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Guest Editorial

The Future of Ophthalmic Diagnostics: Artificial Intelligence, Robotics and Virtual Agents

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The new quest for medical intelligence

Until the 19th century, medical intelligence, i.e. the ability to diagnose patients' condition and offer an adequate follow up and management strategy, was mostly based on experience. Individual doctors would have to see many patients and exercise their sharp mind constantly to hopefully get better with passing years.

With the industrial revolution, medical intelligence relied more on communication. Learned societies, conventions, or peer-reviewed journals made the exchange of information more intense between doctors and scientists, and eventually laid the foundations for experimental and evidence-based medicine. Sample based prospective randomized clinical trials based on painstakingly assembled medical records has become the actual universal tool to discriminate between false or true hypothesis when we intend to set new standards of care.

In the near future, however, it is anticipated that virtual or hardware machines will be entrusted to routinely collect the bulk of the subjective and objective data required to support the buildup of a new, more efficient and advanced form of medical intelligence. Sophisticated mathematical models and innovative digital processes will contribute to efficiently make sense from seemingly unrelated facts by means of artificial intelligence (A.I.) methods.

A.I. has the potential to revolutionize the way we diagnose, treat, and manage eye conditions. R&D effort in this field are much dependent on the availability of large amounts of qualitative data, or normative databases. AI algorithms can analyze images of the retina and accurately identify areas of damage, helping to detect disease earlier and more accurately. This can lead to better outcomes for patients, as well as a reduction in the workload for ophthalmologists. In ophthalmology A.I. was already successfully applied to the detection age-related macular degeneration and diabetic retinopathy.

A.I. is also quite promising for the development of personalized or more precise treatment plans for patients to improved outcome. AI algorithms can analyze comprehensive patient data, including medical history or imaging, to define a more accurate prescription or treatment strategy for each patient. This can help to improve patient outcomes.

Ariane ophthalmic suite combines artificial intelligence, robotics and virtual agents into a streamlined integrated solution to deliver advanced diagnostics, prescriptions, and surgical planning in just 6 minutes…

MIKAJAKI (Geneva) has re-engineered ophthalmic diagnostics through the integration of virtual agents, robotics, and artificial intelligence (A.I.) technologies into a streamlined solution "Ariane Ophthalmic Suite" (AOS), based on the combination of 3 complementary elements.

The "Ariane-Insight" online conversational virtual agent (SmartBot) collects patient's subjective data such as personal/family history, risk factors or symptoms as well as functional and visual tests (OSDI, Duochrome, Parent's wheel, Amsler grid, visual field, PSF keratoconus detection, Glare, Halos…).

A proprietary probabilistic engine selects the most appropriate questions based on previous patient's answers, from a bank of 600 criteria. Less than 20 questions are usually needed to predict the most probable diagnostics from 166 ophthalmic conditions.

The "EyeLib" is a self-standing, compact (footprint under 10 square feet or 2 square meter), full auto, robotized optoelectronic diagnostic station. A Registration Booth records data from an identification card or a bar code and captures the patient's 3D face identity and body morphometry to secure the transmission of medical data into the electronic medical record (EMR) and automatically adjust the height of the diagnostic station and chinrest to the patient's morphology.

A self-service full-auto wavefront analysis lensmeter records the detailed power map of patient's prescription lenses.

The EyeLib then uses an integrated array of 10 technologies (anterior and posterior sd-OCT including HD epithelial map of the cornea and eye biometry, RGCL, RNFL, retinography, wavefront refraction and aberrometry, anterior and posterior elevation topography, scheimpflug analysis, retro-illumination; tonometry…) to image and measure over 100 anatomical or optical parameters of the patient's eyes, in less than 6 minutes. The station can be used as a supervised onsite self-service exam or as part of a telemedicine process.

The "SmartVision report" uses a collection of decision-making or A.I. analytic algorithms to generate a comprehensive diagnostic synthesis. The report combines subjective data from the "Ariane-InSight" virtual agent and objective data from the "EyeLib" station to provide eye healthcare professional with a higher level of ophthalmic intelligence for their patients.

A.I. powered analytics predict the most probable "symptom and signs-based" diagnostics, as well as subjective refraction prescription for glasses and contact lenses or IOL power with a much higher accuracy than conventional refractometer or formulas. Computer vision algorithms automatically identify the risk for acute angle glaucoma or keratoconus, and detect the presence of cataract, intraocular lens, ICL or posterior capsular opacification.

A decision-making algorithm applies 20 objectives rules to the full dataset to determine the best possible anterior segment surgical indication from 17 available refractive, cataract or keratoconus procedures (PRK, Lasik, Smile, ICL, toric, EDOF or MF-IOL, topoguided PTK, ICRS, XLINK…) and efficiently assist the physician in surgical planning.

Plug-in technologies to meet all 7 goals of digital ophthalmology in the daily practice

The Ariane ophthalmic suite uses cutting-edge technologies to support a comprehensive diagnostic approach and provide efficient, reliable, and accessible eye healthcare services to a broader population.

Because the full dataset generated by this integrated solution contains most of the relevant subjective and objective information required, eye healthcare professionals can benefit from the output of various A.I. algorithm generating the enhanced medical intelligence they need to manage patients with common or are ophthalmic conditions.

Ophthalmologists and eye healthcare professionals may also gain more control on patient flows and operating costs when they incorporate these "plug in" technologies into their practices.

From a public health standpoint, this unique innovative approach may be the first to fulfill all 7 goals of digital health in ophthalmology: Practical, proofed, predictive, preventive, precision, personalized, participatory.

MIKAJAKI's EyeLib is CE marked since 2021 and was already deployed for clinical use in 8 countries (France, Spain, Luxemburg, Switzerland, Singapore, Malaysia, Poland, South Africa) with distribution planned in 20 more.

MIKAJAKI's groundbreaking innovation was honored with a 2023 innovation keynote lecture award by the German Ophthalmology Congress (DOC). This recognition of our vision and achievement is a most significant step in our journey to transform eye healthcare.

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