Advancing Towards Representation of Ophthalmic Visual Field Data in OMOP CDM

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Conflicts of Interest

- Shahin Hallaj: None.
- Swarup S. Swaminathan: Sight Sciences, Ivantis, Heidelberg Engineering, Lumata Health, Abbvie, Topcon, National Institutes of Health/National Eye Institute.
- Sophia Y. Wang: None.
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- Michelle Hribar: None.
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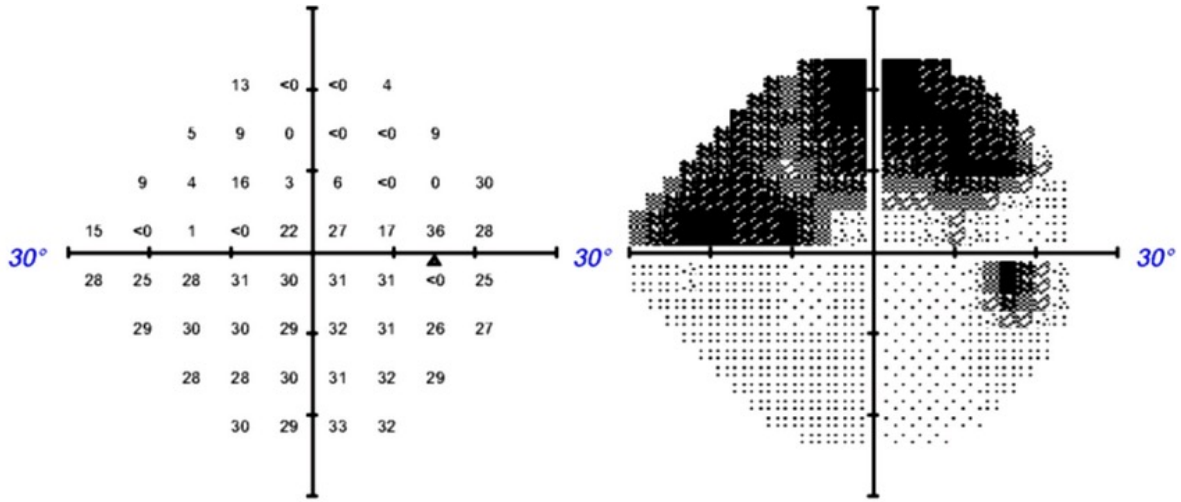
- Linda M. Zangwill: C: Abbvie Inc. Topcon F: National Eye Institute, Carl Zeiss Meditec Inc., Heidelberg Engineering GmbH, Optovue Inc., Topcon Medical Systems Inc. P: Zeiss Meditec AISight Health (cofounder and board member).
- Robert N. Weinreb: C: Abbvie, Aerie Pharmaceuticals, Allergan, Equinox, Iantrek, Implandata, Nicox, Topcon Medical F: Bausch & Lomb, Topcon Medical, Heidelberg Engineering, Carl Zeiss Meditec, Optovue, Centervue P: Toromedes, Carl Zeiss Meditec.
- Sally L. Baxter: Financial Support (F) – Optomed, Topcon.

Introduction



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Patient Identifiers

Single Field Analysis | PRE-LAUNCH EVALUATION SOFTWARE. | Eye: Right

Name: | DOB:

ID:

Parameters: Central 24-2 Threshold Test

Stimulus

Reliability Indices

Fixation Monitor: Gaze/Blind Spot | Stimulus: III, White | Pupil Diameter: 4.6 mm | Date: 01-31-2011

Fixation Target: Central | Background: 31.5 ASB | Visual Acuity: | Time: 2:16 PM

Fixation Losses: 1/13 | Strategy: SITA-Standard | RX: -0.50 DS DC X | Age: 23

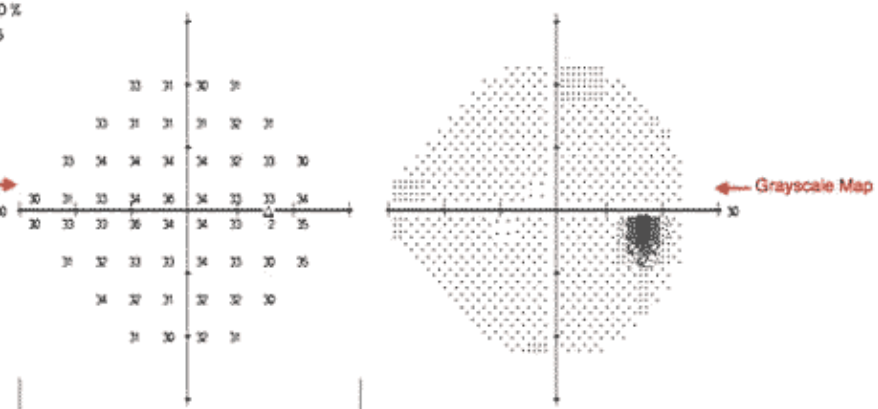
False POS Errors: 1 %

False NEG Errors: 0 %

Test Duration: 04:26

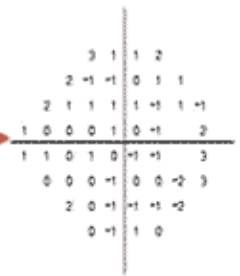
Fovea: 36 dB

Numerical Sensitivity Plot

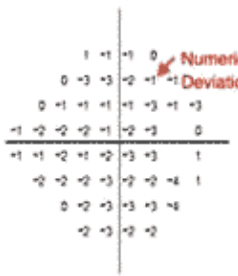


Grayscale Map

Numerical Total Deviation Map



Numerical Pattern Deviation Map



GHT — Glaucoma Hemifield Test

Within normal limits

VFI 100%

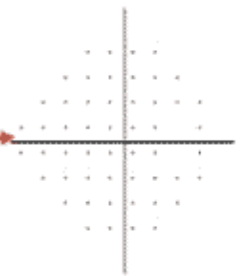
MD +0.28 dB — Mean Deviation

PSD 1.21 dB — Pattern Standard Deviation

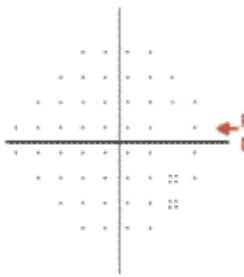
Total Deviation

Pattern Deviation

Probability Total Deviation Map



Probability Pattern Deviation Map



:: < 5%

Ø < 2%

▒ < 1%

■ < 0.5%

Visual Field Laboratory
University of Iowa
College of Medicine
Iowa City, IA
(319) 356-1611

Gaze Tracker

HFA II 750-10127-4.2/4.2

GPA - Resumen | Ojo: Izquierdo

Nombre: | FDN: 16-08-1928

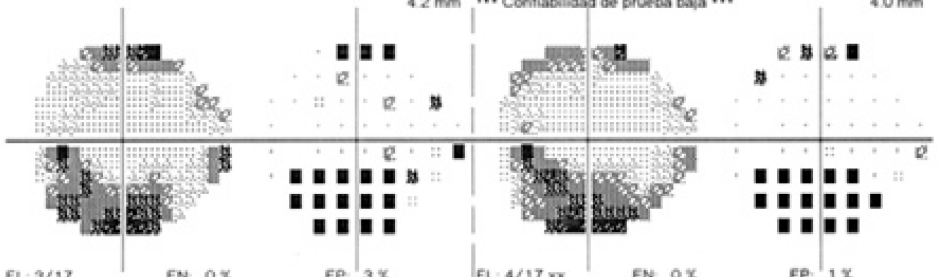
ID:

Valores iniciales: SITA-Standard | Central 24-2 Prueba de umbral

Tonos grises | Desviación del modelo | Tonos grises | Desviación del modelo

03-05-2002 PHG: Fuera de límites normales | 07-10-2002 PHG: Fuera de límites normales

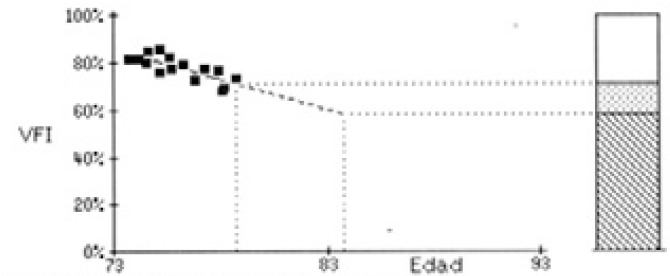
4.2 mm | *** Confiabilidad de prueba baja *** | 4.0 mm



FL: 3/17 FN: 0 % FP: 3 % | FL: 4/17 xx FN: 0 % FP: 1 %

Foveal: APAGADO DM: -8.13 dB P < 0.5% | Foveal: APAGADO DM: -8.20 dB P < 0.5%

VFI: 81% DSM: 8.39 dB P < 0.5% | VFI: 81% DSM: 8.86 dB P < 0.5%



Tasa de progresión: -2.5 ± 1.2 %/año (95% confidencial)

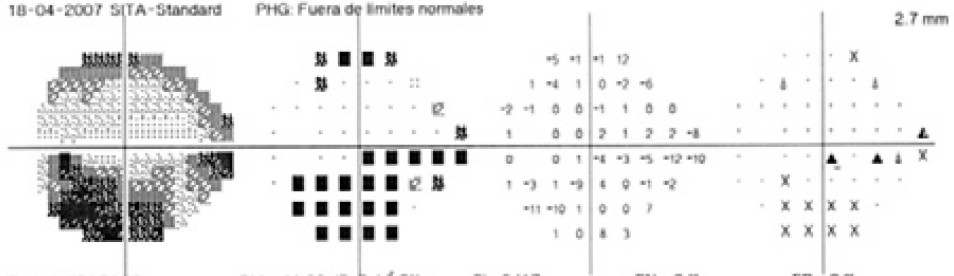
Desviación significativa en P < 0.1%

Seguimiento — Ver copia impresa de GPA completa para análisis completo

Tonos grises | Desviación del modelo | Desviación de los valores iniciales | Análisis de progresión

18-04-2007 SITA-Standard PHG: Fuera de límites normales

2.7 mm



Foveal: APAGADO DM: -11.30 dB P < 0.5% FL: 2/17 FN: 8 % FP: 0 %

VFI: 73% DSM: 8.94 dB P < 0.5% Progresión posible

Exámenes de seguimiento anteriores:

22-09-2006 06-10-2006

:: < 5% ↓ P < 5% deterioro

Ø < 2% ◢ P < 5% (2 consecutivos)

▒ < 1% ▲ P < 5% (3+ consecutivos)

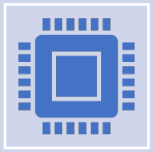
■ < 0.5% X Fuera de rango

Notas:

HFA II 750-11389-4.2

Introduction

The endpoint of clinical glaucoma care is to preserve vision and minimize visual field loss.



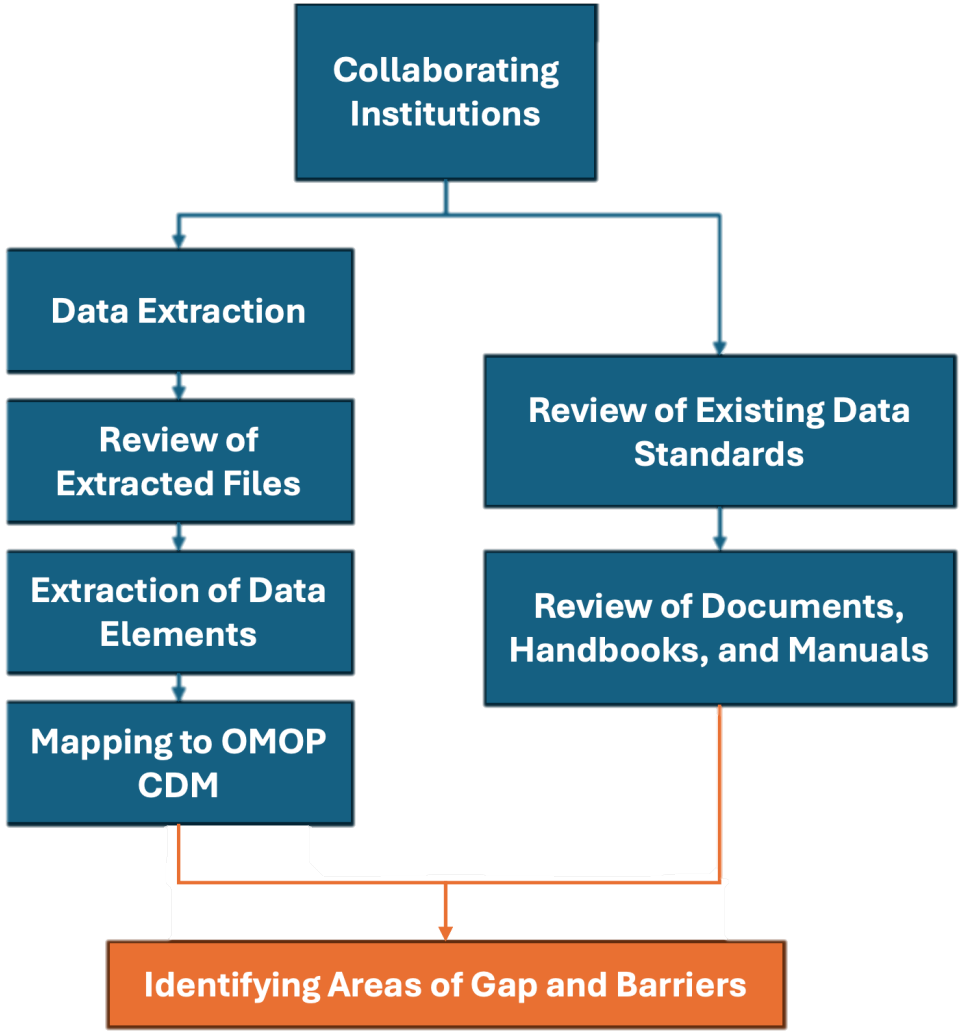
This data is not available in “big data”

e.g., *All of Us*, institutional EHR data warehouses, Epic Cosmos

Enhancing data harmonization and interoperability will facilitate clinical research and, ultimately, patient management.

Methods

- Multi-institutional approach to data extraction from perimeter devices
- Review of:
  - Different methods for extracting data elements
  - Device manuals, handbooks, OPV DICOM supplement, and DICOM conformance documents by the companies
  - Reports and exported raw files and reports
  - Representation of identified data elements in OMOP CDM.



Institutions

- Shiley Eye Institute
- Bascom Palmer Eye Institute
- Byers Eye Institute
- Roski Eye Institute
- Wills Eye Hospital
- Mass Eye and Ear
- John Moran Eye Center
- National Eye Institute
- Casey Eye Institute
- Columbia University Irving Medical Center
- University of Washington

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Devices

Zeiss
Humphrey
Visual Field
Analyzer

Haag-Streit
Octopus 900
Perimeter

Identified Issues: Data Export Methods

There is no standardized extraction method from the devices.

- Data is extractable from HFA using an advanced export tool or directly from the devices.
- Yielded file formats included:
  - PDF encapsulated DICOM
  - Raw DICOM
  - XML
  - OPV DICOM

- Data export from Haag-Streit requires the involvement of the company representative to grant access.
- No user interface
- Yielded file format:
  - CSV

HFA: Humphrey Visual Field Analyzer
OPS: Octopus

Identified Issues: OPV DICOM Standard Adoption

Digital Imaging and Communications in Medicine (DICOM)

Supplement 146

Ophthalmic Visual Field (OPV) Static Perimetry Measurements Storage SOP Class

HAAG-STREIT DIAGNOSTICS

Tradition and Innovation

EyeSuite™ i8.2.x.x

DICOM Conformance Statement

Version 7, October 2016

Revision: 01
Date: 05.07.2021

ZEISS

DICOM Conformance Statement

Glaucoma Workplace Version 3.6

Carl Zeiss Meditec AG

Goeschwitzer Strasse 51-52

07745 Jena

Germany

www.zeiss.com/med

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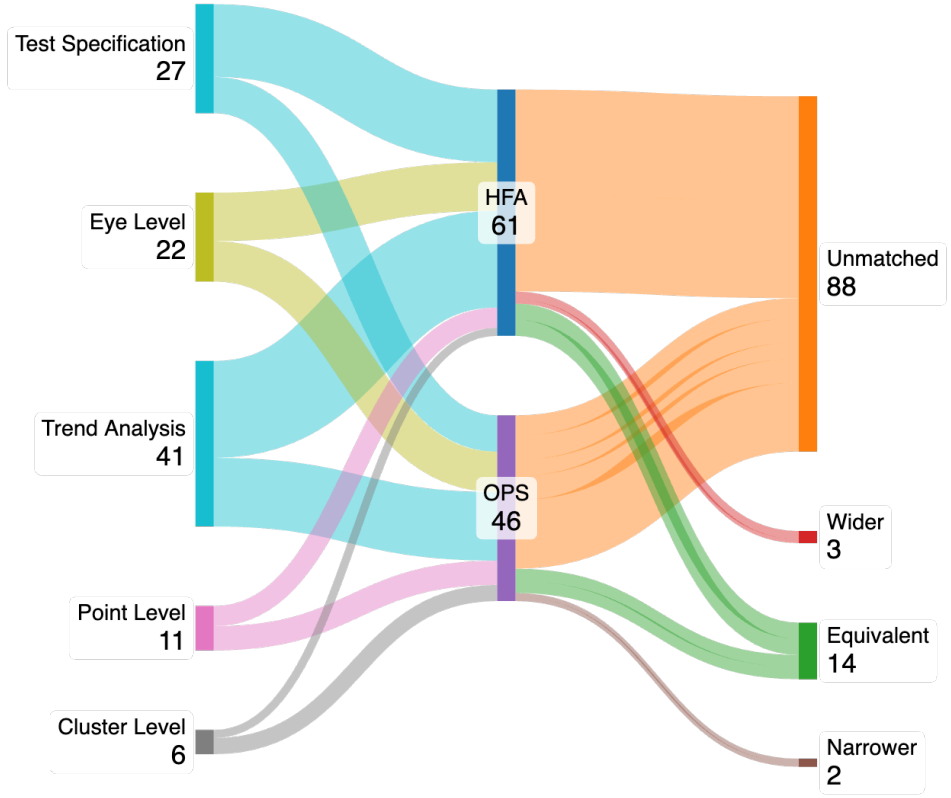
Identified Issues: Non-comparable Data Elements

- Although the concepts examined by HFA and OPS are the same, the only comparable data elements are sensitivity losses (pattern deviation probability map).

- Mostly due to differences in:
  - Maximum stimulus luminance used (OPS:4,000 asb, HFA: 10,000 asb)
  - Device-specific normative databases
  - For mean defect vs. mean deviation: HFA algorithms assign more weight to the central points, whereas OPS weights all the points similarly
  - Test location coordinates

HFA: Humphrey Visual Field Analyzer
OPS: Octopus

Identified Issues: Limited Concept Coverage Within The OMOP CDM



Scan for a Complete List of Data Elements

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Why OPV files?

File type	Bulk/test	Pixel Array	Structured PDF Report	DICOM Tags for Global Metrics	DICOM Tags for Pointwise Metrics	Pointwise Metric Presentation Format	Advantage	Disadvantage
Bulk XML	Bulk	No	No	Yes	Yes	Nested XML Tags	Detailed Pointwise Metrics, Bulk data	No Pixel array, limiting clinical use, old, not available at every center, will not be available in the future as it is a dying format
Single Test XML	Test	No	No	Yes	Yes	Nested XML Tags	Detailed Pointwise Metrics	No Pixel array
Raw DICOM	Test	No	No	No	No	NA	Easy Transfer of Raw Test Data (i.e., without any secondary analysis and metric calculation) Between Different HFA devices	No Useful Global or Pointwise information, No Pixel Array
OPV DICOM	Test	No	No	Yes	Yes	Nested DICOM Tags	Existing tags are vendor neutral, can incorporate data from variety of sources, detailed pointwise metric, digital pointwise data	Tags are named differently from xml files, can be confusing for some, no pixel data per se
DICOM encapsulated PDF	Test	Yes	Yes	Yes	No	Pixel/PDF	Carries structured PDF report + some meta data, may be useful for interoperability (i.e., automatic transfer of some metadata into the EHR such as MD + ability to view PDF using compatible PACS.	Pointwise data is transferred as pixel data not as DICOM attribute, should be parsed separately.
Structured PDF Report	Test	Yes	Yes	No	No	Pixel/PDF	Compatible with PACS systems, can be opened using a basic pdf viewer	Pointwise data is transferred as pixel data not as DICOM attribute, should be parsed separately, No DICOM attribute

Zeiss Humphrey

Why OPV files?

File type	Bulk/test	Pixel Array	Report PDF	DICOM Tags for Global Metrics	DICOM Tags for Pointwise Metrics	Pointwise Metric Presentation Format	Advantage	Disadvantage
OPV DICOM	Test	No	No	Yes	Yes	Nested DICOM Tags	Detailed Pointwise Metrics, Bulk data	No Pixel Data, limiting clinical use, old, not available at every center, will not be available in the future as it is a dying format, Needs DICOM license
CSV	Bulk	No	No	No	No	Columns in a table	CSV Format, Bulk Data, Includes normative values	No Pixel Array, No Ps for pointwise data
ESX	Test	No	No	No	No	Nested XML Tags	An XML object written within a binary file; pointwise data is embedded and encoded in the “<ExaminationXml>” tag	No Useful Global or Pointwise Info, No Pixel Data
Structured PDF Report	Test	Yes	Yes	No	No	Pixel Array	Compatible with PACS systems, can be opened using a basic pdf viewer	Pointwise data is transferred as pixel data not as DICOM attribute, should be parsed separately, No DICOM attribute

Haag Streit Octopus

Proposed New LOINCs in Close Alignment with DICOM

Submission Set ID 7333

ID	Reference ID	Status
70331	OPV DCM	Pending
70332	OPV DCM	Pending
70333	OPV DCM	Pending
70334	OPV DCM	Pending
70335	OPV DCM	Pending
70336	OPV DCM	Pending
70337	OPV DCM	Pending
70338	OPV DCM	Pending
70339	OPV DCM	Pending
70340	OPV DCM	Pending
70341	OPV DCM	Pending
70342	OPV DCM	Pending
70343	OPV DCM	Pending
70344	OPV DCM	Pending
70345	OPV DCM	Pending
70346	OPV DCM	Pending
70347	OPV DCM	Pending
70348	OPV DCM	Pending
70349	OPV DCM	Pending

PyOPV

- Published on PyPI:
  - pypi.org/project/pyopv/
- Developed using sample files from 3 vendors:
  - Haag Streit
  - Zeiss
  - Olleeyes
- Internally validated at Shiley
- External validation in progress at Mass Eye and Ear

Group	Function Name	Description
Read DICOM File	read_dicom	Reads a single DICOM file
	read_dicom_directory	Reads all the DICOM files in the desired dicrectory
DICOM Compliance	get_dicom_standard	Gets the latest DICOM standards and writes it into a CSV file that contains all the possible modules and attributes around SAP
	check_dicom_compliance	Checks for missing tags and generates reports for directories or single files
DICOM Conversion	to_pandas	converts a DICOM file to a pandas dataframe
	to_pandas	Bulk extracts data from DICOM files and converts them into a big pandas data frame that can be used for further analyses down the road
	to_json_dict	converts a DICOM file to a JSON resource
	pointwise_to_pandas	Extracts pointwise data from the DICOM file and converts it to a pandas dataframe
	pointwise_to_nested_json	Extracts pointwise data from the DICOM file and converts it to a nested JSON resource

DICOM Compliance

Vendor	Number of Missing OPV DICOM Attributes [%] (N total = 123)	Number of Missing Required OPV DICOM Attributes [%] (N total = 102)
1	67 [55%]	52 [51%]
2	47 [38%]	32 [31%]
3	32 [26%]	17 [17%]

Thank you!

OHDSI Eye Care Glaucoma Subgroup

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