



AI in Healthcare

The Stethoscope of the 21st century

Dr. Gal Noyman – Veksler

VP Business Development, Data Science Group

www.datascience.co.il



About DSG

- Founded six years ago, DSG is a leading independent global AI Center of Excellence
- DSG consists of three main divisions

1 Developing customized and tailor-made AI-enabled business solutions

2 Providing a solution for AI Governance and AI Quality Assurance  **evolve**

3 Providing a solution for Computational Prescriptive Medicine using EMR  **MDEEP.AI**

- Dozens of projects with a success rate of over 96%
- Unique cross-vertical knowledge in solving complex AI problems
- Access to variety of data sets in diverse domains, different scales and formats of data

DSG Track Record

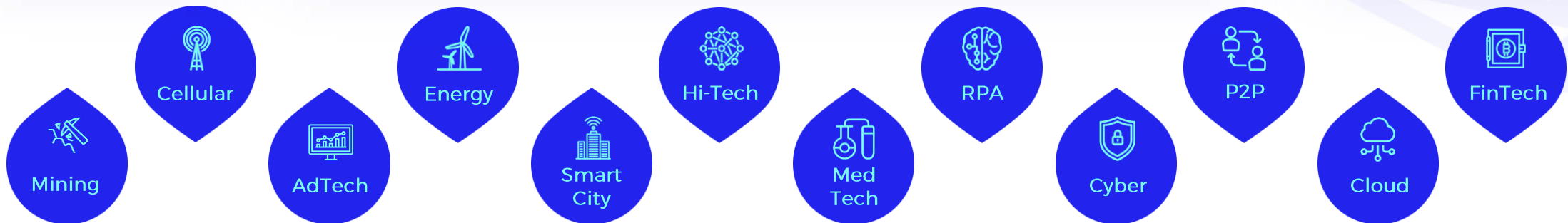
PARTNERS



CLIENTS



CLIENTS



DSG Leadership



Dr. Elan Sasson
CEO

DSG Co-founder. Serial entrepreneur, board member, and Lecturer. Member of LAMBDA AI Lab. Expert in Business Intelligence, data science, machine learning, and mining techniques.



Dr. Gideon Rosenthal
Head of Research

Data science, machine learning, deep learning, graph theory, computational neuroscience, network analysis, statistics, and big data technologies.



Dr. Amjad Abu-Rmileh
Chief Data Scientist

Machine (deep) learning, signal processing, time series analysis, brain computer interface, recommendation systems, modelling and model-based control algorithms.



Dr. Gal Noyman-Veksler
VP Business Development
Head of DSG Medical

Business executive and entrepreneur. Behavioral researcher (Wolf Award winner). Past roles in venture capital firms in healthcare and startups.



Dr. Danielle Afterman
Head Statistician

Statistics. Mathematics. Machine learning and Big data modeling in relation to statistical models. Hidden Markov Models. Operation research with emphasis on data analysis and insights derivation.



Dr. Orna Berry
Advisory Board

Former chief scientist and head of the industrial R&D operations of the Israeli Ministry of Industry, Trade and labor. Entrepreneur, investor, and board member. Past roles included Dell EMC GM, Israel Center of Excellence.

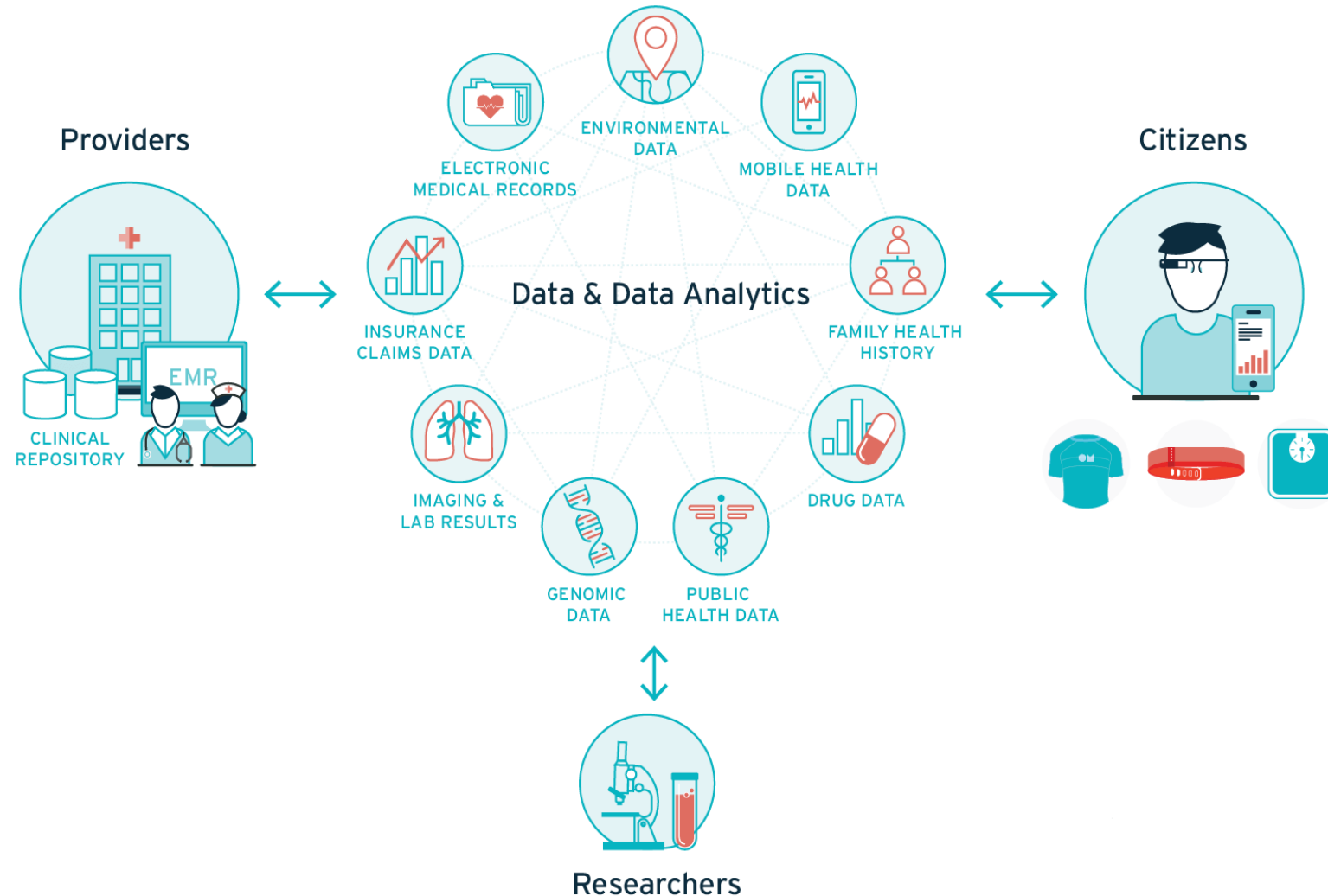


Prof. Carmel Sofer
Advisory Board

Research fellow in computational psychology. Entrepreneur, investor, and active board member. Past roles included President of Comverse Europe.



The many stakeholders in the healthcare ecosystem



The Wealth of Health (AI)



Dosage error reduction

\$16B



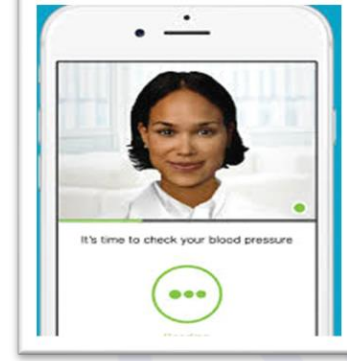
Fraud detection

\$17B



Administrative workflow assistance

\$18B



Virtual nursing assistants

\$20B



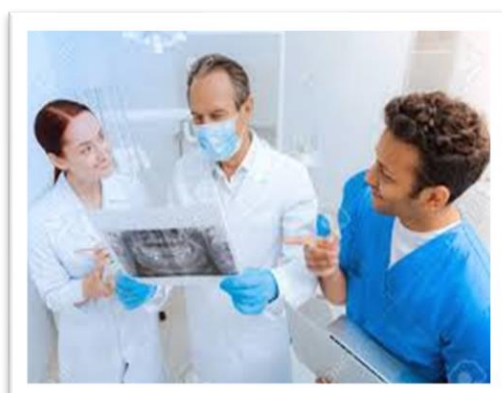
Robot-assisted surgery

\$40B



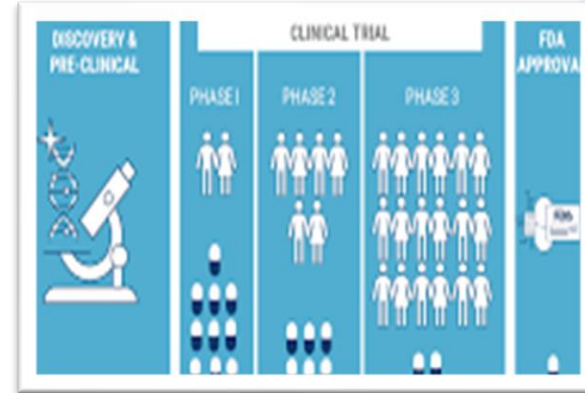
Automated image diagnosis

\$3B



Preliminary diagnosis

\$5B



Clinical trial participant identifier

\$13B

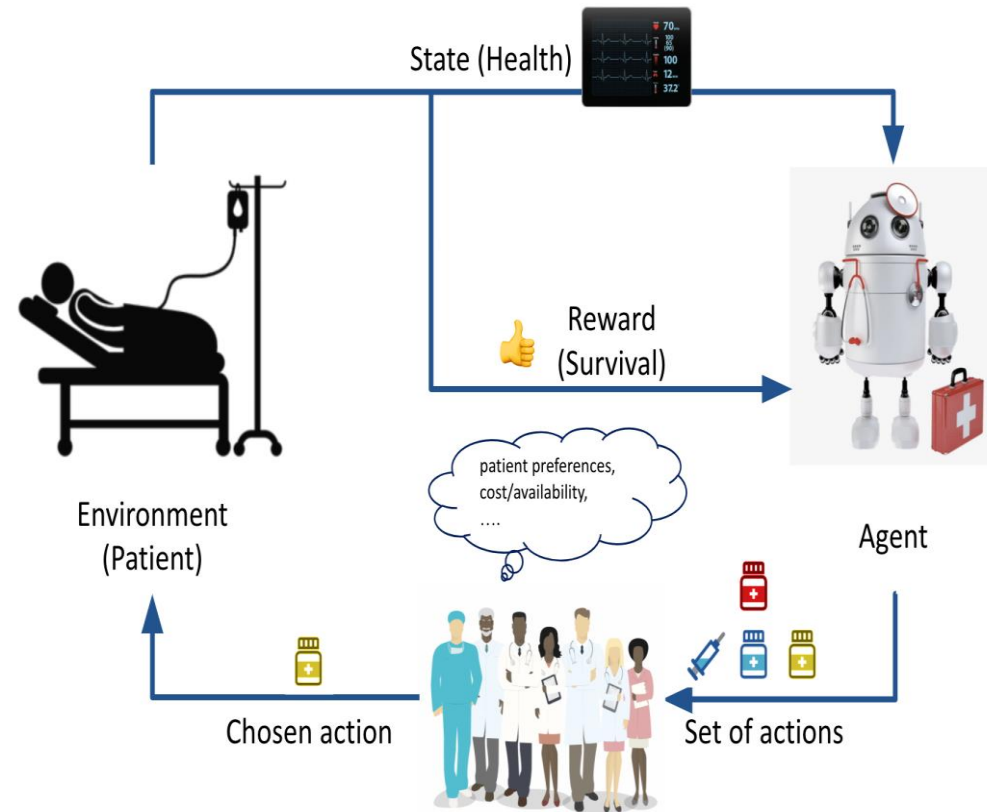


Connected machines

\$14B

Key Issues in AI in Health

- Privacy and data access
- Many data sources and databases
- Trustworthy AI and Regulation
- Explainability
- The Physician in the Loop – Clinical Feedback



FDA is increasingly approving AI applications

REVIEW ARTICLE | FOCUS

NATURE MEDICINE

Table 1 | Peer-reviewed publications of AI algorithms compared with doctors

Specialty	Images	Publication
Radiology/ neurology	CT head, acute neurological events	Titano et al. ²⁷
	CT head for brain hemorrhage	Arbabshirani et al. ¹⁹
	CT head for trauma	Chilamkurthy et al. ²⁰
	CXR for metastatic lung nodules	Nam et al. ⁸
	CXR for multiple findings	Singh et al. ⁷
	Mammography for breast density	Lehman et al. ²⁶
	Wrist X-ray*	Lindsey et al. ⁹
Pathology	Breast cancer	Ehteshami Bejnordi et al. ⁴¹
	Lung cancer (+ driver mutation)	Coudray et al. ³³
	Brain tumors (+ methylation)	Capper et al. ⁴⁵
	Breast cancer metastases*	Steiner et al. ³⁵
	Breast cancer metastases	Liu et al. ³⁴
Dermatology	Skin cancers	Esteva et al. ⁴⁷
	Melanoma	Haenssle et al. ⁴⁸
Ophthalmology	Skin lesions	Han et al. ⁴⁹
	Diabetic retinopathy	Gulshan et al. ⁵¹
	Diabetic retinopathy*	Abramoff et al. ³¹
	Diabetic retinopathy*	Kanagasingam et al. ³²
	Congenital cataracts	Long et al. ³⁸
	Retinal diseases (OCT)	De Fauw et al. ⁵⁶
	Macular degeneration	Burlina et al. ⁵²
	Retinopathy of prematurity	Brown et al. ⁶⁰
	AMD and diabetic retinopathy	Kermany et al. ⁵³
	Gastroenterology	Polyps at colonoscopy*
Polyps at colonoscopy		Wang et al. ³⁷
Cardiology	Echocardiography	Madani et al. ²³
	Echocardiography	Zhang et al. ²⁴

Prospective studies are denoted with an asterisk.

Table 2 | FDA AI approvals are accelerating

Company	FDA Approval	Indication
Apple	September 2018	Atrial fibrillation detection
Aidoc	August 2018	CT brain bleed diagnosis
iCAD	August 2018	Breast density via mammography
Zebra Medical	July 2018	Coronary calcium scoring
Bay Labs	June 2018	Echocardiogram EF determination
Neural Analytics	May 2018	Device for paramedic stroke diagnosis
IDx	April 2018	Diabetic retinopathy diagnosis
Icometrix	April 2018	MRI brain interpretation
Imagen	March 2018	X-ray wrist fracture diagnosis
Viz.ai	February 2018	CT stroke diagnosis
Arterys	February 2018	Liver and lung cancer (MRI, CT) diagnosis
MaxQ-AI	January 2018	CT brain bleed diagnosis
Alivecor	November 2017	Atrial fibrillation detection via Apple Watch
Arterys	January 2017	MRI heart interpretation

The Data Science Journey

• AI Organization Structure



VISION
DEVELOPMENT



PLANNING



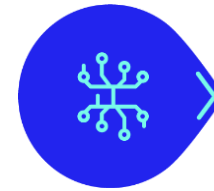
DATA
SOURCES



DATA SCIENCE
TEAM



METHODOLOGY
& TOOLS



AI/ML
APPLICATIONS



DEPLOYMENT



MONITORING

• AI Vision Strategy

• Data Science Training



01
STRATEGIC



02
TACTIC



03
ACTIONABLE



04
PRODUCTION



05
RELIABLE

ML 1.0

ML 2.0



What can go wrong?

Everything!

- It all starts with your vision – theory > operational definition of the problem
- AI is means to an end – what do you wish to achieve?
- Data transfer between different units
- Small groups

The Computational Prescriptive Medicine Platform

A Prescriptive clinical Decision Support System from **Research** to **Production** to **Monitoring**

- A set of ML algorithms for early detection of generic patient deterioration
- A general actionable framework to handle clinical data feature store including: EMR, clinical notes, genomics, signal and imaging data
- Disease specific ML models per different stakeholders predicting clinical and resource allocation outcomes

AI Use Case 1 : Predicting COVID-19 Deterioration

AI-enabled early detection system that uses relevant patient data to examine the progress (severity) of the COVID19 signs and symptoms



DATA SET

Clinical data from Sheba hospital of hundreds of patients.

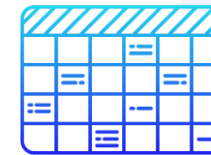
Data consists of all medical events.



TOOLS

Historical model (admission)

Hybrid model (tracking)



MODEL & RESULTS

Production-grade model to predict whether the patient will deteriorate in the following 6 hours.
Additionally, providing (local and global) explainability for model predictions

AI Use Case 2 : Clinical Notes and Genomics

AI-enabled solution to extract pre-defined ontologies from free text written by geneticists



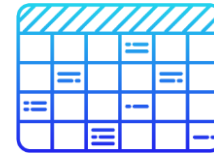
DATA SET

Thousands of geneticists' clinical notes



TOOLS

Deep learning models implemented in TensorFlow



MODEL & RESULTS

Production grade deep learning model to create embeddings of text segments candidates and comparing them with embedded ontology terms

Lessons learned – The Data Science Journey

- MUST have access to data and plenty of it – $N=20$ is not enough!
- Data strategy at point 0 will simplify your journey. This is a marathon, not a sprint.
- There is no AI out of the box – don't believe the hype!
Tough problems require complex managed solutions
- Question your findings throughout the process and keep you eyes on the prize

Lessons learned – AI in Health

- Engage the clinicians throughout the process – they are your HUMAN IN THE LOOP
- Actionable insights – what > why > what can you do?

**TRUE INNOVATION IN HEALTH REQUIRES SUSTAINABLE, EXPLAINABLE,
AUDITABLE, ROBUST AI SOLUTIONS**



For more information

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