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ROBERTO PERILLI
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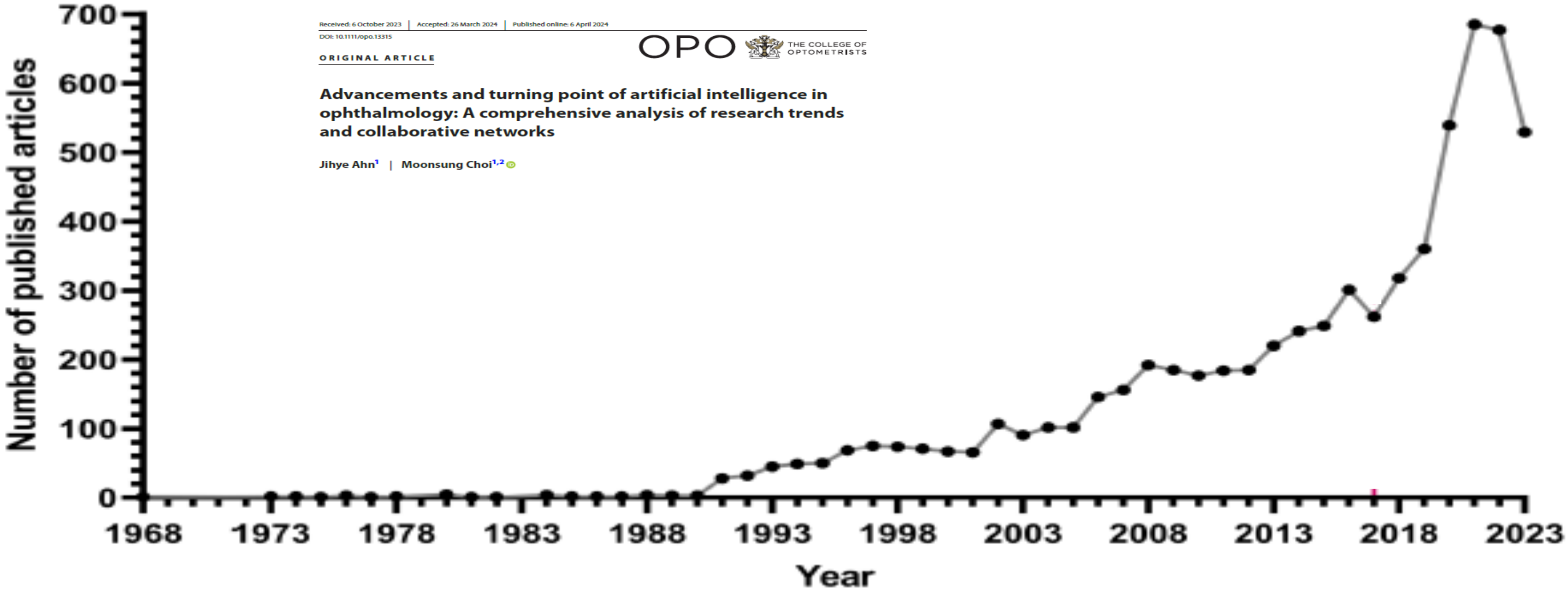

The number of annual artificial intelligence articles in ophthalmology from 1968 to 2023.

Received: 6 October 2023 | Accepted: 26 March 2024 | Published online: 6 April 2024
DOI: 10.1111/opo.13315
OPO THE COLLEGE OF OPTOMETRISTS
ORIGINAL ARTICLE

Advancements and turning point of artificial intelligence in ophthalmology: A comprehensive analysis of research trends and collaborative networks

Jihye Ahn[1] | Moonsung Choi[1,2]

TABLE 1 Top 10 ophthalmology journals publishing the highest number of cited articles from 1968 to 2023.

	Journal	Documents	Citations
1968–2016	Vision Research	518	27,154
	Investigative Ophthalmology and Visual Science	390	23,109
	Journal of Vision	329	16,021
	Ophthalmology	173	14,774
	American Journal of Ophthalmology	110	6960
	Optometry and Vision Science	212	6264
	British Journal of Ophthalmology	122	5967
	Archives of Ophthalmology	68	5270
	Journal of Cataract and Refractive Surgery	103	4158
	Retina, The Journal of Retinal and Vitreous Diseases	53	2675
2017–2023	Ophthalmology	80	4897
	Translational Vision Science and Technology	367	3639
	American Journal of Ophthalmology	157	3187
	Investigative Ophthalmology and Visual Science	116	3143
	JAMA Ophthalmology	73	2536
	Progress in Retinal and Eye Research	19	2281
	British Journal of Ophthalmology	138	2245
	Journal of Vision	203	1502
	Eye	105	1255
	Graefe's Archive for Clinical and Experimental Ophthalmology	106	1162

TABLE 2 Top 10 most-cited articles from 1968 to 2023.

	Published year	Title	Citations
1968–2016	2000	A saliency-based search mechanism for overt and covert shifts of visual attention[28]	2075
	1997	The 'independent components' of natural scenes are edge filters[29]	1421
	2010	Randomized Trial Evaluating Ranibizumab Plus Prompt or Deferred Laser or Triamcinolone Plus Prompt Laser for Diabetic Macular Edema[30]	1036
	2008	Vergence–accommodation conflicts hinder visual performance and cause visual fatigue[31]	983
	2008	SUN: A Bayesian framework for saliency using natural statistics[32]	937
	1996	The Freiburg Visual Acuity Test—Automatic Measurement of Visual Acuity[33]	732
	2007	The central fixation bias in scene viewing: Selecting an optimal viewing position independently of motor biases and image feature distributions[34]	694
	2009	Saliency, attention, and visual search: An information theoretic approach[35]	623
	2008	State-of-the-art retinal optical coherence tomography[36]	616
	2007	Impact of Dry Eye Syndrome on Vision-Related Quality of Life[37]	596
2017–2023	2018	Optical coherence tomography angiography[38]	904
	2017	TFOS DEWS II Management and Therapy Report[39]	667
	2017	Automated Identification of Diabetic Retinopathy Using Deep Learning[40]	650
	2018	Artificial intelligence and deep learning in ophthalmology[41]	517
	2018	Efficacy of a Deep Learning System for Detecting Glaucomatous Optic Neuropathy Based on Color Fundus Photographs[42]	385
	2018	Artificial intelligence in retina[43]	368
	2017	Automated Grading of Age-Related Macular Degeneration from Color Fundus Images Using Deep Convolutional Neural Networks[44]	338
	2018	Automated Diagnosis of Plus Disease in Retinopathy of Prematurity Using Deep Convolutional Neural Networks[45]	315
	2018	Fully Automated Detection and Quantification of Macular Fluid in OCT Using Deep Learning[46]	292
	2018	A Deep Learning Algorithm for Prediction of Age-Related Eye Disease Study Severity Scale for Age-Related Macular Degeneration from Color Fundus Photography[47]	261

TABLE 3 Top 10 journals and co-cited journals for research of AI and ophthalmology.

Rank	Journal	Counts (%)	IF	Q	Co-cited journal	Citations	IF	Q
1	Scientific Reports	577 (2.7%)	4.6	2	Proc CVPR IEEE	21,470	Conference	Conference
2	IEEE Access	556 (2.6%)	3.9	3	Invest Opth Vis Sci	19,509	Preprint Server	Preprint Server
3	Translational Vision Science & Technology	324 (1.5%)	3.9	3	Ophthalmology	19,441	13.7	1
4	Sensors	316 (1.5%)	3	3	Arxiv	15,246	4.4	2
5	Biomedical Signal Processing and Control	266 (1.2%)	5.1	2	PLoS ONE	12,787	2.9	3
6	Applied Sciences-Basel	248 (1.1%)	3.6	4	Sci Rep	12,723	4.6	2
7	Multimedia Tools and Applications	243 (1.1%)	2.7	4	Lect Notes Comput Sc	12,528	Conference	Conference
8	Plos One	216 (1.0%)	2.9	3	Am J Ophthalmol	9,867	4.1	1
9	Diagnostics	212 (1.0%)	3.6	3	IEEE Access	9,432	3.9	3
10	American Journal of Ophthalmology	204 (0.9%)	4.1	1	Neuroimage	9,124	4.7	2

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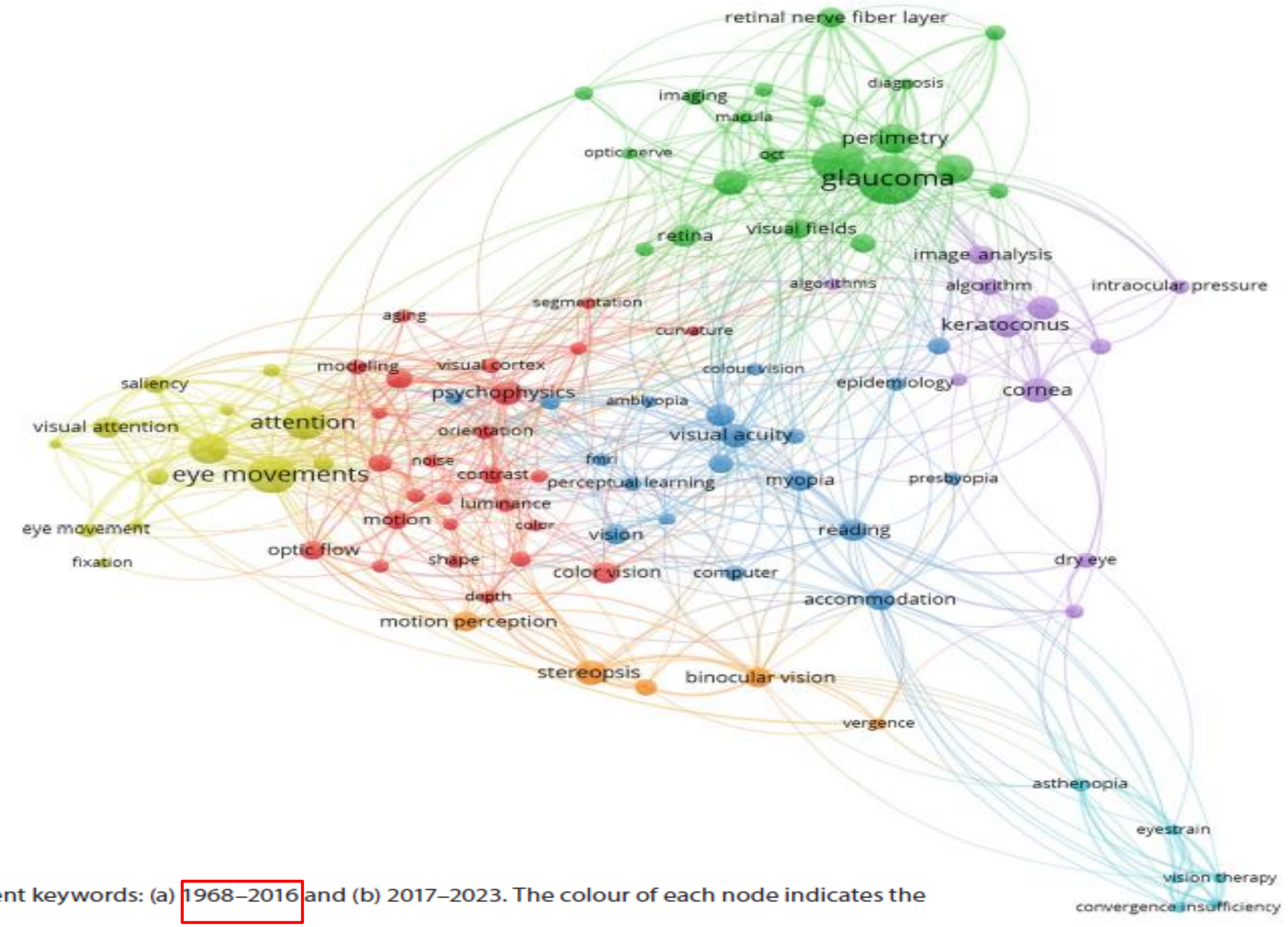

FIGURE 3 Co-occurrence network of the 100 most frequent keywords: (a) 1968–2016 and (b) 2017–2023. The colour of each node indicates the cluster to which the node belongs.

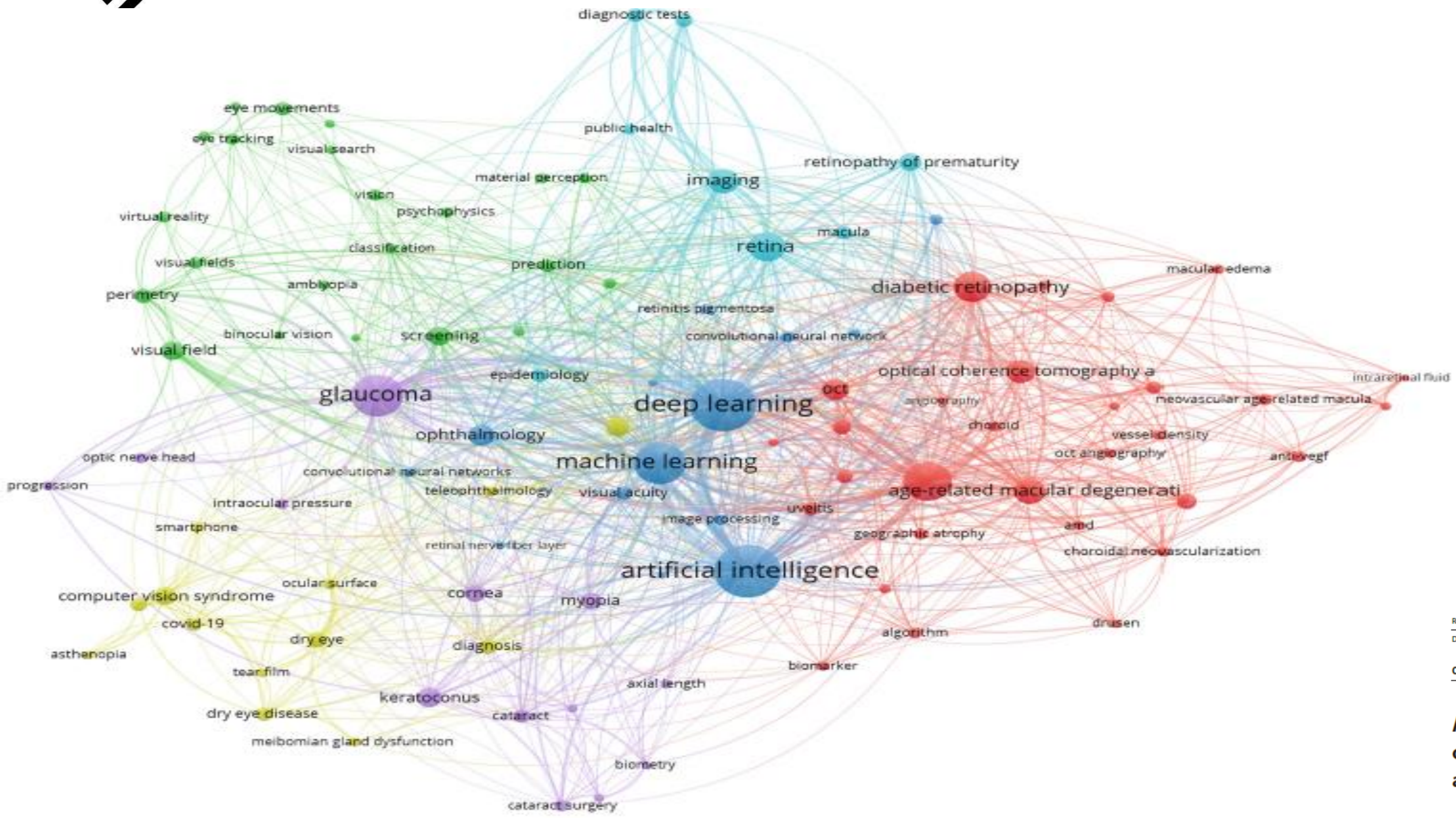

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TABLE 2 Top 10 countries and institutions on research of AI and ophthalmology.

Rank	Country	Counts (%)	Institution	Counts (%)
1	China (Asia)	22,561 (27.3%)	University of California System	1,086 (1.2%)
2	The United States (North American)	15,243 (18.5%)	University of London	1,019 (1.1%)
3	India (Asia)	5,250 (6.4%)	National University of Singapore	935 (1.0%)
4	United Kindom (Europe)	3,997 (4.8%)	Chinese Academy of Sciences	872 (0.9%)
5	South Korea (Asia)	2,975 (3.6%)	Harvard University	858 (0.9%)
6	Germany (Europe)	2,765 (3.3%)	University College London	772 (0.8%)
7	Italy (Europe)	2,632 (3.2%)	Fudan University	665 (0.7%)
8	Japan (Asia)	2,277 (2.8%)	Shanghai Jiao Tong University	651 (0.7%)
9	Canada (North American)	2,092 (2.5%)	Sun Yat-sen University	638 (0.7%)
10	Australia (Australia)	2,042 (2.5%)	Harvard University Medical Affiliates	586 (0.6%)

frontiers | Frontiers in Medicine

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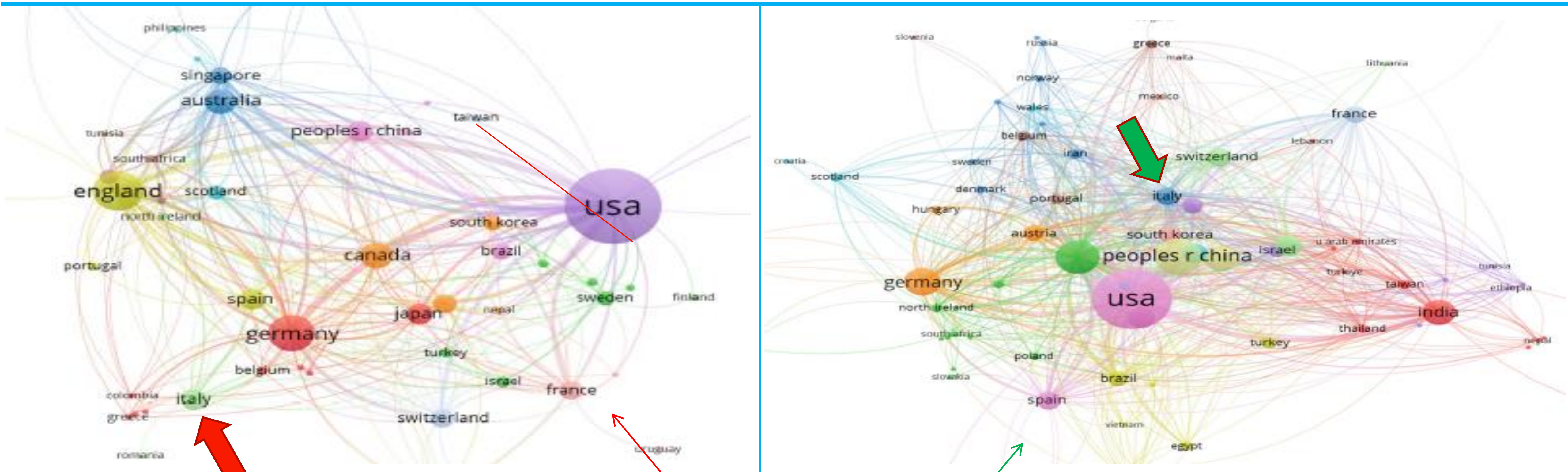
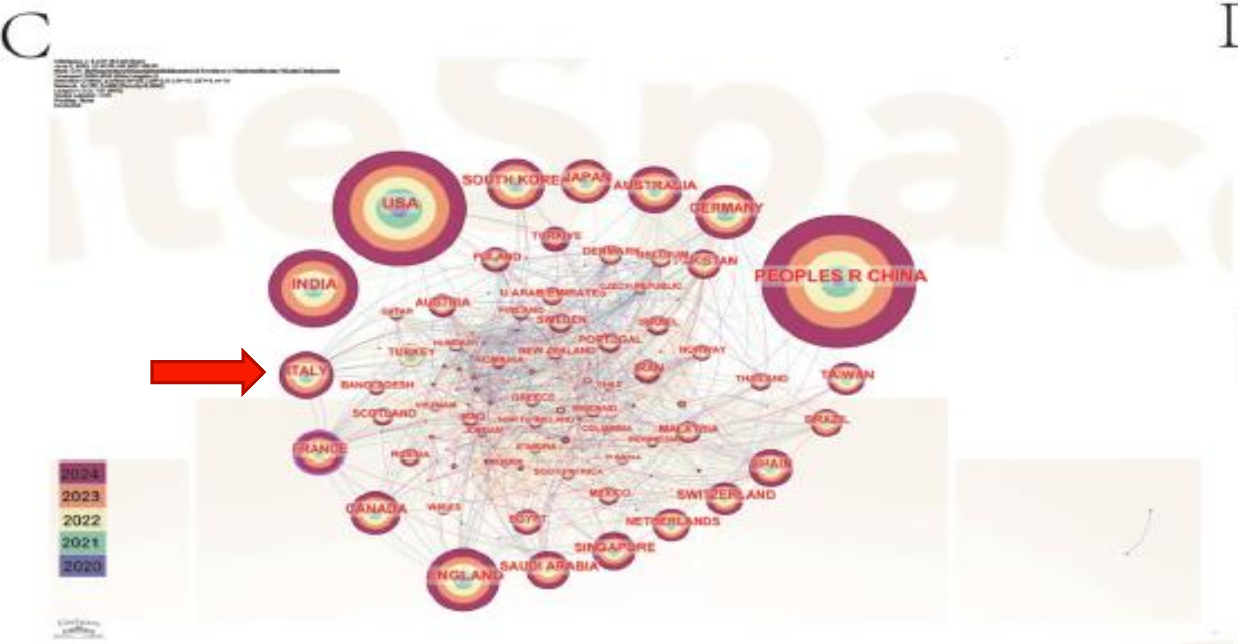


FIGURE 4 The co-authorship network of the countries: (a) 1968–2016 and (b) 2017–2023. The colour of each node indicates the cluster to which the node belongs.



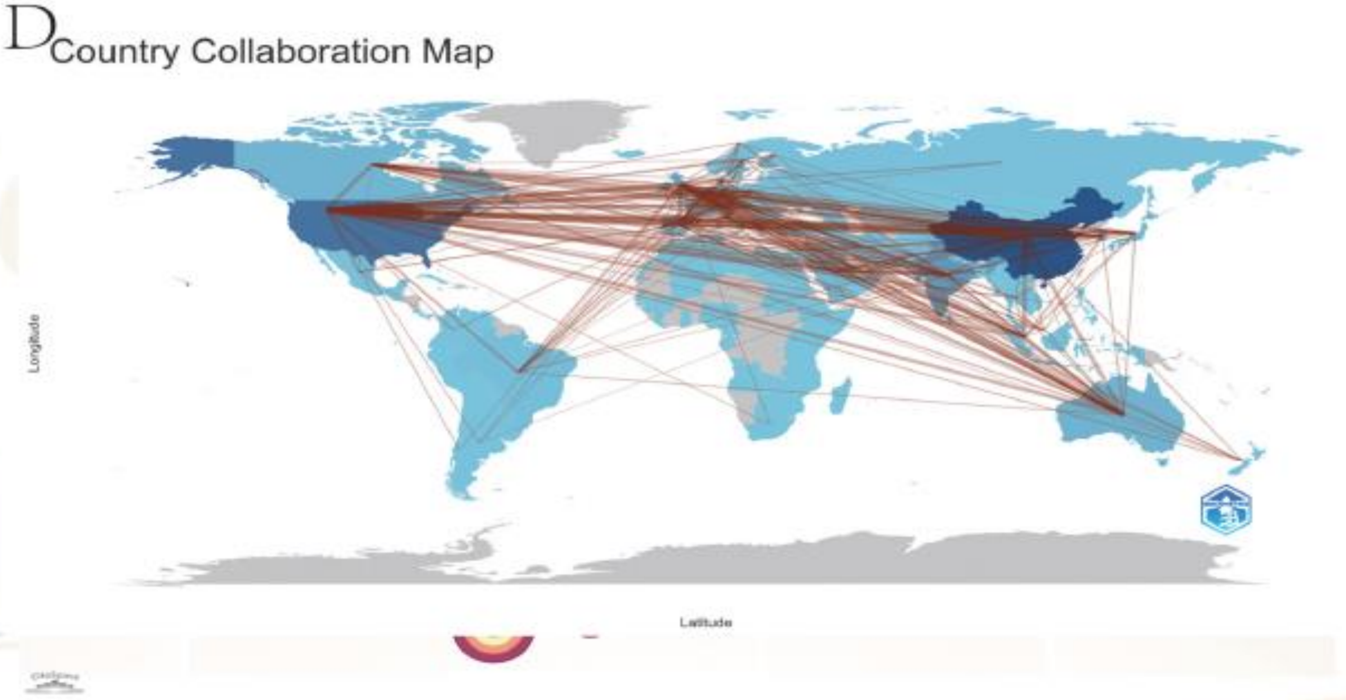


FIGURE 2
Distribution and trend of publications and citations from different years and countries. **(A)** The report of publication in 5 years. **(B)** The citation trend from 2015 to 2025. **(C)** The visualization of cooperation between countries. **(D)** The geographical distribution of publication. From CiteSpace 6.4 R1 and R package "Bibliometrix."

frontiers | Frontiers in Medicine

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PROGRAM AT A GLANCE

June 23rd

8:30 › 17:00	MAUGERI	Tutorials
14:00 › 17:00	MAUGERI	Doctoral Consortium
16:30 › 20:00	UNIVERSITY OF PAVIA CENTRAL BUILDING AULA DEL '400	Registrations
17:30 › 19:00		Opening Ceremony **Keynote - Niels Peek:** "Data science for precision healthcare: theory and practice"
19:00 › 20:00		Welcome Reception

June 24th

9:00 › 9:50	CAMPUS MEDICINE	Oral Long - Session 1. Transformer-based and Neural Architectures in Medical Data
9:50 › 10:20	CAMPUS MEDICINE	Sponsor Talk: Leife Reply AI in Healthcare: Balancing Prediction, Generation, and Explainability
10:20 › 11:00	CAMPUS MEDICINE	Posters 1 and Coffee Break
11:00 › 12:00	CAMPUS MEDICINE	Keynote - Silvana Quaglini "AI and Telemedicine: synergies and challenges"
12:00 › 13:00	CAMPUS MEDICINE	Oral Long - Session 2. Graph Neural Networks and Spatiotemporal Modeling
13:00 › 14:30	CAMPUS MEDICINE	Posters 2 and Lunch
14:30 › 15:30	CAMPUS MEDICINE	Keynote - Bjoern Eskofier "AI for future healthcare"
15:30 › 16:30	CAMPUS MEDICINE	Oral Long - Session 3. Causal and Counterfactual Inference + Meta-AI & Methodological Analysis
16:30 › 17:00	CAMPUS MEDICINE	Posters 3 and Coffee Break
17:00 › 18:00	CAMPUS MEDICINE	Oral Short - Parallel Session 1. Multi-Task / Multi-Modal Learning, Federated Learning Oral Short - Parallel Session 2. Traditional ML, Causal Inference and Probabilistic modeling
20:00	Villa Botta Adorno	Social Dinner (Meeting point and departure at 19:30)

June 25th

9:00 › 10:20	CAMPUS MEDICINE	Oral Long - Session 4. Medical Imaging, Signal Processing and Reinforcement Learning
10:20 › 11:00	CAMPUS MEDICINE	Posters 4 and Coffee Break
11:00 › 12:00	CAMPUS MEDICINE	Keynote - Marinka Zitnik
12:00 › 13:00	CAMPUS MEDICINE	Oral Short - Parallel Session 3 - Deep Learning Oral Short - Parallel Session 4 - Large Language Models and NLP
13:00 › 14:30	CAMPUS MEDICINE	Posters 5 and Lunch
14:30 › 16:30	CAMPUS MEDICINE	Oral Long - Session 5. Explainability and Fairness in AI
16:30 › 17:00	CAMPUS MEDICINE	Posters 6 and Coffee Break
17:00 › 18:00	CAMPUS MEDICINE	Oral Short - Parallel Session 5 - Signal Processing Oral Short - Parallel Session 6 - Graph Based Learning, Reinforcement Learning, XAI
20:00	Mulino della Frega	Young* Party (Meeting point and departure at 19:30)

* Open to everyone

June 26th

9:00 › 13:00	MAUGERI	Workshops W1, W5, W6, W8
14:00 › 18:00	MAUGERI	Workshops W3, W11, W13, W17
9:00 › 18:00	CAMPUS MEDICINE	Workshops W4, W7, W14, W16

Society and Editorial Board Meetings (by invitation only)

June 24	13:00	CAMPUS MEDICINE	1.5	AIME Board Meeting (invite only)
June 24	18:15	CAMPUS MEDICINE	1.5	SIBIM General Assembly (members only)
June 25	13:00	CAMPUS MEDICINE	1.5	Editorial Board Artificial Intelligence in Medicine (invite only)

PROGRAM AT A GLANCE

AIME 2025

23rd International Conference on Artificial Intelligence in Medicine

PAVIA, ITALY - JUNE 23-26 2025

EVENTS Included in your AIME Conference registration, please confirm your attendance at the registration desk to collect your tickets.

SOCIAL DINNER
JUNE 24th - 20.00

Villa Botta Adorno
Piazza della Libertà, 3
Torre d'Isola (PV)

Meeting point & bus departure at 19.30 Piazza Castello

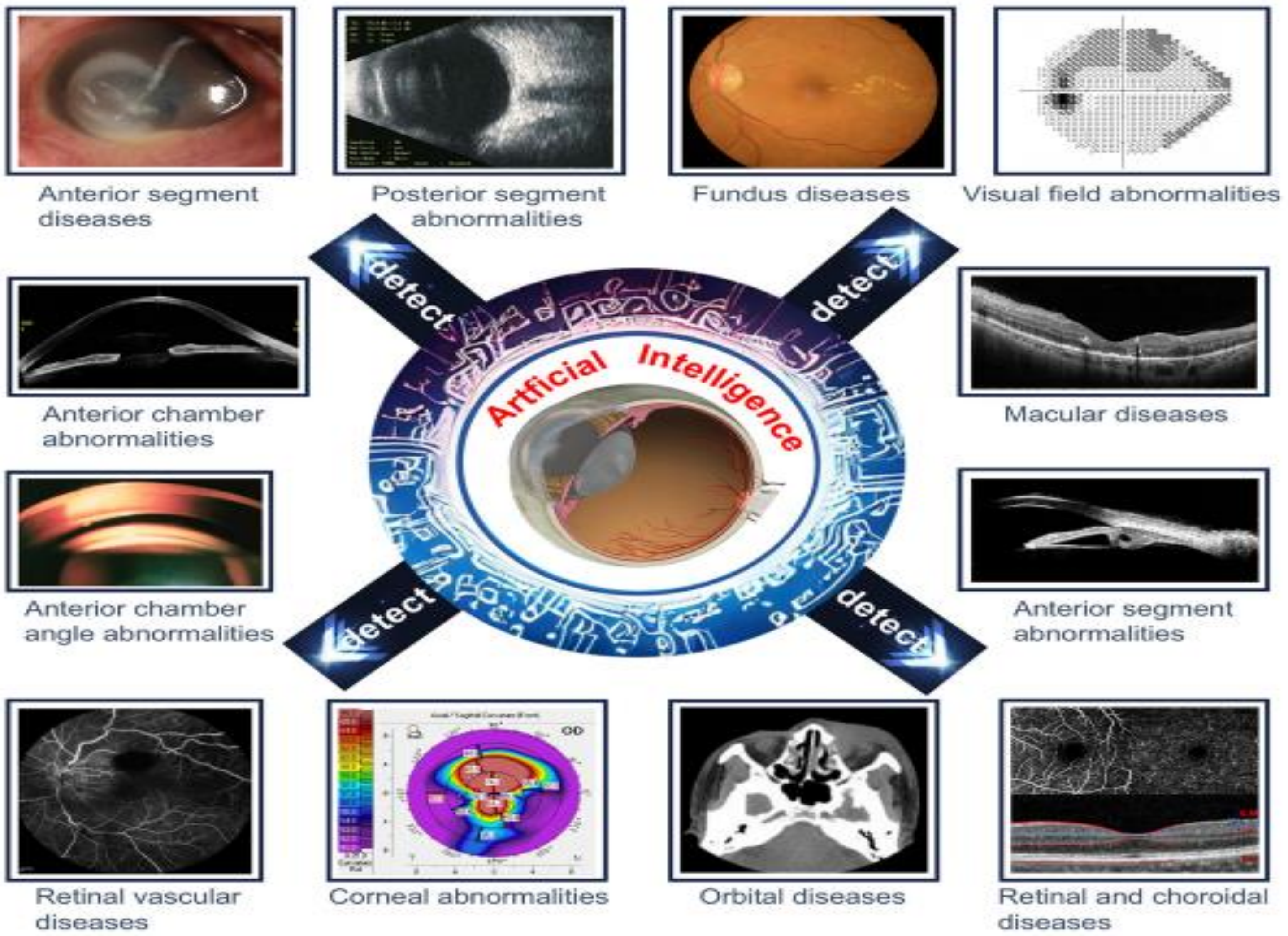
AIME 2025
23rd International Conference
on Artificial Intelligence in Medicine
PAVIA, ITALY - JUNE 23-26 2025

8:30 › 9:50	**Oral Long - Session 1: Transformer-based and Neural Architectures in Medical Data**
8:30	**PTransformer: A Prompt-based Multimodal Transformer Architecture For Medical Tabular Data** Yucheng Ruan, Xiang Lan, Daniel J. Tan, Hairil Rizal Abdullah and Mengling Feng
8:50	**Leveraging Multi-Agent Systems for Domain-Pertinence Query Classification in Informative Chatbots** Patrizio Bellan, Saba Ghanbari Haez, Leonardo Sanna, Simone Magnolini and Mauro Dragoni
9:10	**Elucidating mechanics of T cell signaling: Modelling surface receptor pathways using artificial neural networks** Julie Midroni, Duncan Kirby and Anton Zilman
9:30	**Conformal Prediction for ECG Interpretation: A Study on Human-AI Collaboration in Clinical Decision Support** Duarte Folgado, Lorenzo Famiglini, Andrea Campagner, Hélder Dores, Marília Barandas, Hugo Gamboa and Federico Cabitza

12:00 › 13:00	**Oral Long - Session 2: Graph Neural Networks and Spatiotemporal Modeling**
12:00	**AtGCN: A Lightweight Graph Convolutional Network for Ataxic Gait Detection** Karan Bania and Tanmay Verlekar
12:20	**STM-GNN: space-time-and-memory graph neural networks for predicting multi-drug resistance risks in dynamic patient networks** Damien Geissbuhler, Alban Bornet, Catarina Marques, André Anjos, Sónia Pereira and Douglas Teodoro
12:40	**A Graph Based Raman Spectral Processing Technique for Exosome Classification** Vuong Ngo, Edward Bolger, Stan Goodwin, John O'Sullivan, Dinh Viet Cuong and Mark Roantree

POSTERS — Wednesday, June 25th

4-F1	**Automated Instance Segmentation of Peripheral Nerve Microscopy Images** Krzysztof Spalinski, Antonina Spalinska, Michal Kopka, Paulina Przybylek, Magdalena Jasionowska-Skop and Artur Przelaskowski	1.7
4-G1	**Enhancing Diabetic Retinopathy Classification with Swin Transformer and Shifted Window Attention** Meher Boulaabi, Takwa Ben Aïcha Gader, Afef Kacem Echi and Zied Bouraoui	1.7
4-H1	**Explainable AI for Allergy Diagnosis: A CACTUS Framework to Address Doctor Variability** Luca Gherardini, Paulina Tworek, Maja Szczypka, Yousef Khan, Marek Mikołajczyk, Roman Lewandowski and Jose Sousa	1.7



Cell Reports Medicine 4, 101095, July 18, 2023

Artificial intelligence in ophthalmology: The path to the real-world clinic

Table 1. Major studies on the application of AI in DR

Study	Year	Study design	Data type	Data size	AI type	Task	Performance
Liu et al.[22]	2022	retrospective	TFI	1,171,365	EfficientNet-B5	detection of diabetic macular edema	AUC = 0.88–0.96 Sen = 71–100, Spec = 66–88
Dai et al.[23]	2021	retrospective	TFI	666,383	ResNet and Mask R-CNN	DR grading	AUC = 0.92–0.97, Sen = 87.5–93.7, Spec = 74.3–90.0
Lee et al.[24]	2021	retrospective	TFI	311,604	seven algorithms from five companies: OpthAI, AirDoc, Eyenuk, Retina-AI Health, and Retmarker	detection of referable DR	Sen = 51.0–85.9, Spec = 60.4–83.7
Araújo et al.[25]	2020	retrospective	TFI	103,062	A novel Gaussian-sampling method built upon a multiple-instance learning framework	detection of referable DR	Cohen's quadratic weighted Kappa (κ) = 0.71–0.84
Heydon et al.[26]	2020	prospective	TFI	120,000	machine-learning-enabled software, EyeArt v2.1	detection of referable DR	Sen = 95.7, Spec = 54.0
Natarajan et al.[27]	2019	prospective	SFI	56,986	Medios AI, a deep-learning-based system	detection of referable DR	Sen = 95.9–100, Spec = 78.7–88.4
Gulshan et al.[28]	2019	prospective	TFI	5,762	Inception-v3	detection of referable DR	AUC = 0.96–0.98, Sen = 88.9–92.1, Spec = 92.2–95.2
Li et al.[29]	2018	retrospective	TFI	177,287	Inception-v3	detection of vision-threatening referable DR	AUC = 0.96–0.99, Sen = 92.5–97.0, Spec = 91.4–98.5
Ting et al.[6]	2017	retrospective	TFI	189,018	adapted VGGNet	detection of referable and vision-threatening DR	for referable DR: AUC = 0.89–0.98, Sen = 90.5–100, Spec = 73.3–92.2; for vision-threatening DR: AUC = 0.96, Sen = 100, Spec = 91.1
Gulshan et al.[7]	2016	retrospective	TFI	140,426	Inception-v3	detection of referable DR	AUC = 0.99, Sen = 87.0–97.5, Spec = 93.9–98.5

AUC, area under the curve, representing an aggregate measure of AI performance across all possible classification thresholds; R-CNN, region-based convolutional neural network; Sen, sensitivity, representing the rate of positive samples correctly classified by an AI model; SFI, smartphone-based fundus images; Spec, specificity, representing the rate of negative samples correctly classified by an AI model; TFI, traditional fundus images.

Table 2. Major studies on the application of AI in glaucoma

Study	Year	Study design	Data type	Data size	AI type	Task	Performance
Xiong et al.[42]	2022	retrospective	VFs and OCT images	2,463 pairs	multimodal AI algorithm, FusionNet	detection of GON	AUC = 0.87–0.92, Sen = 77.3–81.3, Spec = 84.8–90.6
Li et al.[43]	2022	retrospective	TFI	31,040 images and longitudinal data from 7,127 participants	U-Net and PredictNet	prediction of glaucoma incidence and progression	For predicting glaucoma incidence, AUC = 0.88–0.90; for predicting glaucoma progression, AUC = 0.87–0.91
Fan et al.[44]	2022	retrospective	TFI and VFs	66,715	ResNet50	detection of POAG in patients with ocular hypertension	AUC = 0.74–0.91, Sen = 76–86, Spec = 80–85
Li et al.[45]	2021	retrospective	anterior-segment OCT images	1.112 million images of 8694 vol scans	3D-ResNet-34 and 3D-ResNet-50	detection of narrow iridocorneal angles (task 1) and peripheral anterior synechiae (task 2) in eyes with suspected PACG	task 1 AUC = 0.943, Sen = 86.7, Spec = 87.8 Task 2 AUC = 0.902, Sen = 90.0, Spec = 89.0
Dixit et al.[46]	2021	retrospective	a longitudinal dataset of merged VFs and clinical data	672,123 VF results and 350,437 samples of clinical data	convolutional long short-term memory neural network	assessment of glaucoma progression	AUC = 0.89–0.93
Medeiros et al.[47]	2021	retrospective	OCT images and TFI	86,123 pairs	ResNet50	detection of progressive GON damage	AUC = 0.86–0.96
Li et al.[12]	2020	retrospective	UWFI	22,972	InceptionResNetV2	detection of GON	AUC = 0.98–1.00, Sen = 97.5–98.2, Spec = 94.3–98.4
Yousefi et al.[48]	2020	retrospective	VFs	31,591	PCA, manifold learning, and unsupervised clustering	monitoring glaucomatous functional loss	Sen = 77, Spec = 94
Ran et al.[49]	2019	retrospective	OCT images	6,921	ResNet-based 3D system	detection of GON	AUC = 0.89–0.97, Sen = 78–90, Spec = 79–96
Martin et al.[50]	2018	prospective	CLS parameters and initial IOP	435 subjects	random forest	detection of POAG	AUC = 0.76
Li et al.[29]	2018	retrospective	TFI	48,116	Inception-v3	detection of referable GON	AUC = 0.99, Sen = 95.6, Spec = 92.0
Asaoka et al.[51]	2016	retrospective	VFs	279	deep feedforward neural network	detection of preperimetric glaucoma	AUC = 0.93, Sen = 77.8, Spec = 90.0

CLS, contact lens sensor; GON, glaucomatous optic neuropathy; IOP, intraocular pressure; OCT, optical coherence tomography; PACG, primary angle-closure glaucoma; PCA, principal-component analysis; POAG, primary open-angle glaucoma; UWFI, ultra-widefield fundus images; VF, visual field.

Table 3. Major studies on the application of AI in AMD

Study	Year	Study design	Data type	Data size	AI type	Task	Performance
Potapenko et al.[63]	2022	prospective	OCT images	106,840	temporal deep-learning model	detection of CNV activity in AMD patients	AUC = 0.90–0.98, Sen = 80.5–95.6, Spec = 84.6–95.9
Yellapragada et al.[64]	2022	retrospective	TFI	100,848	self-supervised non-parametric instance discrimination	classification of AMD severity	Acc = 65–87
Rakocz et al.[65]	2021	retrospective	3D OCT images	1,942	SLIVER-net architecture	detection of AMD progression risk factors	AUC = 0.83–0.99
Yim et al.[8]	2020	retrospective	3D OCT images	130,327	3D U-Net, 3D dense convolution blocks, and 3D prediction network	predicting conversion to wet AMD	AUC = 0.75–0.89
Hwang et al.[66]	2019	retrospective	OCT images	35,900	VGG16, InceptionV3, and ResNet50	differentiating normal macula and three AMD types (dry, inactive wet, and active wet AMD)	AUC = 0.98–0.99, Acc = 90.7–92.7
Keel et al.[67]	2019	retrospective	TFI	142,725	Inception-v3	detection of neovascular AMD	AUC = 0.97–1.00, Sen = 96.7–100, Spec = 93.4–96.4
Peng et al.[61]	2019	retrospective	TFI	59,302	Inception-v3	classification of patient-based AMD severity	AUC = 0.93–0.97
Grassmann et al.[68]	2018	retrospective	TFI	126,211	a network ensemble of six different neural net architectures	Predicting the AMD stage	Quadratic weighted κ = 0.92, Acc = 63.3
Kermany et al.[69]	2018	retrospective	OCT images	208,130	Inception-v3	detection of referable AMD	AUC = 0.99–1.00, Sen = 96.6–97.8, Spec = 94.0–97.4
Burlina et al.[62]	2017	retrospective	TFI	133,821	AlexNet	detection of referable AMD	AUC = 0.94–0.96, Sen = 72.8–88.4, Spec = 91.5–94.1

Acc, accuracy; CNV, choroidal neovascularization.

Table 4. Major studies on the application of AI in cataract

Study	Year	Study design	Data type	Data size	AI type	Task	Performance
Keenan et al.[16]	2022	retrospective	Slit-lamp images	18,999	DeepLensNet	diagnosis and quantitative classification of age-related cataract	Mean squared error = 0.23–16.6
Tham et al.[78]	2022	retrospective	TFI	25,742	ResNet50 and XGBoost classifier	detection of visually significant cataract	AUC = 0.92–0.97, Sen = 88.8–96.0, Spec = 81.1–90.3
Xu et al.[79]	2021	retrospective	TFI	9,912	Global-local attention network	Cataract diagnosis and grading	For cataract diagnosis: Acc = 90.7; for cataract grading: Acc = 83.5
Lu et al.[80]	2021	prospective	Slit-lamp images	847	Faster R-CNN and ResNet50	Cataract grading	AUC = 0.80–0.98, Sen = 85.7–94.7, Spec = 63.6–93.2
Lin et al.[81]	2020	prospective	Participants' demographic variables, birth conditions, family medical history, and environmental factors	1,738	Random forest and adaptive boosting methods	detection of congenital cataracts	AUC = 0.82–0.96, Sen = 56–82, Spec = 78–98
Xu et al.[82]	2020	retrospective	TFI	8,030	Hybrid global-local feature representation model	Cataract grading	Acc = 86.2, Sen = 79.8–95.0, Spec = 83.3–88.4
Wu et al.[83]	2019	retrospective	Slit-lamp images	37,638	ResNet50	diagnosis of cataracts and detection of referable cataracts	For cataract diagnosis: AUC = 0.99–1.00; for detecting referable cataracts: AUC = 0.92–1.00
Lin et al.[84]	2019	prospective	Slit-lamp images	700	AI platform, CC-Cruiser	diagnosis of childhood cataracts and provision of treatment recommendation	For cataract diagnosis: Acc = 87.4; for treatment determination: Acc = 70.8
Zhang et al.[85]	2019	retrospective	TFI	1,352	ResNet18, SVM, and FCNN	Cataract grading	Acc = 92.7, Sen = 82.4–99.4, Spec = 81.3–98.5
Gao et al.[86]	2015	retrospective	Slit-lamp images	5,378	Convolutional-recursive neural network	Cataract grading	MAE = 0.304

FCNN, fully connected neural network; SVM, support vector machine.

Table 5. Major studies on the application of AI in keratitis

Study	Year	Study design	Data type	Data size	AI type	Task	Performance
Redd et al.[93]	2022	retrospective	corneal images	980	MobileNet	differentiation of BK and FK	AUC = 0.83–0.86, For detecting BK, Acc = 75; for detecting FK, Acc = 81
Ren et al.[94]	2022	prospective	conjunctival swabs	149	random forest	differentiation of BK, FK, and VK using the conjunctival bacterial microbiome characteristics	for referring microbiota composition, Acc = 96.3; for referring gene functional composition, Acc = 93.8
Wu et al.[95]	2022	prospective	tear Raman spectroscopy	75	CNN and RNN	detection of keratitis	Acc = 92.7–95.4, Sen = 93.8–95.6, Spec = 94.8–97.4
Tiwari et al.[96]	2022	retrospective	corneal images	2,746	VGG-16	differentiation of active corneal ulcers from healed scars	AUC = 0.95–0.97, Sen = 78.2–93.5, Spec = 84.4–91.3
Li et al.[15]	2021	retrospective	slit-lamp and smartphone images	13,557	DenseNet121	detection of keratitis	AUC = 0.97–1.00, Sen = 91.9–97.7, Spec = 96.9–98.2
Ghosh et al.[97]	2021	retrospective	slit-lamp images	2,167	ensemble learning	discrimination between BK and FK	AUC = 0.90, Sen = 77, F1 score = 0.83
Wang et al.[98]	2021	retrospective	slit-lamp and smartphone images	6,073	Inception-v3	differentiation of BK, FK, and VK	AUC = 0.85–0.96, QWK = 0.54–0.91
Xu et al.[92]	2020	retrospective	slit-lamp images	115,408	deep sequential feature learning	differentiation of BK, FK, VK, and other types of infectious keratitis	Acc = 80.0
Lv et al.[99]	2020	retrospective	IVCM images	2,088	ResNet101	diagnosis of FK	AUC = 0.98–0.99, Sen = 82.6–91.9 Spec = 98.3–98.9
Gu et al.[100]	2020	retrospective	slit-lamp images	5,325	Inception-v3	detection of infectious and non-infectious keratitis	AUC = 0.88–0.95

BK, bacterial keratitis; CNN, convolutional neural network; FK, fungal keratitis; IVCM, *in vivo* confocal microscopy; QWK, quadratic weighted kappa; RNN, recurrent neural network; VK, viral keratitis.

Lancet Digit Health 2021;
3: e486–95

Application of Comprehensive Artificial intelligence Retinal Expert (CARE) system: a national real-world evidence study

Duoru Lin*, Jianhao Xiong*, Congxin Liu*, Lanqin Zhao, Zhongwen Li, Shanshan Yu, Xiaohang Wu, Zongyuan Ge, Xinyue Hu, Bin Wang, Meng Fu, Xin Zhao, Xin Wang, Yi Zhu, Chuan Chen, Tao Li, Yonghao Li, Wenbin Wei, Mingwei Zhao, Jianqiao Li, Fan Xu, Lin Ding, Gang Tan, Yi Xiang, Yongcheng Hu, Ping Zhang, Yu Han, Ji-Peng Olivia Li, Lai Wei†, Pengzhi Zhu†, Yizhi Liu†, Weirong Chen†, Daniel S W Ting†, Tien Y Wong†, Yuzhong Chen†, Haotian Lin†

Summary

Background Medical artificial intelligence (AI) has entered the clinical implementation phase, although real-world performance of deep-learning systems (DLSs) for screening fundus disease remains unsatisfactory. Our study aimed to train a clinically applicable DLS for fundus diseases using data derived from the real world, and externally test the model using fundus photographs collected prospectively from the settings in which the model would most likely be adopted.

Lancet Digit Health 2021;
3: e486–95

See Comment page e463

For the Chinese translation of the abstract see Online for appendix 1

Research in context

Evidence before this study

Medical artificial intelligence (AI) has entered the clinical implementation phase, although real-world performance of deep-learning systems (DLSs) for screening fundus disease remains unsatisfactory. A clinically applicable DLS for fundus diseases should be trained by real-world data and externally tested by fundus photographs collected prospectively from the settings in which the model would most likely be adopted. We searched PubMed and Web of Science on June 1, 2020 for articles published between Jan 1, 2010, and May 31, 2020, using the keywords "artificial intelligence", "deep learning", "fundus disease" (or other disease names, including "diabetic retinopathy" and "age-related macular degeneration"), and "real-world", but identified no known studies that tested DLS for fundus diseases using prospectively collected nationwide real-world data. We did not apply any language restrictions. The US Food and Drug Administration authorised the first autonomous AI-based diagnostic system for diabetic-retinopathy detection after a small-scale clinical trial in primary-care offices. Another study was done by Google Health, which used a validated DLS trained on retrospective well curated retinal images for the detection of diabetic retinopathy, was applied in 11 clinics in real-world settings in Thailand. However, the performance of the DLS was well below expectation in a real-world environment, and further model training and testing is required.

Added value of this study

This national real-world evidence study trained a DLS to identify 14 retinal abnormalities using fundus photographs collected from different medical real-world settings and tested the DLS using photographs prospectively collected from settings across China and a series of designed datasets. The model performed well in a real-world environment. This study also showed that an AI solution can be deployed in remote areas with poor network infrastructure and scarce medical resources, while maintaining a high degree of accuracy.

Implications of all the available evidence

Using representative data to train a DLS and testing the model with prospectively-collected real-world data across the country can improve model performance in a real-world environment. This study provides an important reference for the National Medical Products Administration in regulatory decisions about new medical AI-device products.

Added value of this study

Our study showed that a population screening programme for multiple blindness-causing eye diseases was likely to be highly cost-effective in both rural and urban China. All three screening strategies (non-telemedicine screening, non-AI telemedicine screening, and AI telemedicine screening) met the criterion of a highly cost-effective health intervention. In addition, our study showed that annual AI screening in both rural and urban areas in China was the optimal screening strategy.

Lancet Glob Health 2023; 11: e456–65

Published Online
January 23, 2023

Implications of all the available evidence

Our results suggest that routine screening for multiple blindness-causing eye diseases could be highly cost-effective in China, providing robust economic evidence for informed policy making regarding its large-scale promotion. Moreover, our findings indicate that novel screening strategies, such as AI-based screening, could achieve greater cost-effectiveness in population screening. These novel screening approaches could play a unique role in high-quality eye-care delivery and improve the equity and accessibility of eye health resources. More importantly, they can serve as a feasible example for other countries, especially LMICs with similar settings or epidemiological features.

Economic evaluation of combined population-based screening for multiple blindness-causing eye diseases in China: a cost-effectiveness analysis

Hanruo Liu*, Ruyue Li, Yue Zhang, Kaiwen Zhang, Mayinuer Yusufu, Yanting Liu, Dapeng Mou, Xiaoniao Chen, Jiaxin Tian, Huiqi Li, Sujie Fan, Jianjun Tang*, Ningli Wang*

Summary

Background More than 90% of vision impairment is avoidable. However, in China, a routine screening programme is currently unavailable in primary health care. With the dearth of economic evidence on screening programmes for multiple blindness-causing eye diseases, delivery options, and screening frequencies, we aimed to evaluate the costs and benefits of a population-based screening programme for multiple eye diseases in China.

Review > Nat Med. 2019 Jan;25(1):44-56. doi: 10.1038/s41591-018-0300-7. Epub 2019 Jan 7.

High-performance medicine: the convergence of human and artificial intelligence

Eric J Topol [1]

Affiliations + expand

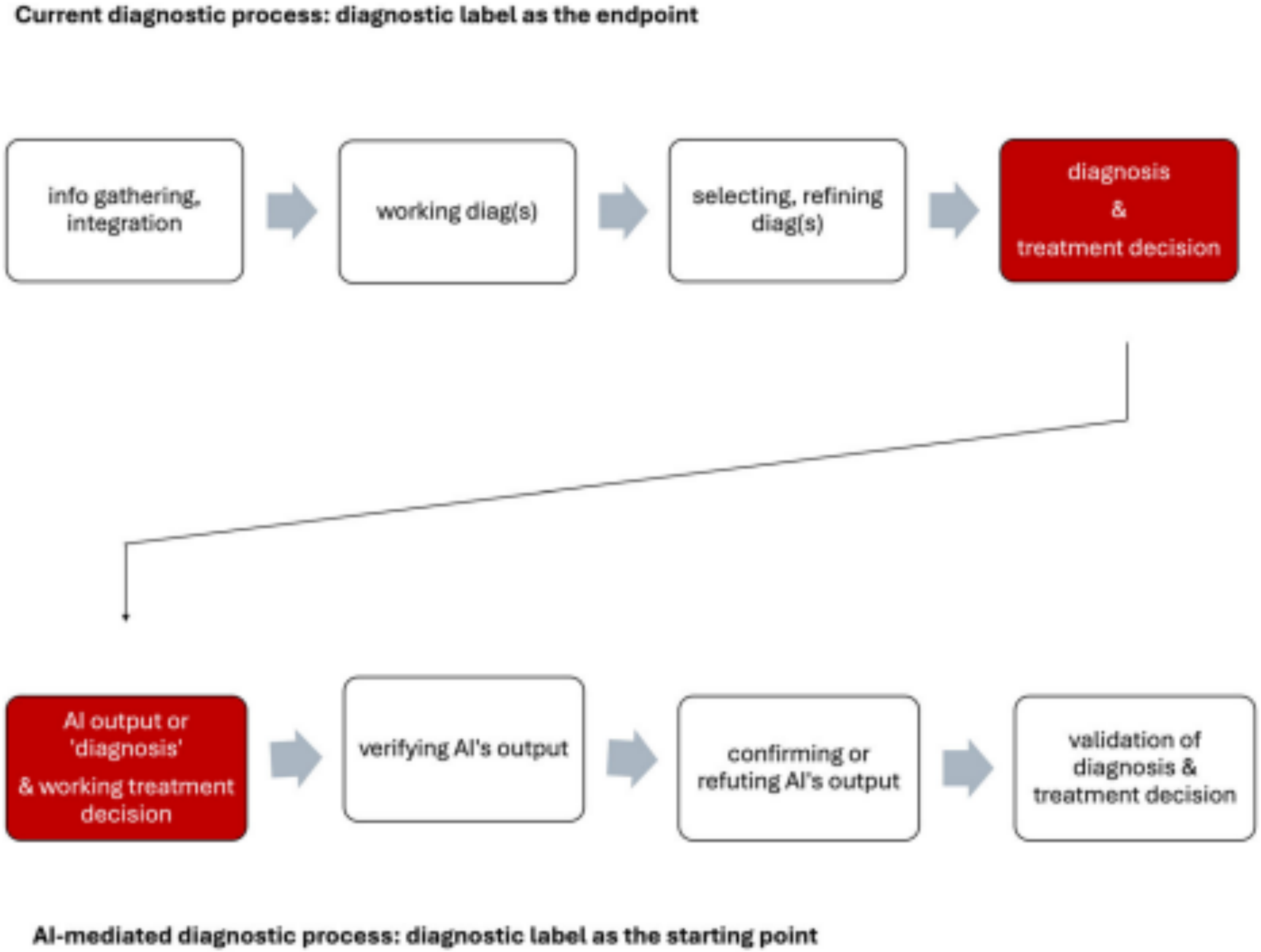
PMID: 30617339 DOI: 10.1038/s41591-018-0300-7

Abstract

The use of artificial intelligence, and the deep-learning subtype in particular, has been enabled by the use of labeled big data, along with markedly enhanced computing power and cloud storage, across all sectors. In medicine, this is beginning to have an impact at three levels: for clinicians, predominantly via rapid, accurate image interpretation; for health systems, by improving workflow and the potential for reducing medical errors; and for patients, by enabling them to process their own data to promote health. The current limitations, including bias, privacy and security, and lack of transparency, along with the future directions of these applications will be discussed in this article. Over time, marked improvements in accuracy, productivity, and workflow will likely be actualized, but whether that will be used to improve the patient-doctor relationship or facilitate its erosion remains to be seen.

Cell Reports Medicine
Review

Fig. 1 | Changes to the diagnostic process. A simplified, information-focused illustration of the complex, dynamic, longitudinal process clinicians embark on in formulating a diagnosis. It depicts how the diagnostic label, currently representing the endpoint of the diagnostic process becomes instead the starting point of the new, AI-mediated process.



npj | digital medicine
Comment
Published in partnership with Seoul National University Bundang Hospital
https://doi.org/10.1038/s41746-025-01460-1

Transforming diagnosis through artificial intelligence

Luciana D'Adderio & David W. Bates

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Cell Reports Medicine
Review

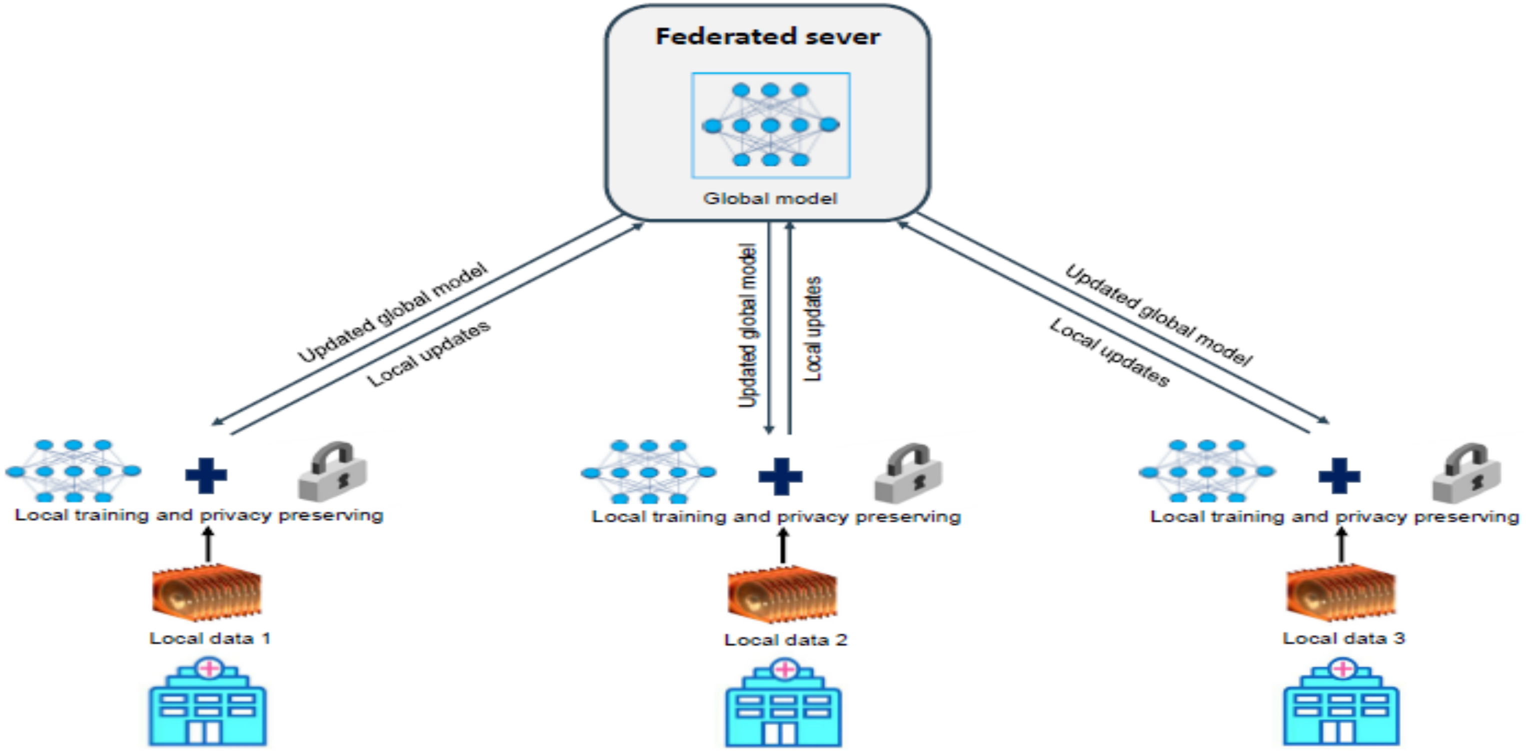
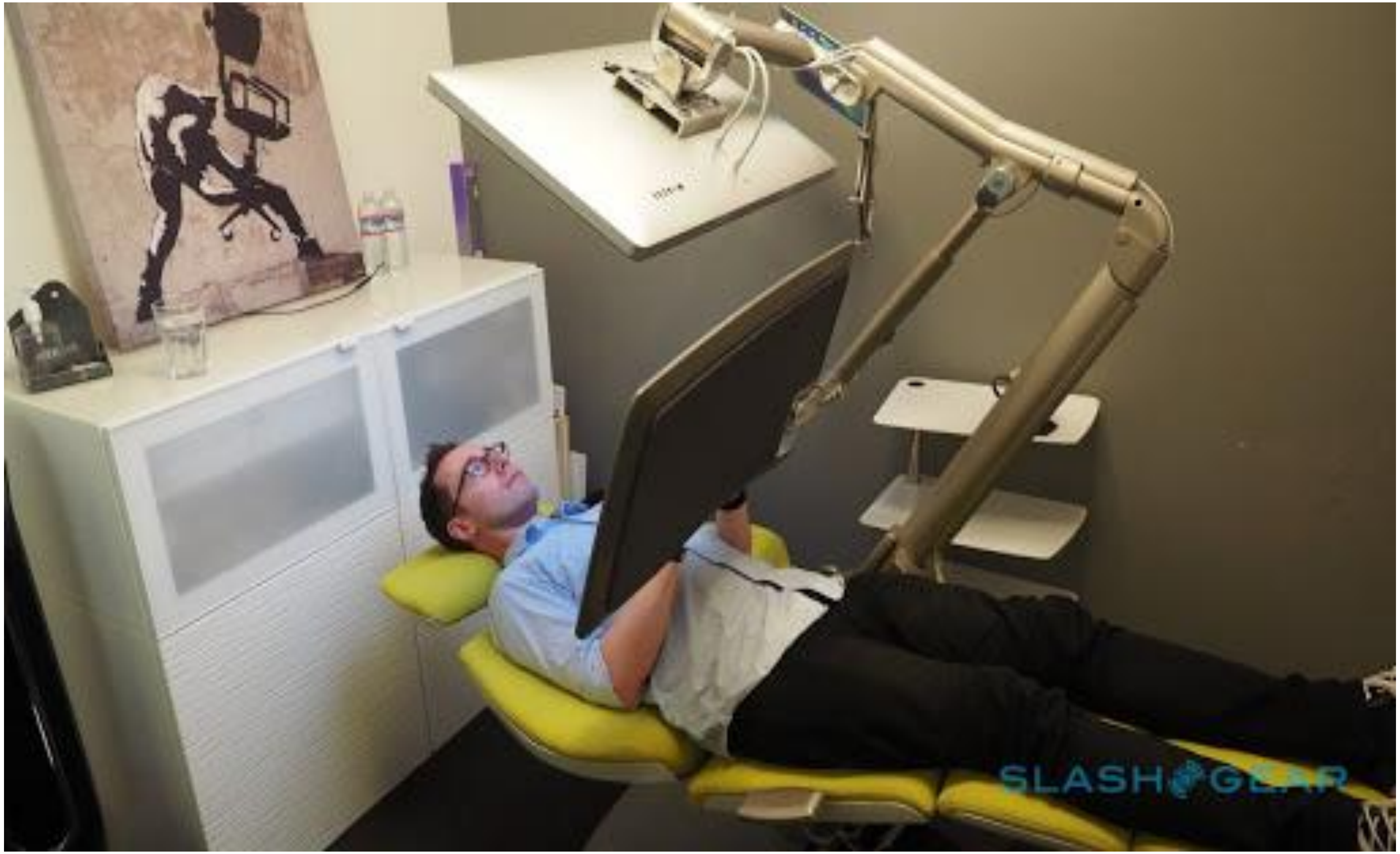
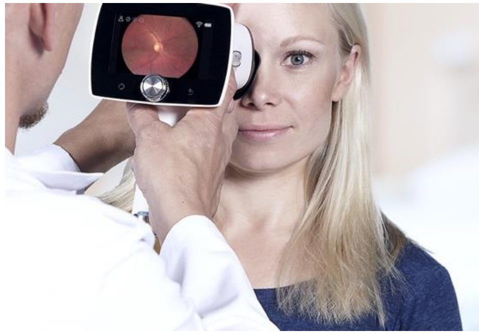


Figure 4. Framework of federated learning
Local hospitals are given a copy of a current global model from a federated server to train on their own datasets. After a certain number of iterations, the local hospitals send model updates back to the federated server and keep their datasets in their own secure infrastructure. The federated server aggerates the contributions from these hospitals. Then the updated global model is shared with the local hospitals and they can continue local training. The main advantage of federated learning is that it establishes a global model without directly sharing datasets, preserving patient privacy across sites.

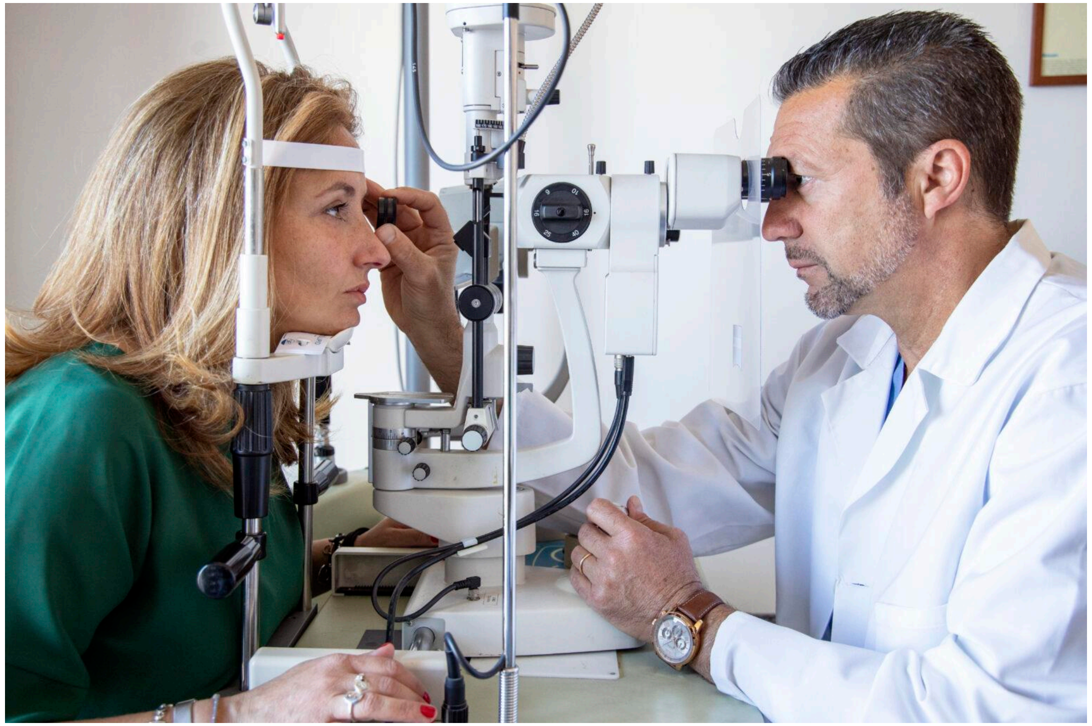

SLASHGEAR

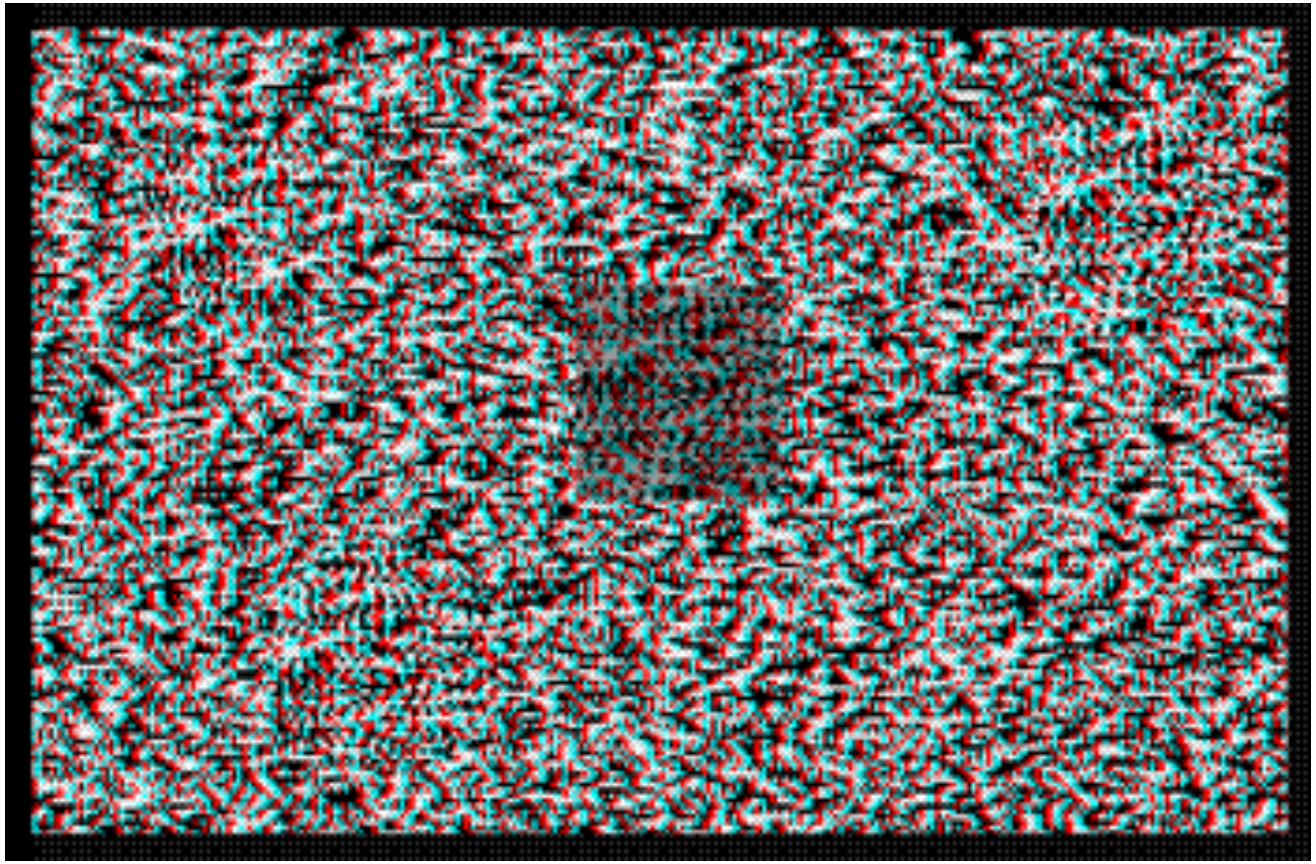

GRUPPO GROTTE C.A.I.
GGS
SAVONA

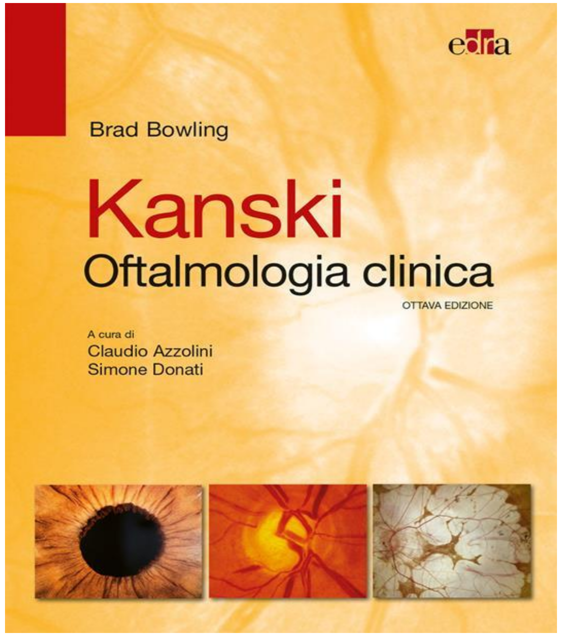


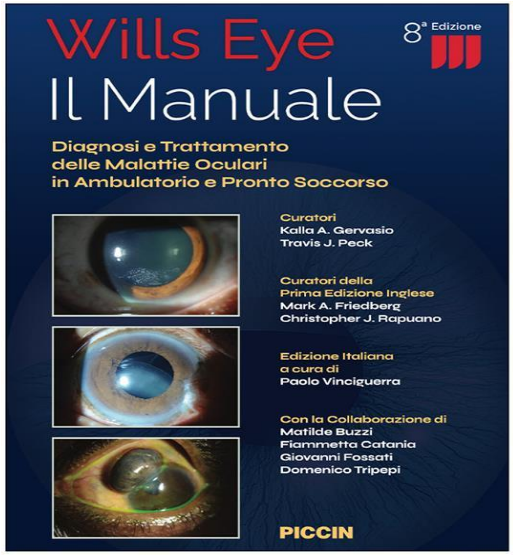
Pros and Cons

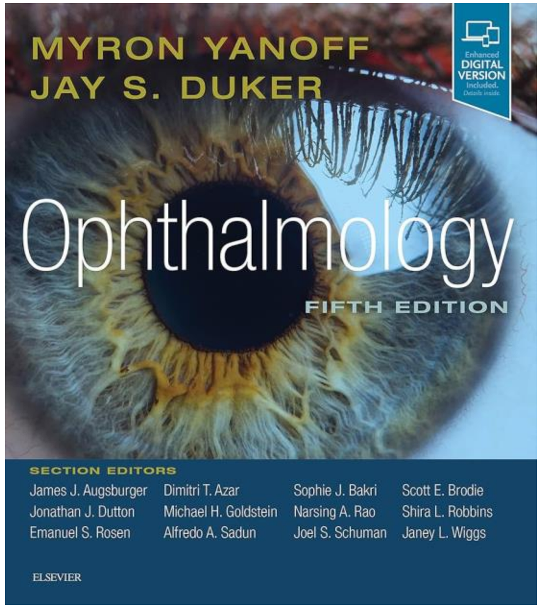
Pros	Cons
1) IMMAGINI FERME	1) NO STEREOPSI
2) POSSIBILITA' DI INGRANDIMENTO	2) NO PERIFERIA
3) VISUALIZZAZIONE DI BUONA PARTE DELLE CONDIZIONI "SIGHT-THREATENING"	
4) SORPRESE	





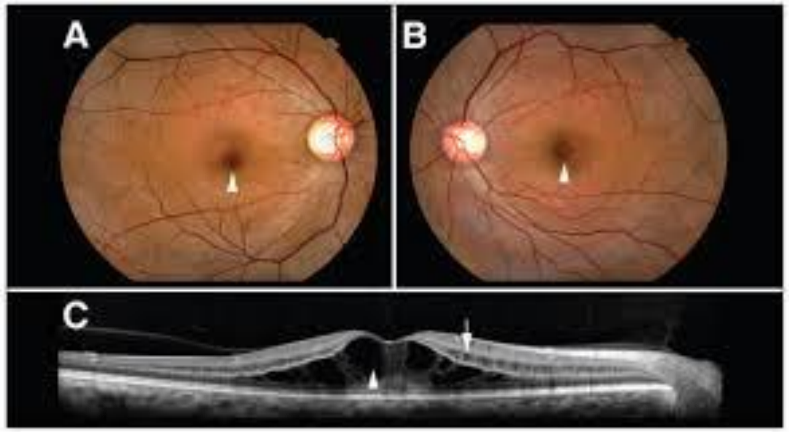






Estrudendo un quadrato otteniamo un cubo o un parallelepipedo

Estrudendo un cerchio otteniamo un cilindro

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Alessandro Artom
Asti - AT

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 Progress in Retinal and Eye Research 107 (2025) 101374

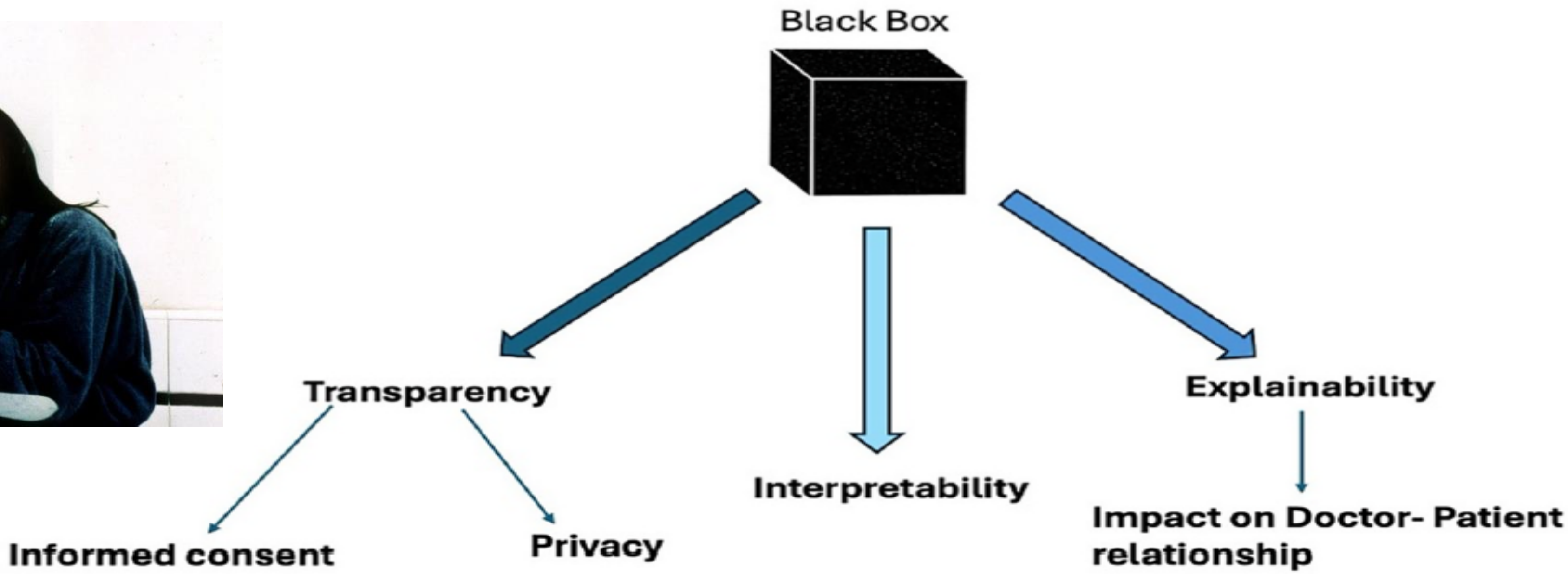


Fig. 3. ***The Black Box Phenomenon in AI*** – A conceptual illustration of the "black box" problem in artificial intelligence, highlighting challenges in transparency, interpretability, and explainability. The image depicts how AI processes input data and generates outputs without clear visibility into its decision-making process. Key concerns such as informed consent, data privacy, and the impact on the patient-doctor relationship are illustrated, emphasizing the ethical and practical implications of opaque AI systems in ophthalmology. (CR creation).

RegioneLombardia
IL CONSIGLIO

XII LEGISLATURA ATTI: 2023/XII.2.6.4.642

SEDUTA DEL 25 GIUGNO 2024 DELIBERAZIONE N. XII/384

invita la Giunta regionale

a coinvolgere le farmacie anche in ambito dermatologico e gli ottici optometristi presenti nei centri ottici in capo oculistico (per esempio per l'esame della vista o la prima visita oftalmica) per attività di screening oculistico nell'ambito delle malattie oculari e teleoptometry.".

invita la Giunta regionale e l'Assessore competente

a valutare la possibilità di stipulare convenzioni, anche a carattere sperimentale, con operatori qualificati, come, a titolo di esempio, ottici/optometristi (prima visita oculistica) e farmacie dei servizi (in particolare per attività di presa in carico dei pazienti cronici), per aumentare la capacità di erogazione delle prestazioni, in presenza di tempi di attesa particolarmente critici e impattanti sulle condizioni di salute dei cittadini.".

quotidianosanità.it
Homnya srl
anno XV • numero 382
24 settembre 2025

Lavoro e Professioni

Radiografie per traumi minori richieste dagli infermieri. Opi Trento: "Nessuna invasione di campo, la prescrizione è esclusiva competenza medica"

Ordine Professioni Infermieristiche Trento

24 SET - L'Ordine degli infermieri di Trento ci tiene a chiarire i termini del progetto sperimentale. "L'infermiere di triage valuta. attribuisce il codice di priorità" e "può anticipare la richiesta di un esame radiologico come parte di un percorso codificato, sulla base di sintomi o condizioni specifiche rilevate, con l'obiettivo di rendere più rapido ed efficiente il successivo iter assistenziale. Parlare di illegittimità o concorrenza tra ruoli significa distorcere la realtà". Leggi >

PIANO NAZIONALE DI GOVERNO DELLE LISTE DI ATTESA PER IL TRIENNIO 2025-2027

Presidenza del Consiglio dei Ministri
DIPARTIMENTO PER GLI AFFARI REGIONALI E LE AUTONOMIE
Ufficio per il coordinamento delle attività della segreteria della Conferenza permanente per i rapporti tra lo Stato, le Regioni e le Province autonome di Trento e Bolzano

Presidenza del Consiglio dei Ministri
DAR 0002435 P-4.37.2.10
del 11/02/2025
57226929

- un nuovo paradigma del sistema di offerta, centrato su:
  - nuovi strumenti di programmazione dialetticamente collegati all'analisi della domanda;
  - nuovi attori del sistema di erogazione e di progettazione dell'assistenza e della presa in carico (quelli definiti nel DM n. 77/2022, la farmacia dei servizi, ecc.);
  - nuovi strumenti di garanzia e tutela: ambiti territoriali di garanzia, integrazione con il privato accreditato, liste di tutela, ecc;
  - nuove modalità erogative di assistenza: prestazioni a distanza sia come modello di offerta di cura (*televisita, telemonitoraggio*) che per l'appropriatezza prescrittiva (teleconsulto);

EU Artificial Intelligence Act

The Act · Implementation · Compliance · About us

Alert: The EU AI Office AI Safety Unit is hiring and accepting expressions of interests for various roles, including technical, policy and legal positions

The EU Artificial Intelligence Act

Up-to-date developments and analyses of the EU AI Act

(20) Al fine di ottenere i massimi benefici dai sistemi di IA proteggendo nel contempo i diritti fondamentali, la salute e la sicurezza e di consentire il controllo democratico, l'alfabetizzazione in materia di IA dovrebbe dotare i fornitori, i deployer e le persone interessate delle nozioni necessarie per prendere decisioni informate in merito ai sistemi di IA. Tali nozioni possono variare in relazione al contesto pertinente e possono includere la comprensione della corretta applicazione degli elementi tecnici durante la fase di sviluppo del sistema di IA, le misure da applicare durante il suo utilizzo, le modalità adeguate per interpretare l'output del sistema di IA e, nel caso delle persone interessate, le conoscenze necessarie per comprendere in che modo le decisioni adottate con l'assistenza dell'IA incideranno su di esse. Nel contesto dell'applicazione del presente regolamento, l'alfabetizzazione in materia di IA dovrebbe fornire a tutti i pertinenti attori della catena del valore dell'IA le conoscenze necessarie per garantire l'adeguata conformità e la sua corretta esecuzione. Inoltre, l'ampia attuazione delle misure di alfabetizzazione in materia di IA e l'introduzione di adeguate azioni di follow-up potrebbero contribuire a migliorare le condizioni di lavoro e, in ultima analisi, sostenere il consolidamento e il percorso di innovazione di un'IA affidabile nell'Unione. Il consiglio europeo per l'intelligenza artificiale («consiglio per l'IA») dovrebbe sostenere la Commissione al fine di promuovere gli strumenti di alfabetizzazione in materia di IA, la sensibilizzazione del pubblico e la comprensione dei benefici, dei rischi, delle garanzie, dei diritti e degli obblighi in relazione all'uso dei sistemi di IA. In cooperazione con i pertinenti portatori di interessi, la Commissione e gli Stati membri dovrebbero agevolare l'elaborazione di codici di condotta volontari per migliorare l'alfabetizzazione in materia di IA tra le persone che si occupano di sviluppo, funzionamento e uso dell'IA.

Commissione europea

Plasmare il futuro digitale dell'Europa

Legge sull'IA

La legge sull'IA è il primo quadro giuridico in assoluto in materia di IA, che affronta i rischi dell'IA e posiziona l'Europa a svolgere un ruolo guida a livello mondiale.

Il regolamento sull'IA (regolamento (UE) 2024/1689 che stabilisce norme armonizzate sull'intelligenza artificiale) è il primo quadro giuridico completo in assoluto sull'IA a livello mondiale. L'obiettivo delle norme è promuovere un'IA affidabile in Europa.

La legge sull'IA stabilisce una serie chiara di norme basate sul rischio per gli sviluppatori e i deployer di IA per quanto riguarda gli usi specifici dell'IA. La legge sull'IA fa parte di un più ampio pacchetto di misure politiche a sostegno dello sviluppo di un'IA affidabile, che comprende anche il pacchetto sull'innovazione in materia di IA, il lancio delle fabbriche di IA e il piano coordinato sull'IA. Insieme, queste misure garantiscono la sicurezza, i diritti fondamentali e l'IA antropocentrica e rafforzano la diffusione, gli investimenti e l'innovazione nell'IA in tutta l'UE.

Per agevolare la transizione verso il nuovo quadro normativo, la Commissione ha varato il patto per l'IA, un'iniziativa volontaria che mira a sostenere la futura attuazione, dialogare con i portatori di interessi e invitare i fornitori e gli operatori di IA provenienti dall'Europa e dal resto del mondo a rispettare in anticipo gli obblighi fondamentali della legge sull'IA.

Commissione europea

Plasmare il futuro digitale dell'Europa

Perché abbiamo bisogno di regole sull'IA?

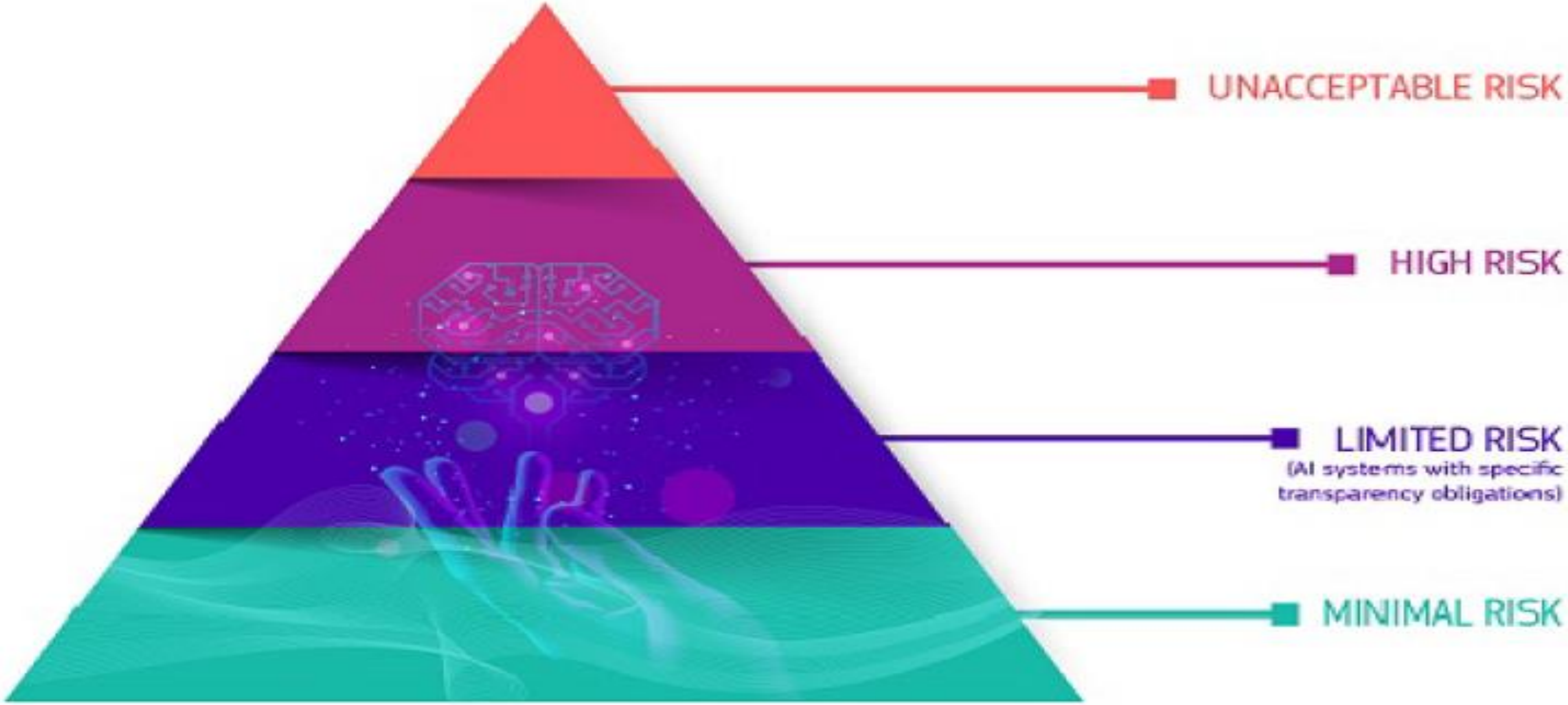
La legge sull'IA garantisce che gli europei possano fidarsi di ciò che l'IA ha da offrire. Sebbene la maggior parte dei sistemi di IA non presenti rischi e possa contribuire a risolvere molte sfide per la società, alcuni sistemi di IA creano rischi che dobbiamo affrontare per evitare risultati indesiderati.

Ad esempio, spesso non è possibile scoprire perché un sistema di IA ha preso una decisione o una previsione e ha intrapreso una particolare azione. Pertanto, può diventare difficile valutare se qualcuno sia stato ingiustamente svantaggiato, ad esempio in una decisione di assunzione o in una domanda di un regime di pubblica utilità.

Sebbene la legislazione esistente offra una certa protezione, non è sufficiente per affrontare le sfide specifiche che i sistemi di IA possono comportare.

Un approccio basato sul rischio

La legge sull'IA definisce 4 livelli di rischio per i sistemi di IA:

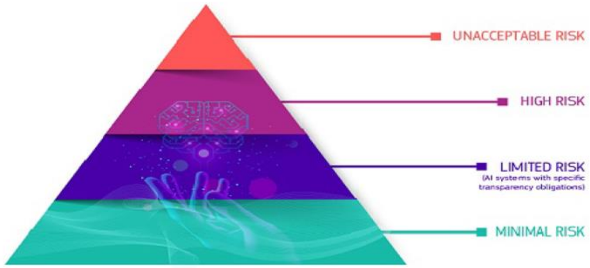


Commissione europea

Plasmare il futuro digitale dell'Europa

Un approccio basato sul rischio

La legge sull'IA definisce 4 livelli di rischio per i sistemi di IA:



Rischio inaccettabile

Tutti i sistemi di IA considerati una chiara minaccia per la sicurezza, i mezzi di sussistenza e i diritti delle persone sono vietati. La **legge sull'IA vieta otto pratiche,** vale a dire:

1. manipolazione e inganno dannosi basati sull'IA
2. sfruttamento dannoso delle vulnerabilità basato sull'IA
3. punteggio sociale
4. Valutazione o previsione del rischio di reato individuale
5. raschiamento non mirato di materiale Internet o CCTV per creare o espandere banche dati di riconoscimento facciale
6. riconoscimento delle emozioni nei luoghi di lavoro e negli istituti di istruzione
7. categorizzazione biometrica per dedurre determinate caratteristiche protette
8. identificazione biometrica remota in tempo reale a fini di contrasto in spazi accessibili al pubblico

Rischio elevato

I casi d'uso dell'IA che possono comportare gravi rischi per la salute, la sicurezza o i diritti fondamentali sono classificati come ad alto rischio. Questi casi **d'uso ad alto rischio** includono:

- Componenti di sicurezza dell'IA nelle infrastrutture critiche (ad esempio i trasporti), il cui guasto potrebbe mettere a rischio la vita e la salute dei cittadini
- Soluzioni di IA utilizzate negli istituti di istruzione, che possono determinare l'accesso all'istruzione e al corso della vita professionale di qualcuno (ad esempio punteggio degli esami)
- Componenti di sicurezza dei prodotti basati sull'IA (ad esempio applicazione dell'IA nella chirurgia assistita da robot)

Iter

20 marzo 2025: approvato (modificato rispetto al testo del proponente) (trasmesso all'altro ramo)

Successione delle letture parlamentari		
S.1146	**approvato**	**20 marzo 2025**
C.2316	approvato con modificazioni	25 giugno 2025
S.1146-B	approvato definitivamente, non ancora pubblicato	17 settembre 2025

Giovedì 18/09/2025 • 09:31

QUOTIDIANOPIÙ

MONDO DIGITALE DAL SENATO

Intelligenza Artificiale: via libera alla prima legge italiana

Con 77 voti favorevoli, 55 contrari e 2 astensioni, il Senato ha approvato definitivamente il DDL recante disposizioni e deleghe al Governo in materia di **intelligenza artificiale**. Un testo strategico per garantire sviluppo, sicurezza e competitività nazionale, tutelando persone, minori, lavoratori e dati personali.

quotidianosanità.it

Quotidiano on line di informazione sanitaria

Martedì 23 SETTEMBRE 2025

Intelligenza artificiale. Il Senato approva in via definitiva il ddl. Tra le novità: tutela contro le discriminazioni, uso dati per ricerca e piattaforma nazionale

Il Senato ha approvato definitivamente il disegno di legge sull'intelligenza artificiale, che introduce nuove regole per il suo impiego in ambito sanitario. Il testo disciplina l'utilizzo etico dell'IA nella diagnosi e cura, tutela i diritti dei pazienti, semplifica l'uso dei dati per la ricerca e istituisce una piattaforma nazionale integrata con il Fascicolo Sanitario Elettronico. IL TESTO

L'**articolo 7** stabilisce i principi fondamentali per l'uso dell'IA in ambito sanitario. Il messaggio è chiaro: le tecnologie devono servire a rafforzare il sistema di prevenzione, diagnosi e cura, ma senza mai sostituirsi alla decisione medica, che rimane prerogativa esclusiva dei professionisti sanitari.

Senato della Repubblica XIX LEGISLATURA

N. 1146-B

DISEGNO DI LEGGE

presentato dal Presidente del Consiglio dei ministri (MELONI)
e dal Ministro della giustizia (NORDIO)
(v. stampato n. **1146***)*

approvato dal Senato della Repubblica il 20 marzo 2025
(v. stampato Camera n. **2316***)*

modificato dalla Camera dei deputati il 25 giugno 2025

Trasmesso dal Presidente della Camera dei deputati alla Presidenza il 26 giugno 2025

Disposizioni e deleghe al Governo in materia di intelligenza artificiale

Disegno di legge collegato alla manovra di finanza pubblica, ai sensi dell'articolo 126-bis del Regolamento

Governo Italiano

Dipartimento per la trasformazione digitale

Sottosegretario Dipartimento Progetti Notizie Innova con noi

Home / Notizie / Articoli / Approvata in via definitiva la...

Approvata in via definitiva la legge italiana sull'Intelligenza Artificiale

Butti: "Italia primo Paese UE con quadro nazionale allineato all'AI Act. Governance con ACN e AgID e 1 miliardo di euro per startup e PMI"

DATA
17 settembre 2025

TEMPO DI LETTURA
2 minuti

Il Senato ha approvato oggi in via definitiva la legge italiana sull'Intelligenza Artificiale. Si tratta del primo quadro normativo nazionale in Europa che disciplina sviluppo, adozione e governance dei sistemi di IA nel rispetto dei principi costituzionali e dei diritti fondamentali e in piena coerenza con l'AI Act europeo.

La legge si fonda su princìpi di uso **antropocentrico, trasparente e sicuro** dell'IA, con particolare attenzione a innovazione, cybersicurezza, accessibilità e tutela della riservatezza. Interviene in modo organico su più settori che possono beneficiare di questa nuova tecnologia – sanità, lavoro, pubblica amministrazione e giustizia, formazione e sport – prevedendo garanzie di tracciabilità, responsabilità umana e centralità della decisione finale di una persona fisica.

Sul piano della **governance**, la norma designa **Agenzia per la Cybersicurezza Nazionale (ACN)** e **Agenzia per l'Italia Digitale (AgID)** quali Autorità nazionali competenti: ACN vigila – con poteri ispettivi – sull'adeguatezza e la sicurezza dei sistemi, AgID gestisce le notifiche e promuove casi d'uso sicuri per cittadini e imprese, in un quadro di coordinamento interistituzionale stabile.

Il provvedimento istituisce inoltre un meccanismo di **programmazione strategica**: la **Strategia nazionale per l'IA** sarà predisposta e aggiornata con **cadenza biennale** dal Dipartimento per la trasformazione digitale della Presidenza del Consiglio, con il supporto di ACN e AgID e il coinvolgimento delle principali autorità settoriali. A rafforzarne la trasparenza è previsto un **monitoraggio annuale al Parlamento**.

I punti chiave della legge

- **Principi e tutele**: uso antropocentrico e sicuro; trasparenza, accessibilità e protezione dei dati.
- **Settori applicativi**: sanità (centralità del medico, dati per ricerca), lavoro (osservatorio e dignità del lavoratore), PA e giustizia (supporto decisionale tracciabile), scuola e sport (formazione e inclusione).
- **Governance nazionale**: ACN e AgID Autorità competenti; coordinamento presso la Presidenza del Consiglio; Strategia IA aggiornata ogni due anni e **report annuale al Parlamento**.
- **Sostegno all'innovazione**: **1 miliardo di euro** per startup e PMI in IA e tecnologie correlate.

Agenda Digitale.eu

AI Act: un nuovo standard globale per la sanità digitale

Registrati ora

Pubblicato il 14 nov 2024

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Partner, Healthcare and Lifesciences Global Lead di Brunswick

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Motivi di entusiasmo per l'applicazione dell'IA nel settore sanitario

Nell'annunciare l'AI Act, il Parlamento europeo ha elencato i "molti vantaggi dell'IA." Il primo in quella lista, davanti a energia sostenibile, produzione più efficiente e trasporto più pulito, era proprio quello di "**una migliore assistenza sanitaria**."

Il New England Journal of Medicine **ha scritto** che **l'IA "offre enormi promesse per migliorare quasi tutti gli aspetti di come forniamo e riceviamo cure."** Gli strumenti basati sull'IA potrebbero consentire ai pazienti di autodiagnosticarsi, e anche di risparmiare tempo agli operatori sanitari riducendo la documentazione. Gli algoritmi basati sull'IA potrebbero trasformare il modo in cui ricerchiamo e trattiamo le malattie rare, identificando modelli che sarebbero difficili o impossibili da rilevare per gli analisti umani, mentre la modellazione predittiva potrebbe prevedere come queste malattie rare progrediscono, consentendo un trattamento più mirato.

Commissione europea | Public Health

L'intelligenza artificiale nel settore dell'assistenza sanitaria

- l'IA può facilitare l'assegnazione efficiente delle risorse sanitarie. La modellizzazione di tipo predittivo può prevedere i ricoveri dei pazienti e ottimizzare l'uso di posti letto, personale e attrezzature ospedalieri. Ciò garantisce che le risorse siano disponibili dove e quando sono più necessarie, riducendo gli sprechi e migliorando la qualità dell'assistenza;
- l'IA inoltre è potenzialmente in grado di affrontare alcune delle sfide più urgenti nel settore dell'assistenza sanitaria, ad esempio l'aumento dei costi, le inefficienze e la domanda di assistenza di qualità superiore;
- l'IA può ridurre i costi e razionalizzare compiti amministrativi come la programmazione dei pazienti, la fatturazione e la gestione elettronica delle cartelle cliniche attraverso l'automazione e l'ottimizzazione delle operazioni, consentendo ai professionisti sanitari di concentrarsi maggiormente sulla cura del paziente;
- nel campo della diagnostica, l'IA migliora l'accuratezza e consente di formulare diagnosi più precoci, spesso offrendo opzioni di trattamento meno invasive e più efficaci sotto il profilo dei costi;
- i piani terapeutici personalizzati basati sull'IA possono integrare gli approcci tradizionali offrendo cure più mirate ed efficaci, migliorando i risultati per i pazienti e contribuendo inoltre a ridurre l'onere finanziario a carico dei sistemi sanitari.

WORLD ECONOMIC FORUM

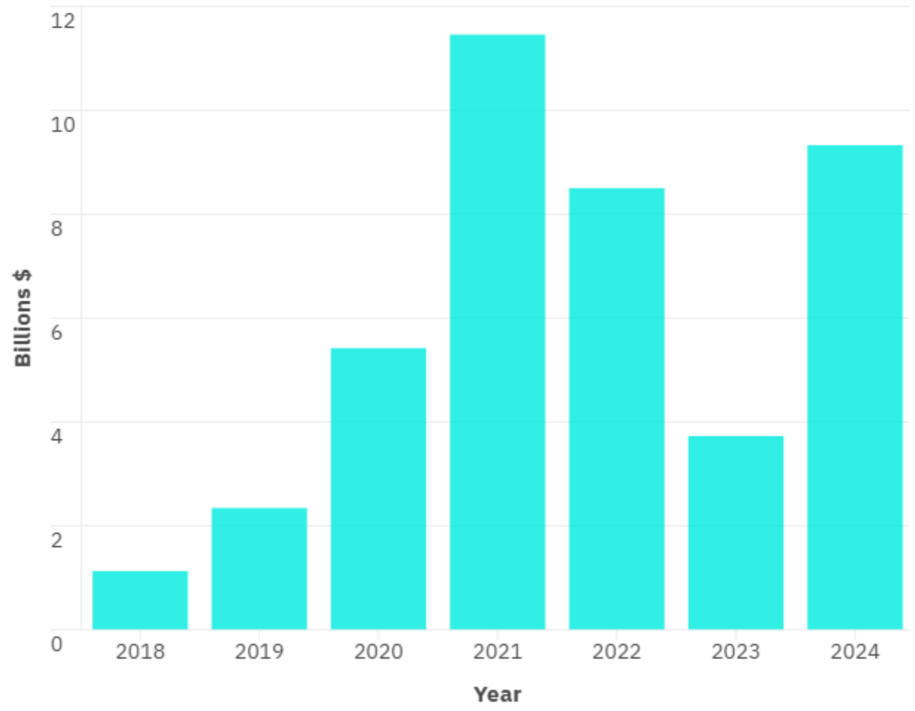
With 4.5 billion people currently without access to essential healthcare services and a health worker shortage of 11 million expected by 2030, AI has the potential to help bridge that gap and revolutionize global healthcare.

It could even get us back on track to meet the United Nations' Sustainable Development Goal of achieving universal health coverage by 2030.

But while the technology is rapidly developing, healthcare is "below average" in its adoption of AI compared to other industries, according to the World Economic Forum's white paper, *The Future of AI-Enabled Health: Leading the Way*.

As the chart below shows, levels of private investment in AI in the healthcare sector vary. And yet, "AI digital health solutions hold the potential to enhance efficiency, reduce costs and improve health outcomes globally," says the white paper. Here are seven examples of AI technologies already making a difference in the medical field.

Medical and healthcare - annual private investment in AI



Source: Our World in Data/ Quid via AI Index Report (2025)/ US Bureau of Labor Statistics (2025)

Canadian Journal of Health Technologies
CDA-AMC Canada's Drug Agency
L'Agence des médicaments du Canada
March 2025 Volume 5 Issue 3
Drugs Health Technologies Health Systems

- The 2025 Watch List also identifies the top 5 issues related to AI technologies in health care. Examples include the importance of establishing guidelines around what data are used to train AI algorithms and how that might contribute to bias as well as considerations about the liability and accountability of health care providers and systems that use these technologies. These are key issues that warrant more attention and will influence the wider adoption, diffusion, and implementation of new and emerging AI technologies.

Horizon Scan

2025 Watch List: Artificial Intelligence in Health Care

Final Thoughts

The items on the 2025 Watch List were selected by people with lived experience using AI in a health care context as patients, caregivers, health care providers, members of industry, and health care decision-makers. The strength of this work is our ability to bring together multiple perspectives to discuss AI both where it might bring major benefits to the Canadian health care systems and where there is a need for caution.

The 2025 Watch List encompasses categories of technologies and associated issues that are interconnected and require systems-level thinking to enhance health care and avoid unintended effects. Adding AI technologies into the health care system without first establishing robust liability and accountability structures, for example, could lead to delayed uptake by some health care providers. However, delaying rollout of these powerful tools until conditions are perfect could also potentially cause harm to people who would not be able to reap the benefits of these technologies in a timely fashion.

There was a feeling shared in the workshop that the widespread use of some AI technologies in the health care system is inevitable — particularly the consumer-led technologies. These technologies will be added to the system whether the system is ready for them or not. As a result, the issues that made the 2025 Watch List emphasize investing in system readiness: ensure that foundational elements related to governance, privacy, and liability are in place to build trust, support the introduction and uptake of these powerful technologies, and lay the necessary groundwork for future developments in this rapidly evolving space.

1843
Ada Lovelace writes "Note G," widely considered to be the first complex computer algorithm, on a sketch of Charles Babbage's Analytical Engine[17]

1946
Researchers unveil ENIAC, the first general-purpose electronic computer[18]

1959
COBOL, a major programming language for business, finance, and administrative systems, is created[19]

1973
Alto, a computer with a graphical user interface, is developed at Xerox PARC[20]

1983
Microsoft releases Microsoft Word[21]

1995
Sun Microsystems releases Java 1.0 as a 'write once, run anywhere' programming language[22]

2006
Amazon launches AWS, and 12,000 developers reportedly sign up on the first day[23]

2008
Apple opens the App Store[24]

2017
"Attention Is All You Need" paper proposes the Transformer architecture and paves the way for modern LLMs[25]

2023
Toolformer, an LLM that can teach itself to use external tools through APIs, is created[26]

Future

2026
People regularly use personal agents to access data and complete tasks across digital ecosystems

2028
A major ERP company launches a new agent-first platform design that lets users create custom data dashboards using natural language

2029
An agent-powered startup goes public, and has the highest market cap-to-employee ratio in history

2030
Agents, not people, are the primary users of most enterprises' internal digital systems

2032
Interacting with agents surpasses apps in average consumer time spent on smart devices

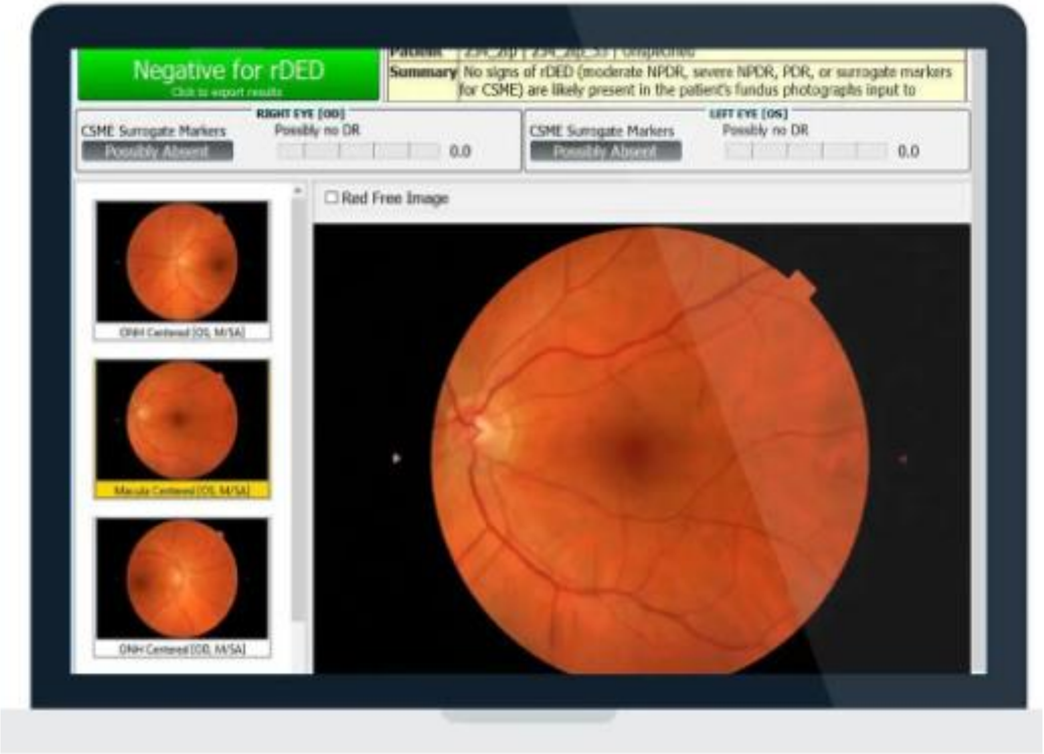
Technology Vision 2025

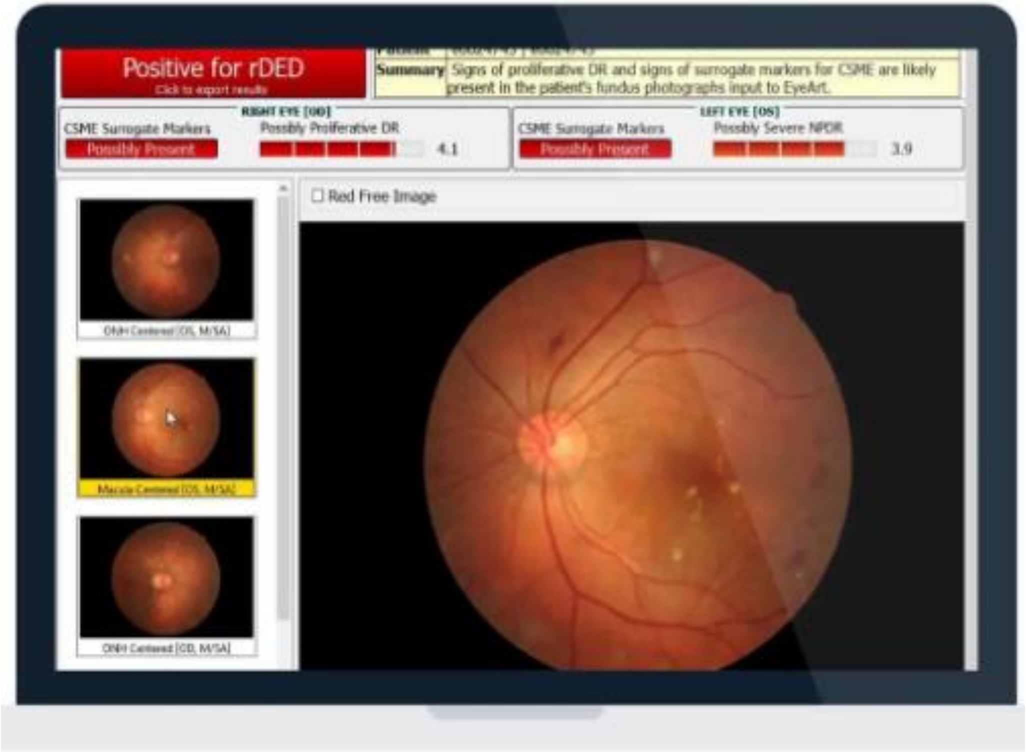
AI: A Declaration of Autonomy

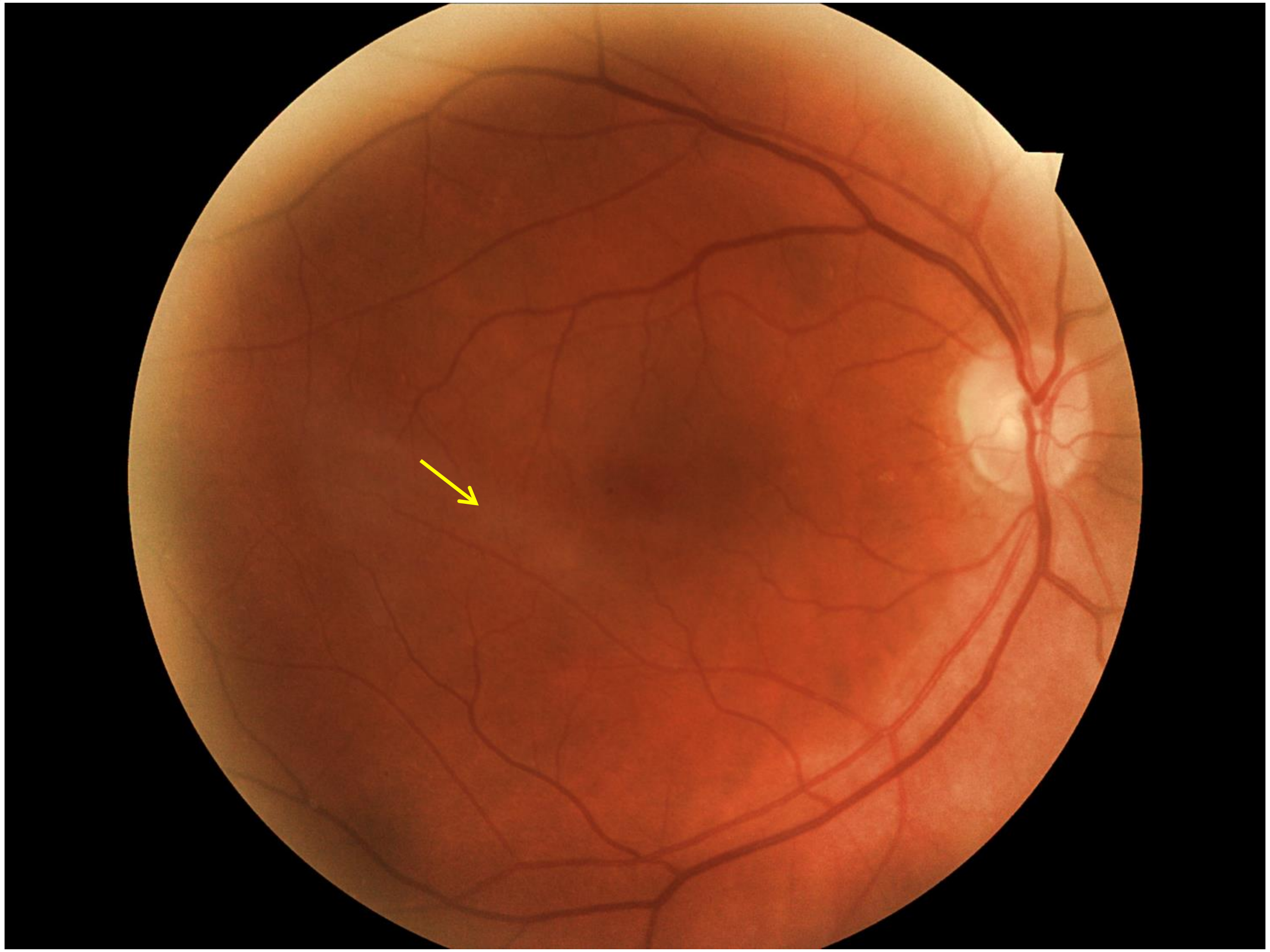
Is trust the limit of AI's limitless possibilities?

Negative for rDED

Positive for rDED







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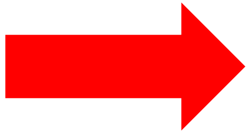

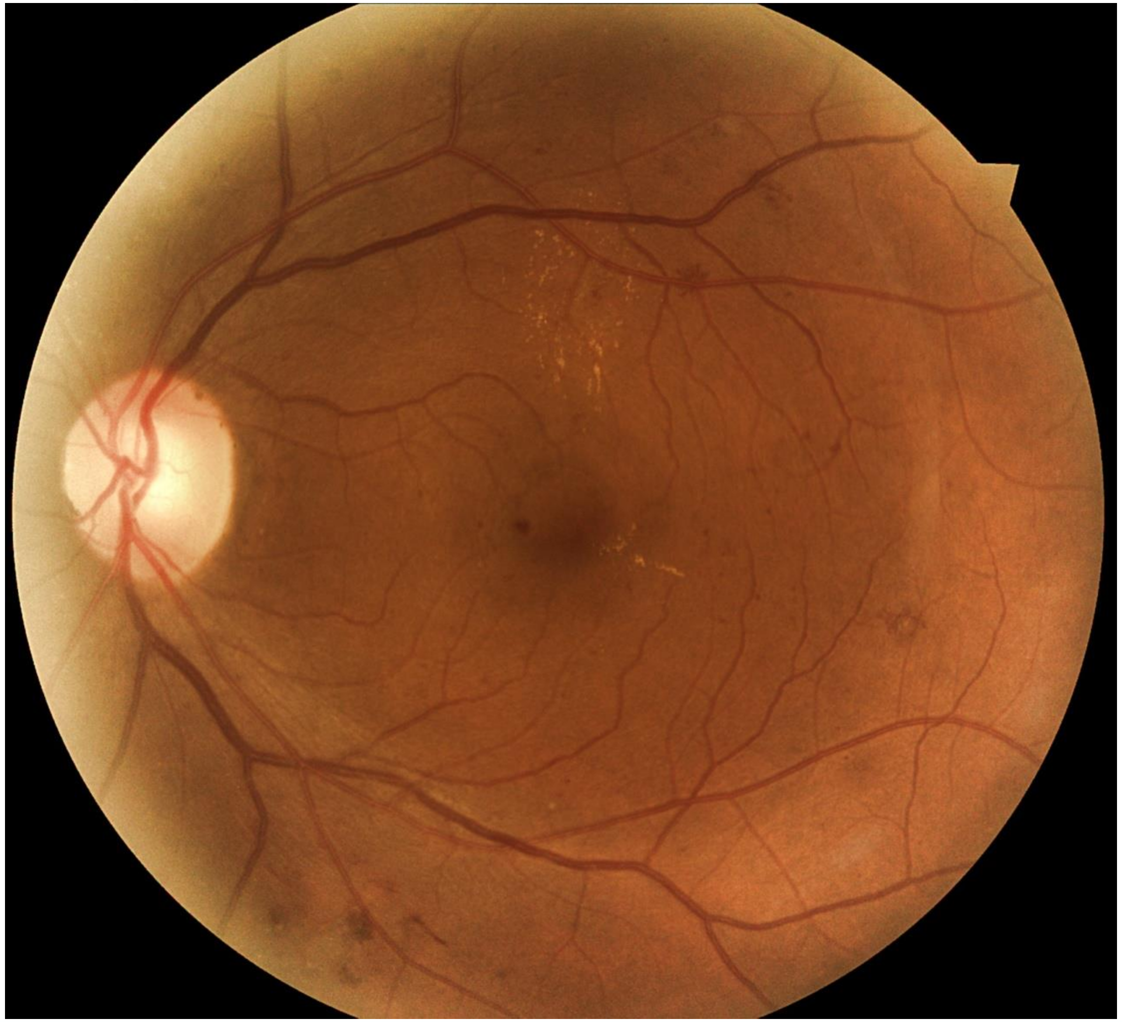

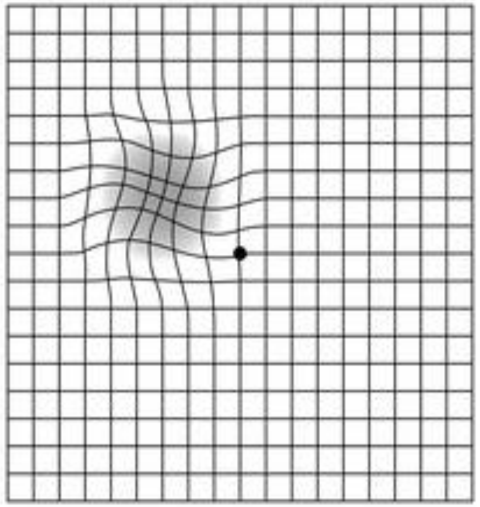

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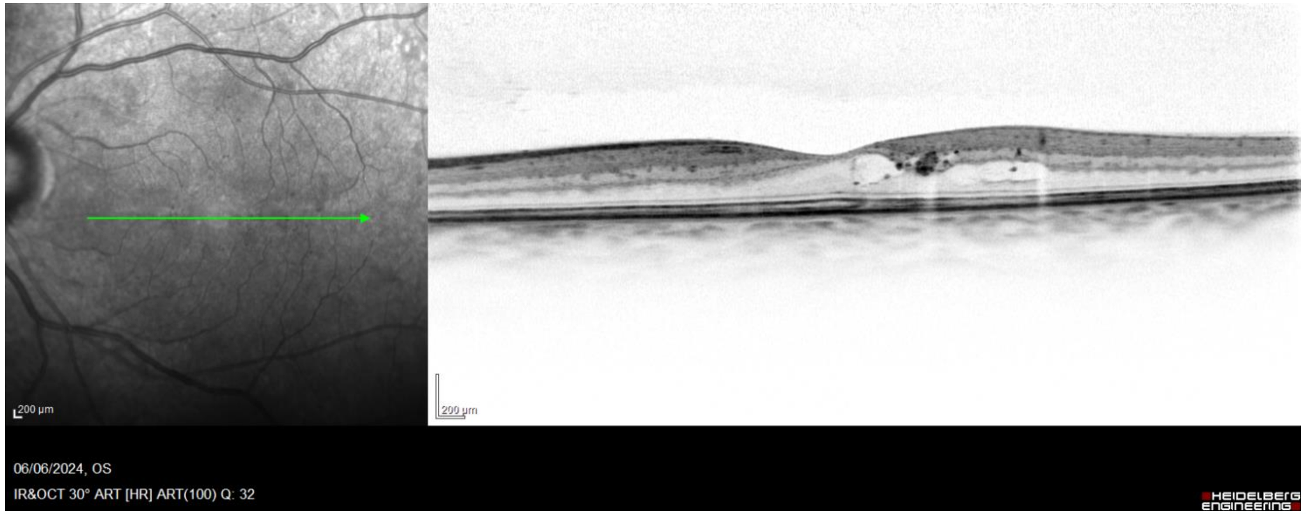
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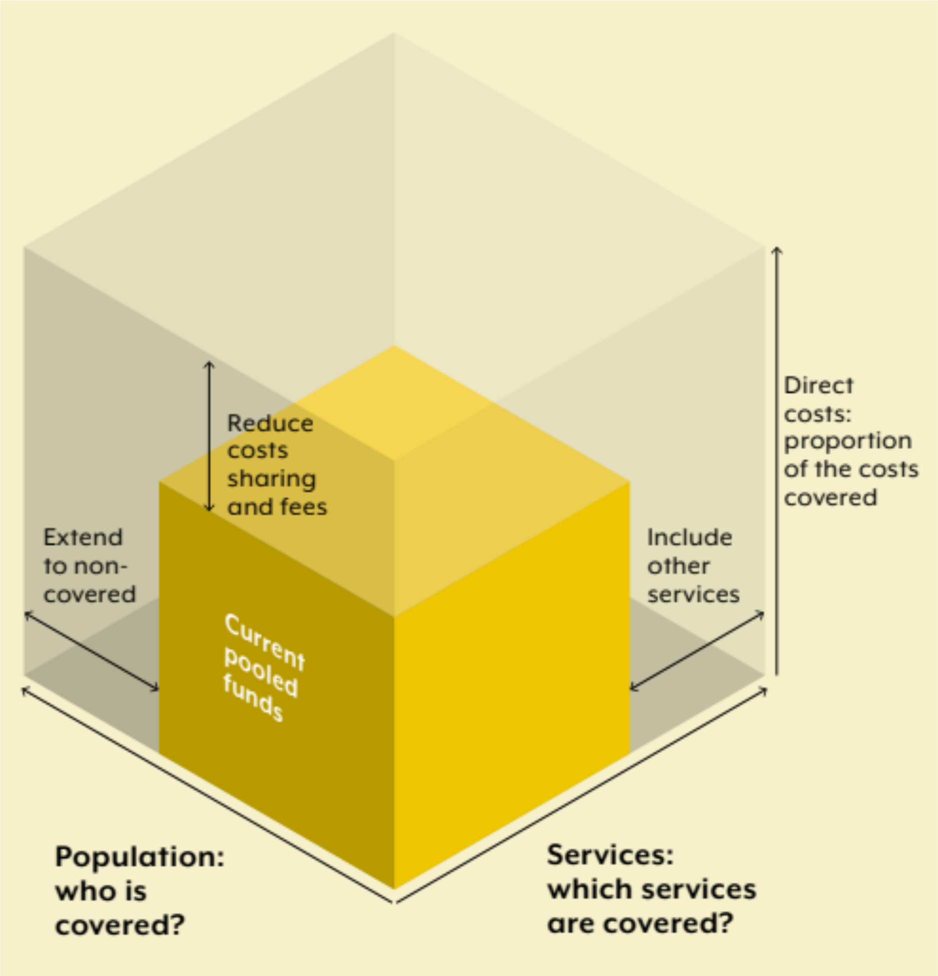
HEIDELBERG ENGINEERING

Figure 5.1 Elements of health-care quality in the context of eye care *(5)*

Figure 5.2 Dimensions of universal health coverage *(1)*



World Health Organization

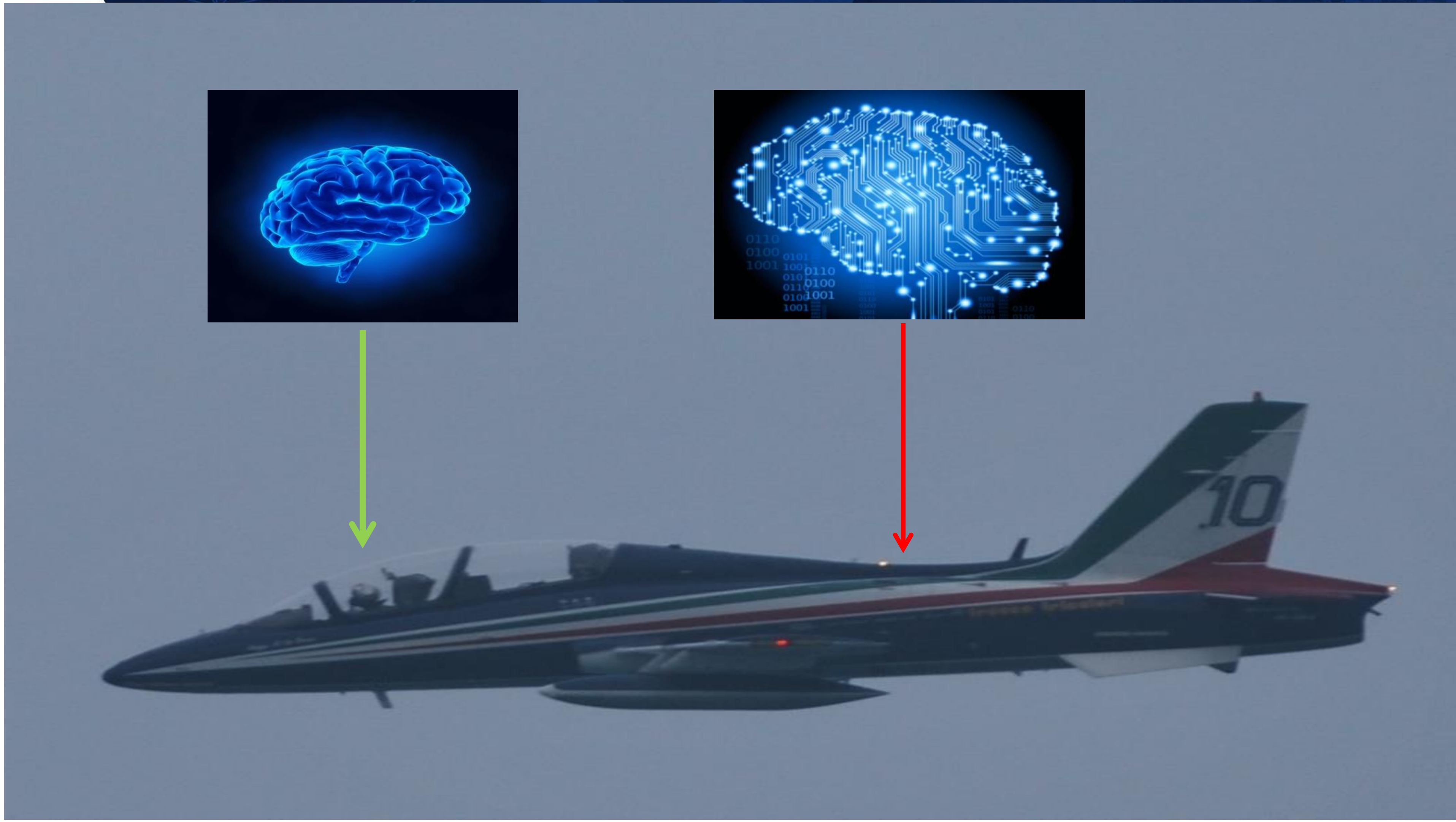
World report on vision

WORLD ECONOMIC FORUM

EMERGING TECHNOLOGIES

Responsible AI governance can be achieved through multistakeholder collaboration

Nov 14, 2023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GRAZIE

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