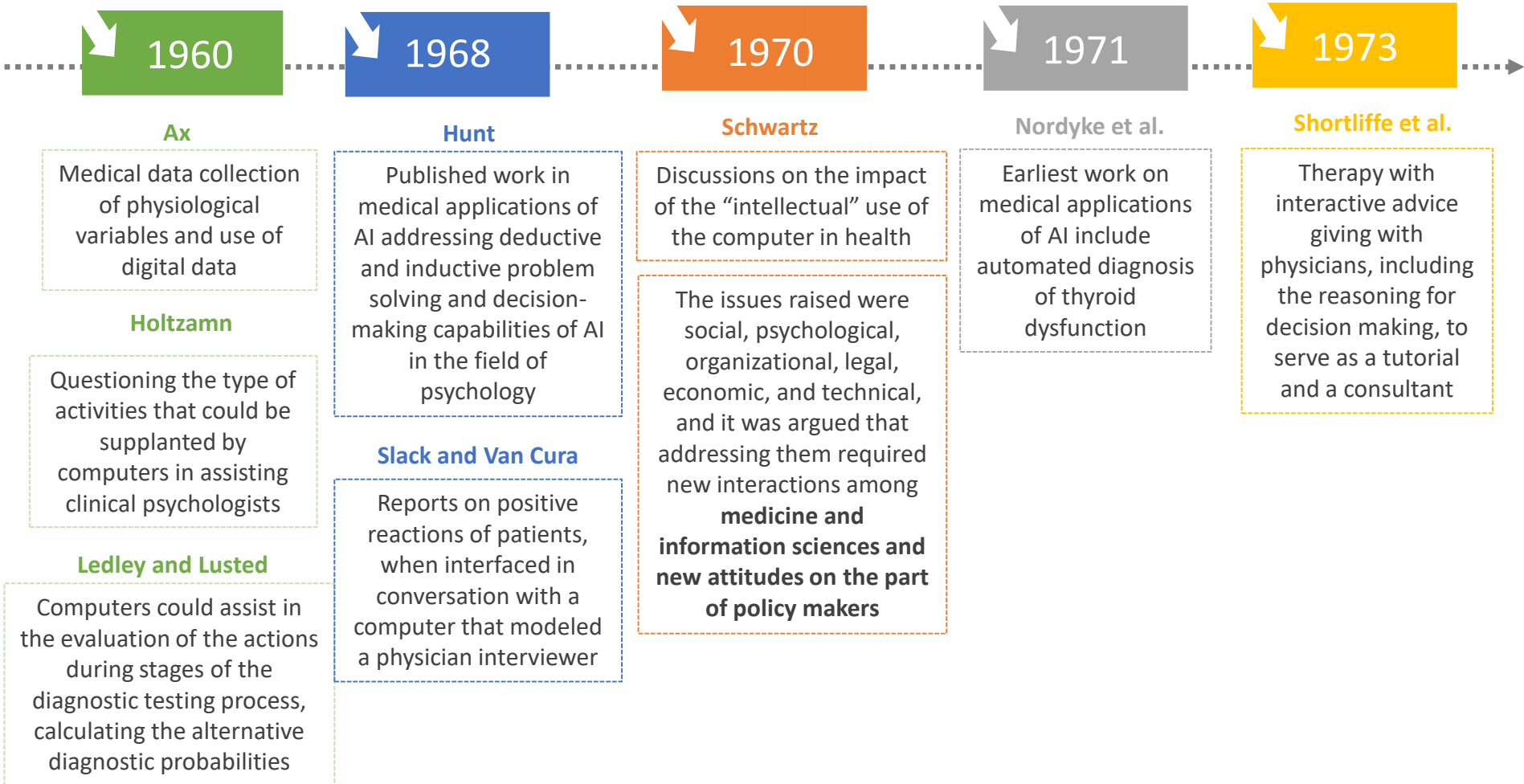
This Communication sets out a European initiative on AI, which aims to:

- **Boost the EU's technological and industrial capacity and AI uptake across the economy**, both by the private and public sectors. This includes investments in research and innovation and better access to data.
- **Prepare for socio-economic changes** brought about by AI by encouraging the modernisation of education and training systems, nurturing talent, anticipating changes in the labour market, supporting labour market transitions and adaptation of social protection systems.
- **Ensure an appropriate ethical and legal framework**, based on the Union's values and in line with the Charter of Fundamental Rights of the EU. This includes forthcoming guidance on existing product liability rules, a detailed analysis of emerging challenges, and cooperation with stakeholders, through a European AI Alliance, for the development of AI ethics guidelines.

All this requires joining forces



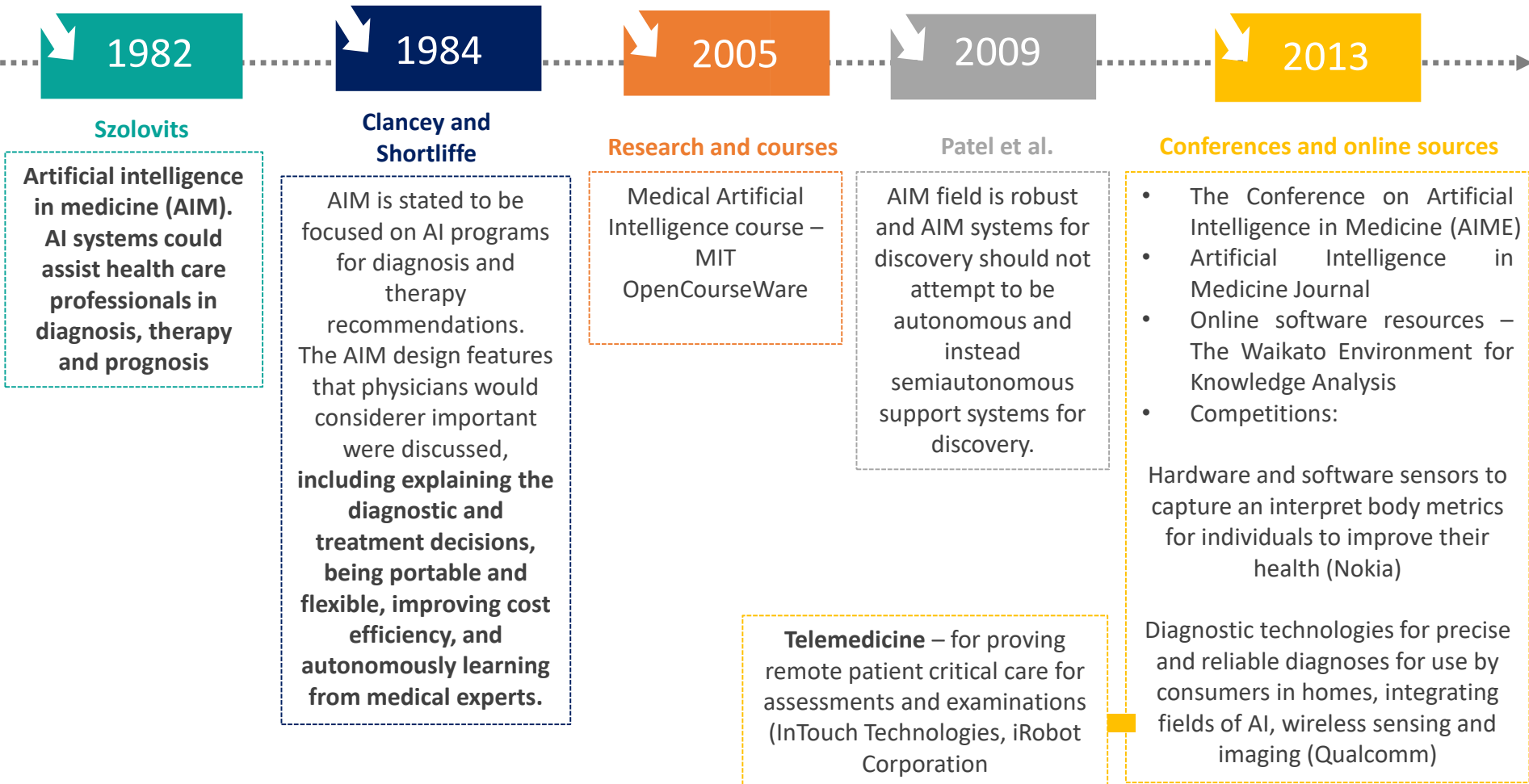
INTRODUCTION TO MEDICAL APPLICATIONS OF ARTIFICIAL INTELLIGENCE



Arvin Agah - Medical Applications of Artificial Intelligence-CRC Press (2013)



INTRODUCTION TO MEDICAL APPLICATIONS OF ARTIFICIAL INTELLIGENCE



Arvin Agah - Medical Applications of Artificial Intelligence-CRC Press (2013)



INTRODUCTION TO MEDICAL APPLICATIONS OF ARTIFICIAL INTELLIGENCE

Set	Type	Theme and Author	Year											
			1990	2000	2001	2002	2004	2005	2006	2007	2008	2009	2010	2011
1st set	Books, Journals, Conference Proceedings	Expert Systems (Fieschi)												
		Software agents (Moreno and Nealon)												
		Foci and fuzzy logic (Barro and Marin)												
		Genetic Computation (Smith and Cagnoni)												
	Survey papers	AI applications in the intensive care (Hanson and Marshall)												
		Medical Applications of case-based reasoning (Holt et al.)												
		Fuzzy logic in medicine (Torres and Nieto)												
		Wearable Computing (Lukowicz)												
		Evolutionary Computation (Pena-Reyes and Sipper)												
		Use of smart and adaptive systems in different areas (Abbod et al.)												
2nd set	Books, Journals, Conference Proceedings	Computational intelligence in health care (Springer)												
		Medical Informatics (Kelemen et al. 2007 e Yoshida et al. 2010)												
		Medical Imaging (Schaefer et al.)												
		Medical Diagnosis (Schmitt et al.)												
	Survey papers	Medical documents' summarization (Afantenos)												
		Hospital scheduling (Spyropoulos)												
		Bioinformatics (Valentini)												
		Brain Patology (Hemanth et al.)												

Medical applications of AI can be categorized in two classes:

1st set – focus on a specific field in AI, as it is applied to diferente areas in medicine

2nd set – concentrates on an explicit area in medicine and covers the utilization of a number of AI techniques in that area

Arvin Agah - Medical Applications of Artificial Intelligence-CRC Press (2013)



Introduction to Medical Applications of Artificial Intelligence

- *As with traditional clinical activity, patient safety must remain paramount and **AI must be developed in a regulated way in partnership between clinicians and computer scientists.** However, regulation cannot be allowed to stifle innovation*
- ***Clinicians can and must be part of the change** that will accompany the development and use of AI. This will require **changes in behaviour** and attitude including rethinking many aspects of **doctors' education and careers.** More doctors will be needed who are as well versed in data science as they are in medicine*
- ***Artificial intelligence should be used to reduce, not increase, health inequality – geographically, economically and socially.***

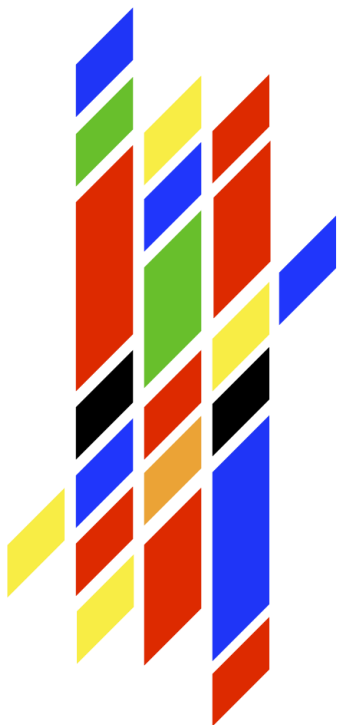


Academy of Medical Royal Colleges, Artificial Intelligence in Healthcare (2019)



Building a new vision...





eHAction

Joint Action supporting
the eHealth Network



INNOVATIVE USE OF HEALTH DATA

WP

WHAT IS THIS ABOUT?

Growth in the range of information that is being collected

mAPPs that monitor patients health

Trusted sources of data, analysing and making value

FOCUS AREAS

TASK 5.1

Mapping, awareness raising and policy relevant actions on innovative use of big data in health

TASK 5.2

Sharing and learning best practices on European level

TASK 5.3

Towards an attempt to define common principles for practical governance

DELIVERABLES

D5.1

Report for the information of the eHN on policy level actions

D5.2

Report on identified cross-border use cases, including assessment of pros & cons of stakeholders, and practical solutions with potential for European scale benefits

D5.3

Proposal for the eHN on the guidance for the implementation of common principles for practical governance of big data with a special focus on data to be used in public health & research

WP.5 INNOVATIVE USE OF HEALTH DATA

The overall objective of WP 5 is to support the application of good practices in MS/C and provide guidance at EU level on handling big data in health within the existing EU regulatory framework, and consequently to ease the uptake of innovative usage of data across the healthcare sector for the benefits of society, individuals and performance of MS/C health systems.

D5.1

Report for the information of the eHN on policy level actions

D5.2

Report on identified cross-border use cases, including assessment of pros & cons of stakeholders, and practical solutions with potential for European scale benefits

D5.3

Proposal for the eHN on the guidance for the implementation of common principles for practical governance of big data with a special focus on data to be used in public health & research



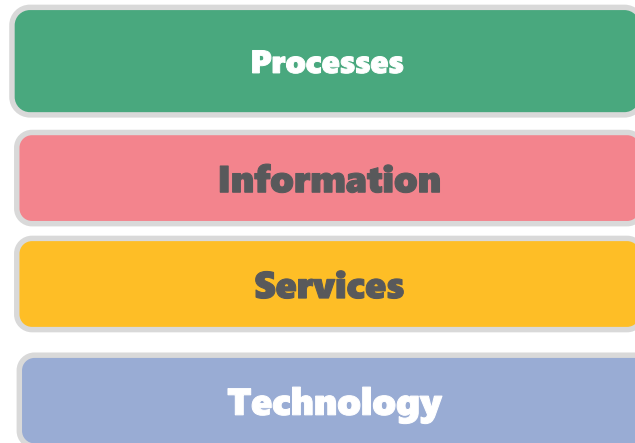
D5.3 - Proposal for the eHN on the guidance for the implementation of common principles for practical governance of big data with a special focus on data to be used in public health & research

- Guidance and framework for the implementation of common principles for practical governance of big data:
 - including privacy protection and security
 - improving health data transferability across borders,
 - implementation of data access and use on a European scale.
- The document will focus on helping Member States:
 - to utilize the potential of harnessing new opportunities arising from big data
 - Improved data analytics capabilities,
 - as well as from personalized medicine
 - use of clinical decision support systems by health professionals
 - use of mobile health tools for individuals to manage their own health and chronic conditions.



Artificial Intelligence and EU Common Semantic Strategy

- In order to move with Big Data, Health Analytics and Artificial Intelligence it's important that each entity or HCP dedicate time to structure and code data.



- To get big data you need to have structured and coded "small data" (e.g EHR)
- Small data connect systems in a meaningful way, big data connect people with timely, in na understandable way to the user



SPMS - ESTRATÉGIA DOS DADOS DE SAÚDE

“FROM DATA TO HEALTH”

ASSUMPTIONS

- Health Information is an essential health service (OMS);
- Central pillar of the National Health Service to ensure the best use of resources and management of Public Health Emergencies;
- Digital transformation: e-health as sustainability factor (Health 2020);

OBJECTIVES:

- **Digital transformation: e-NHS to i-NHS**
- Achieve intelligent information systems that add value to the diagnostic and therapeutic process;
- Consolidate the structure of Monitoring indicators of management, public health surveillance and health care delivery;
- Integrated approach with functional data repository for health monitoring, administration and surveillance;
- Ensure quality, relevance and timeliness;
- *Early warning systems* to detect outbreaks and other risks;



ESTRATÉGIA DOS DADOS DE SAÚDE

EIXOS ESTRATÉGICOS

1

Maintain trust

- Data protection
- Cybersecurity

2

Quality

- Data validation and indicators
- *“Secondary patient record”*

3

Efficiency

- Interoperability and integration
- Full picture of people’s health

4

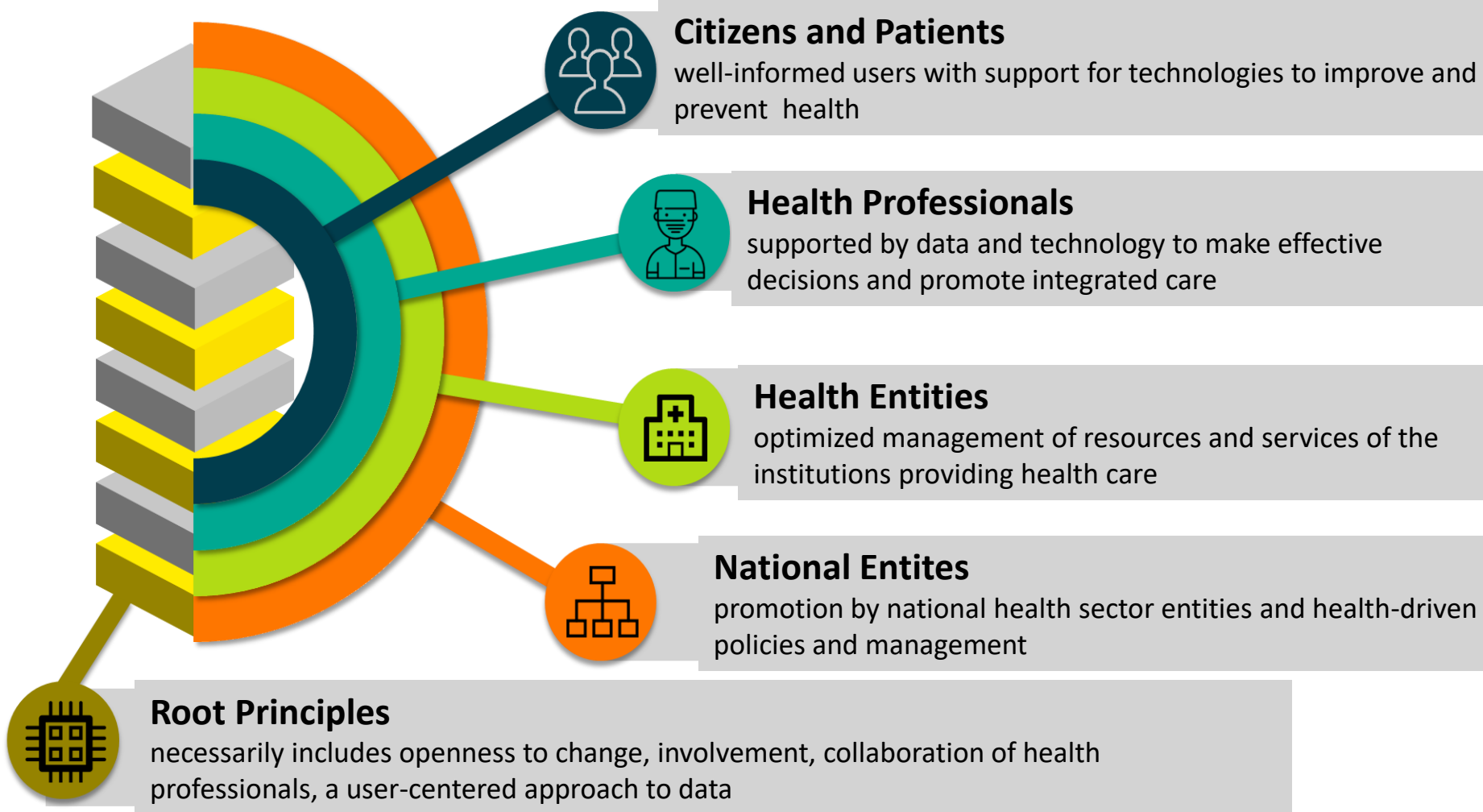
Innovation

- Simplified interaction with Information Systems
- *Intelligent IT services/Artificial Intelligence*



ESTRATÉGIA DOS DADOS DE SAÚDE

EIXOS ESTRATÉGICOS





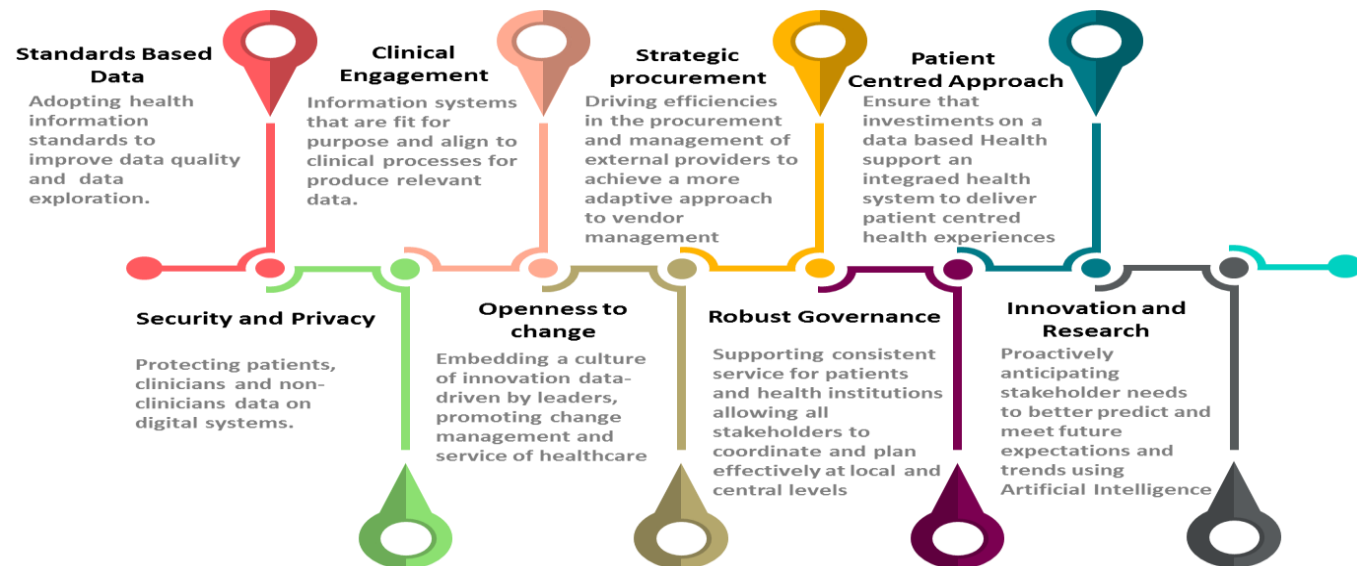
ESTRATÉGIA DOS DADOS DE SAÚDE

ESTRATÉGIA

4 Drivers principais:

- Citizens and Patients;
- Health Professionals;
- Health Institutions;
- National Health Institutions (ACSS, DGS, SPMS, INFARMED, ...)

• 8 root principles





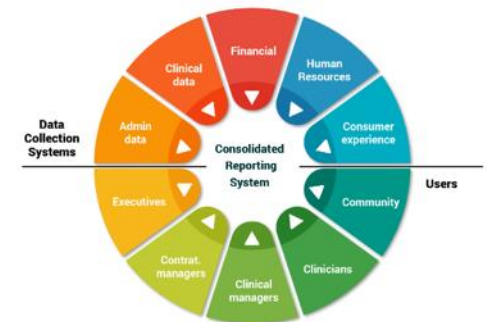
ESTRATÉGIA DOS DADOS DE SAÚDE

KEY FOCUS AREA

- Management of the data chain in a standard way;



- Experimentation and use of new data;
- Collaboration and education in an innovative culture based on data;
- Enrichment of analyzes to promote health prevention;
- Concern about ethics and permanent dialogue

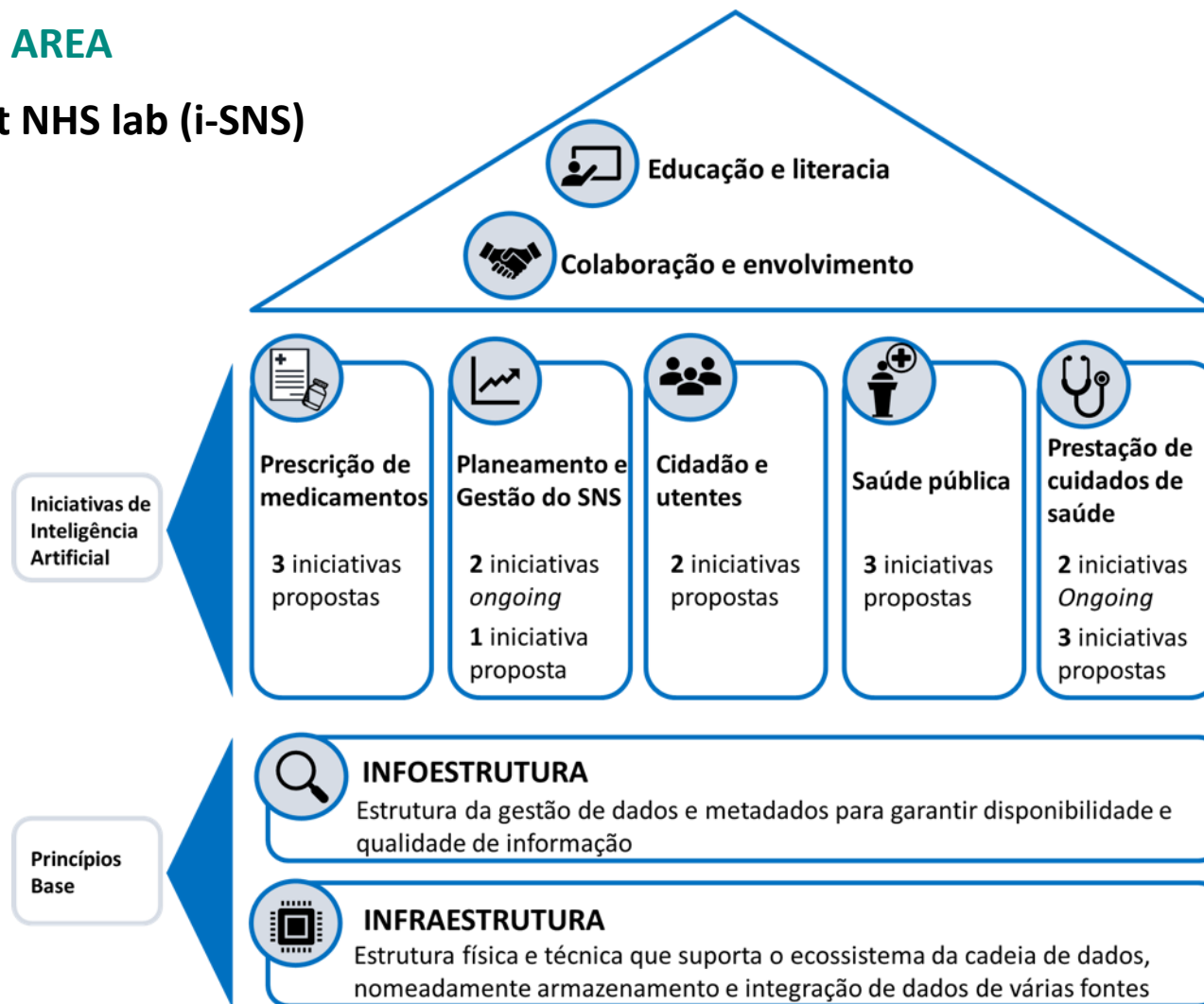




ESTRATÉGIA DOS DADOS DE SAÚDE

KEY FOCUS AREA

- **Intelligent NHS lab (i-SNS)**





BI vs AI

EXAMPLAR PROJECTS

Business Intelligence Systems

- **Primary Care (BICSP, SIARS)**
- **Hospitalar Morbidity (BIMH)**
- **Human Resources (BIRH)**
- **Contracts (SICA)**
- **Finance (SIGEF)**
- **Hospitals (BI Sclinico)**

Open Data

Transparency Area

Artificial Intelligence

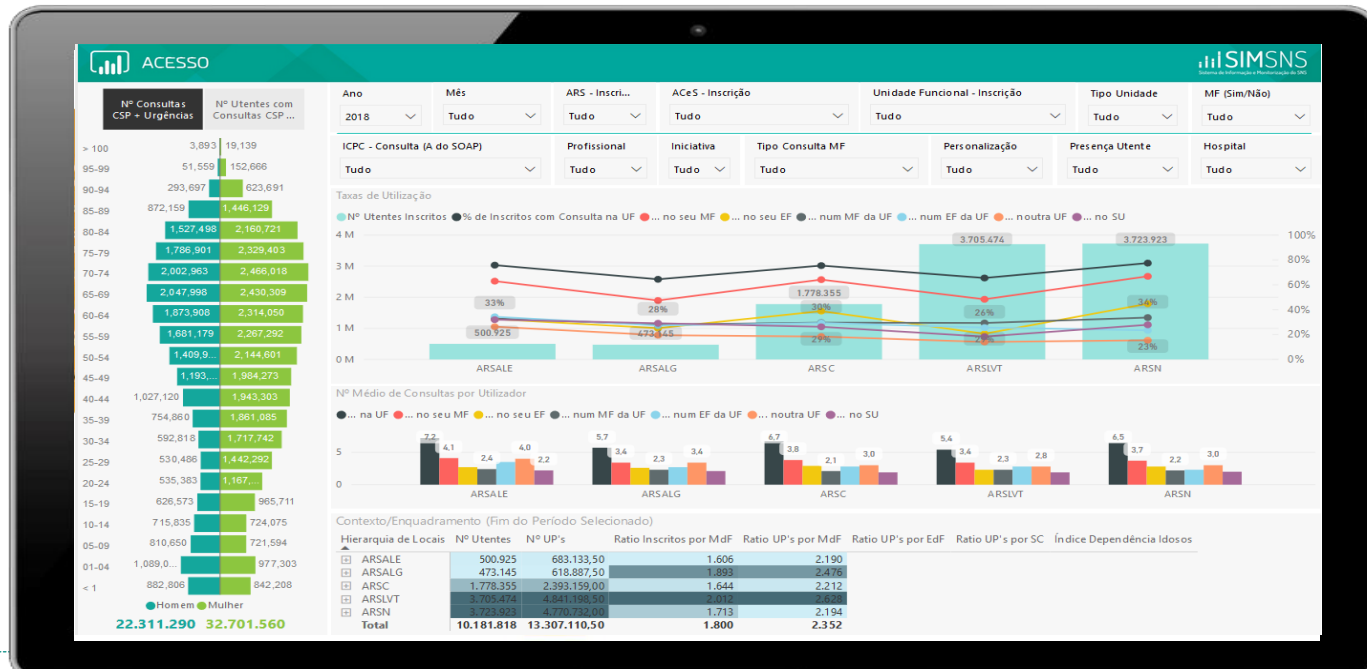
- Identifying and Reducing Antibiotic Under and Over Prescription;
- Identifying and Predicting Emergency Admissions;
- DERMA.AI – Usage of Artificial Intelligence to power Teledermatological Screening
- CARDIO.AI – artificial intelligence to Support clinical decisions

PRIMARY CARE IDENTITY CARD

BICSP

Transversal data:

- NHS Contact Center data integration;
- Prescription integration;
- Hospital data integration;
- Crossing between Primary care and hospitals (example: Modelo do acesso)

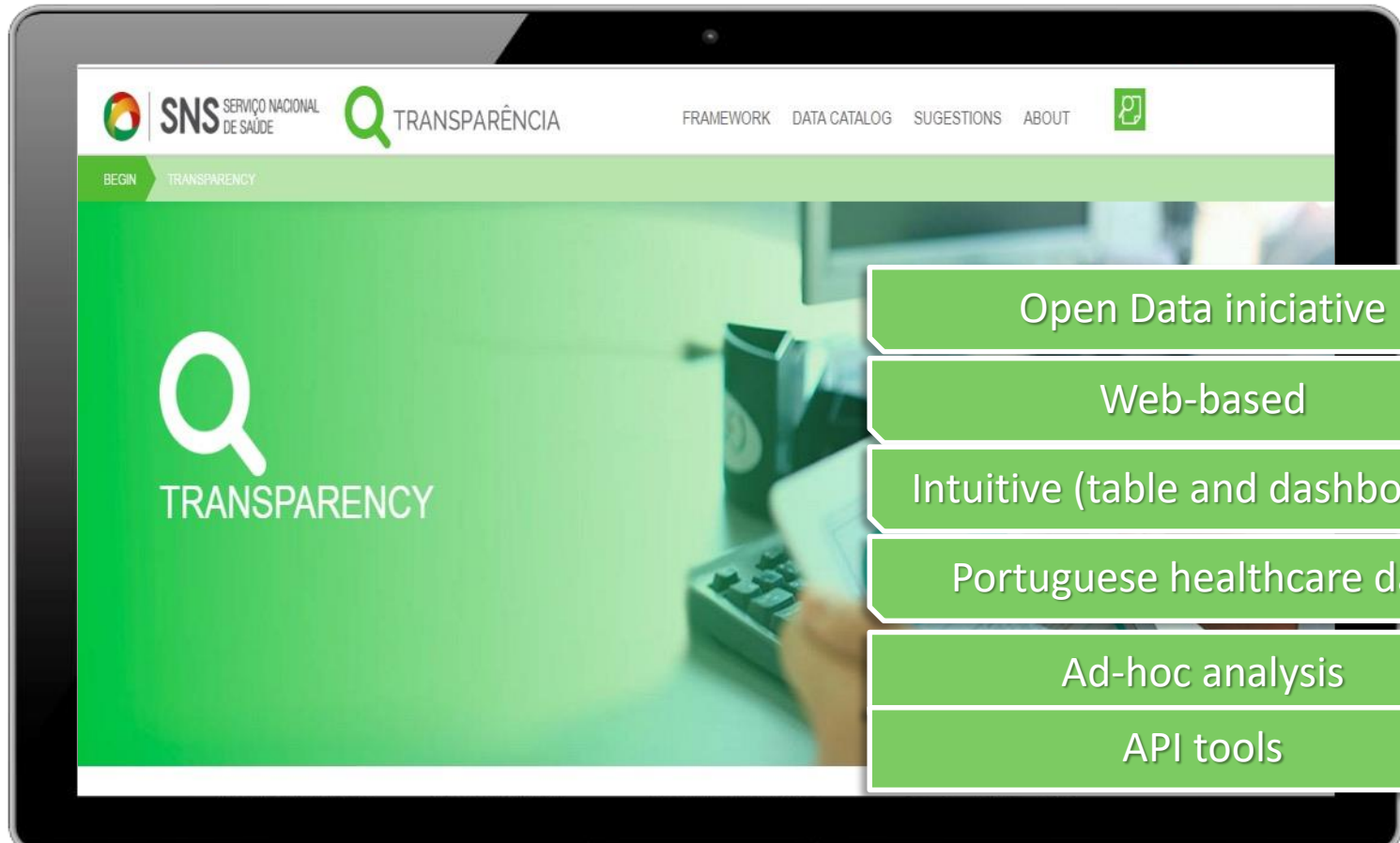




TRANSPARENCY PORTAL

OPEN DATA

www.sns.gov.pt/transparência/





ARTIFICIAL INTELLIGENCE PROJECTS



Journal of Biomedical Informatics

Volume 80, April 2018, Pages 64-77



Deep neural models for ICD-10 coding of death certificates and autopsy reports in free-text

Francisco Duarte ^a, Bruno Martins ^a, Cátia Sousa Pinto ^b, Mário J. Silva ^a

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<https://doi.org/10.1016/j.jbi.2018.02.011>

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Format: Abstract

J Biomed Inform. 2018 Apr;80:64-77. doi: 10.1016/j.jbi.2018.02.011. Epub 2018 Feb 26.

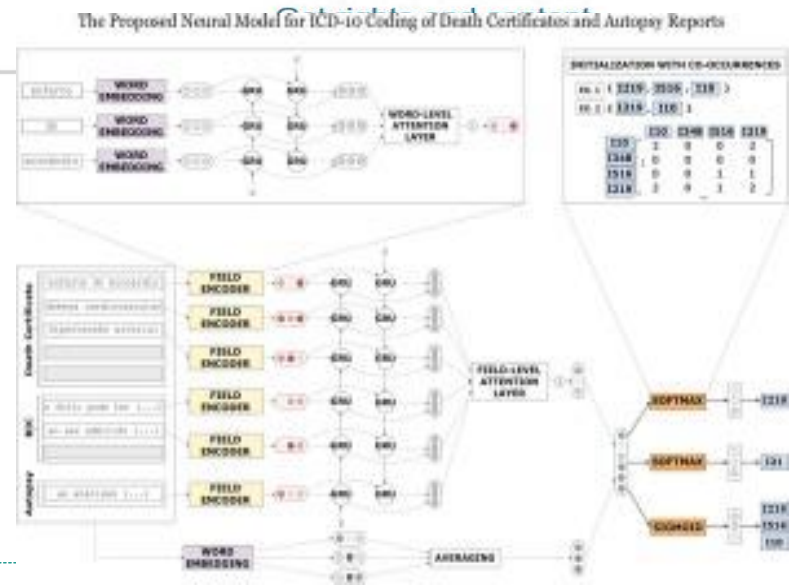
Deep neural models for ICD-10 coding of death certificates and autopsy reports in free-text.

Duarte F¹, Martins B², Pinto CS², Silva MJ¹.

Author information

Abstract

We address the assignment of ICD-10 codes for causes of death by analyzing free-text descriptions in death certificates, together with associated autopsy reports and clinical bulletins, from the Portuguese Ministry of Health. We leverage a deep neural network that comb word embeddings, recurrent units, and neural attention, for the generation of intermediate representations of the textual contents. The n network also explores the hierarchical nature of the input data, by building representations from the sequences of words within individ fields, which are then combined according to the sequences of fields that compose the inputs. Moreover, we explore innovative mechar for initializing the weights of the final nodes of the network, leveraging co-occurrences between classes together with the hierarchical structure of ICD-10. Experimental results attest to the contribution of the different neural network components. Our best model achieves accuracy scores over 89%, 81%, and 76%, respectively for ICD-10 chapters, blocks, and full-codes. Through examples, we also show t... our method can produce interpretable results, useful for public health surveillance.





ARTIFICIAL INTELLIGENCE

ONGOING PROJECTS



Identifying and Predicting Emergency Admissions

Nova SBE | IST-ID | Fundação Calouste Gulbenkian | Serviços Partilhados do Ministério da Saúde, E.P.E. (SPMS)



Identifying and Reducing Antibiotic Under and Over Prescription

Fundação Calouste Gulbenkian | Serviços Partilhados do Ministério da Saúde, E.P.E. (SPMS)



DERMA.AI – Usage of Artificial Intelligence to power Teledermatological Screening

Associação Fraunhofer Portugal Research | Serviços Partilhados do Ministério da Saúde, E.P.E. (SPMS)



SNS24 PathScout.AI | Use of Artificial Intelligence and Natural Language Processing in the NHS Screening, Counseling and Referral NHS 24

Universidade de Évora | Serviços Partilhados do Ministério da Saúde, E.P.E. (SPMS)





SNS24 PATHSCOUT.AI

- ✔ To help the nurse to select the clinical algorithm that best suits, taking advantage of all contacts and the collective experience of all the nurses
- ✔ Helping the nurse to find the most suitable route for the patient's clinical situation

BENEFITS:

- ✔ Increase speed of patient care and referral;
- ✔ Improve the clinical quality of the service, through a better use of the algorithms





DERMA.AI

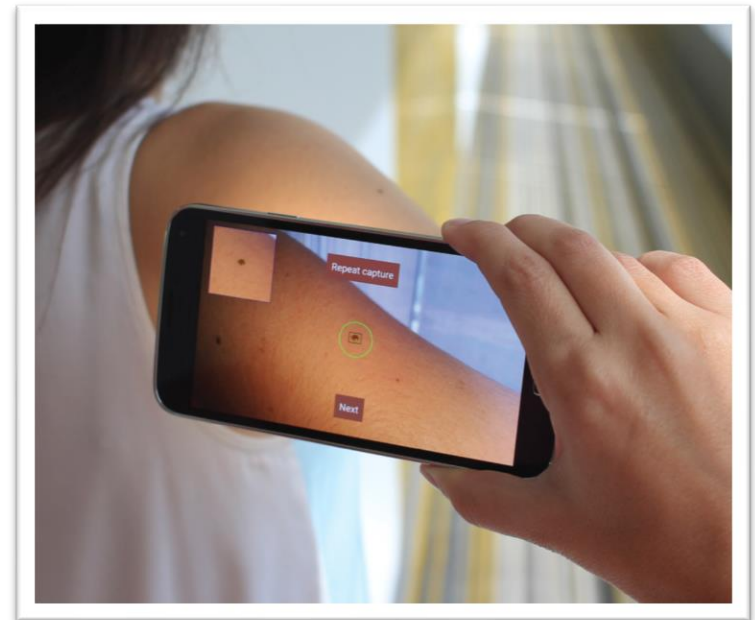
Usage of Artificial Intelligence to power Teledermatological Screening

- ✔ To be developed according with DGS rules for teledermatology
- ✔ Will integrate with referral system (RSE-Ref)

Construction of an IA platform for risk prioritization and decision support

- ✔ Use of machine learning methods and computer vision
- ✔ Joint analysis of dermatological images and structured clinical information

AI algorithms continuously improved through incremental learning strategies





DERMA.AI

Usage of Artificial Intelligence to power Teledermatological Screening

Primary care

- ✓ Quick and intuitive acquisition of images of skin lesions
- ✓ Automatic quality evaluation of acquired images
- ✓ Support for compliance with good practice standards

Society

- ✓ Reduced mortality and morbidity associated with cancer
- ✓ Optimization in health processes through the integration of IA technologies in real environment

Dermatology Services

- ✓ Obtaining Quality Information
- ✓ Support for case prioritization
- ✓ Decision support system that "learns" over time shortens the time needed for injury



Artificial Intelligence Robotics



robot rosa spms



Tudo Imagens Notícias Mapas Compras Mais Definições Ferramentas

Cerca de 5 810 resultados (0,34 segundos)

Saúde testa foquinha robot de cinco mil euros - Sociedade - Correio ...

<https://www.cmjornal.pt/sociedade/.../saude-testa-foquinha-robot-de-cinco-mil-euros> ▼
22/03/2018 - Robot terapêutico chegou ao hospital de Ovar há três semanas. ... Os Serviços Partilhados do Ministério da Saúde (SPMS) estão a testar um robot em ... explicou que se as avaliações forem boas, a 'foquinha Rosa' como é ...

SPMS apoia projeto "Saúde em Ovar Sem Papel (SOSP)" - SPMS

spms.min-saude.pt > Destaques ▼
14/03/2018 - ... do SOSP, a SPMS, EPE entregou ao Hospital de Ovar um robot que ... foi feito pela Secretária de Estado da Saúde, Rosa Valente de Matos.

Página Inicial · Robôs Sociais e Interação Pessoa Robô

<https://fenix.tecnico.ulisboa.pt/disciplinas/RSIPR-2/2015-2016/1-semester> ▼
25/01/2016 - 3.45pm-4.05pm- A study on aBag, Filipe Rosa, Kelly Karipidou, Rodrigo Martins.
4.05pm-4.25pm- Do we trust lying robots? Almeida, Fábio ...
Em falta: spms

Imagens de robot rosa spms



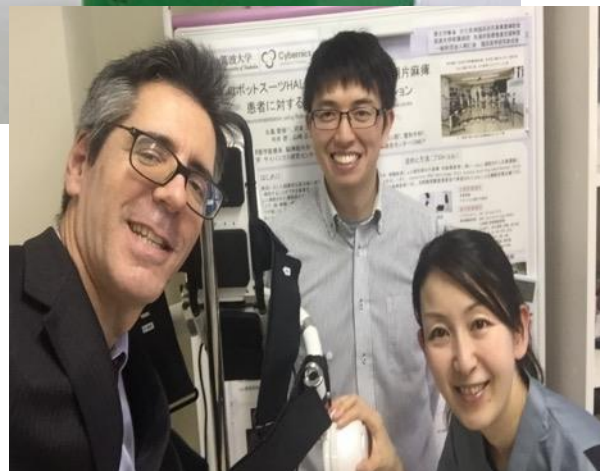
→ Mais imagens de robot rosa spms

Denunciar imagens





Human Touch



More Sharing, Better Health!

Professor Henrique Martins

12 de abril 2019
COCIR General Assembly



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