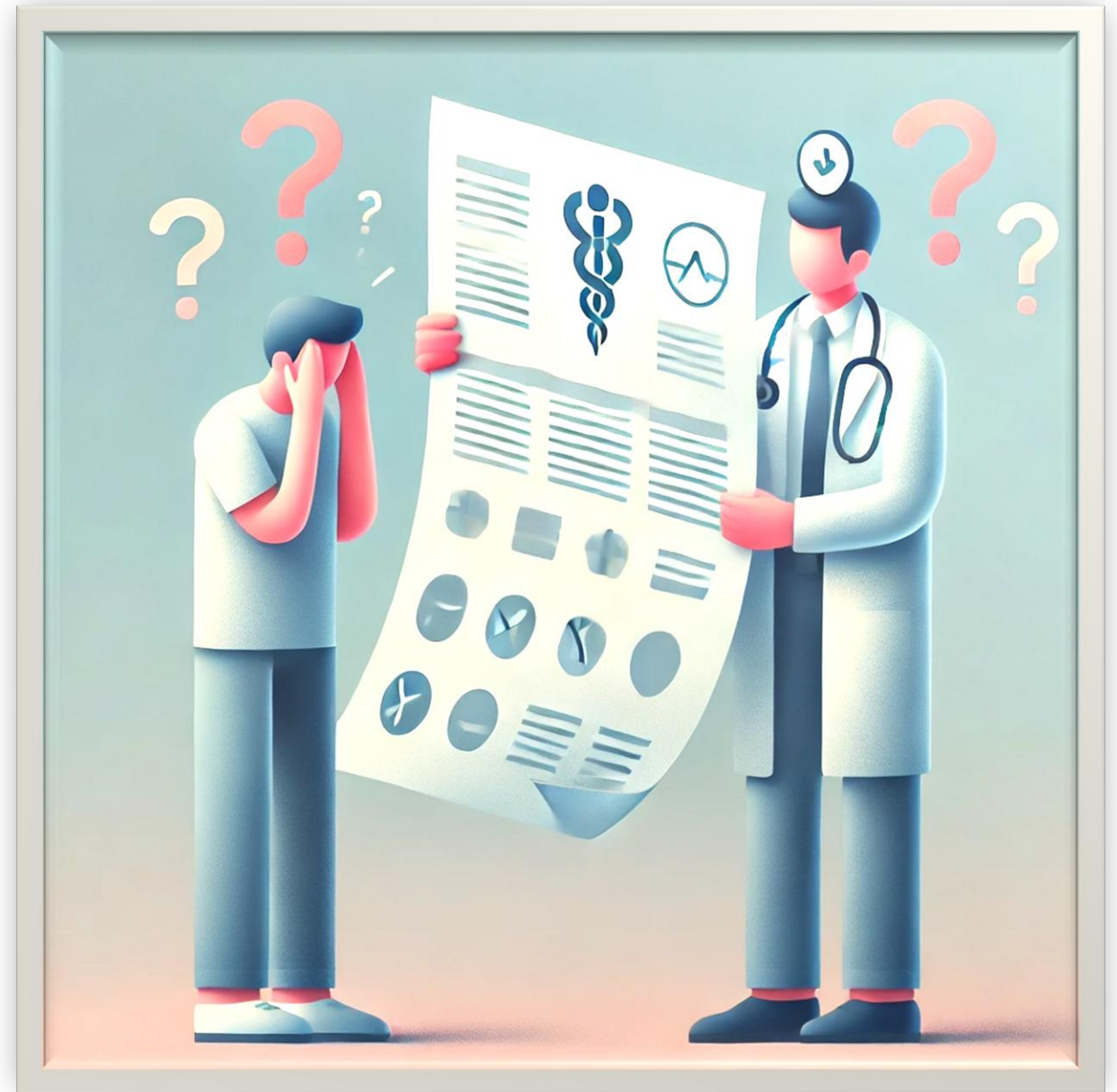


Patient Friendly Letter

Clear communication and inclusion through the power of AI

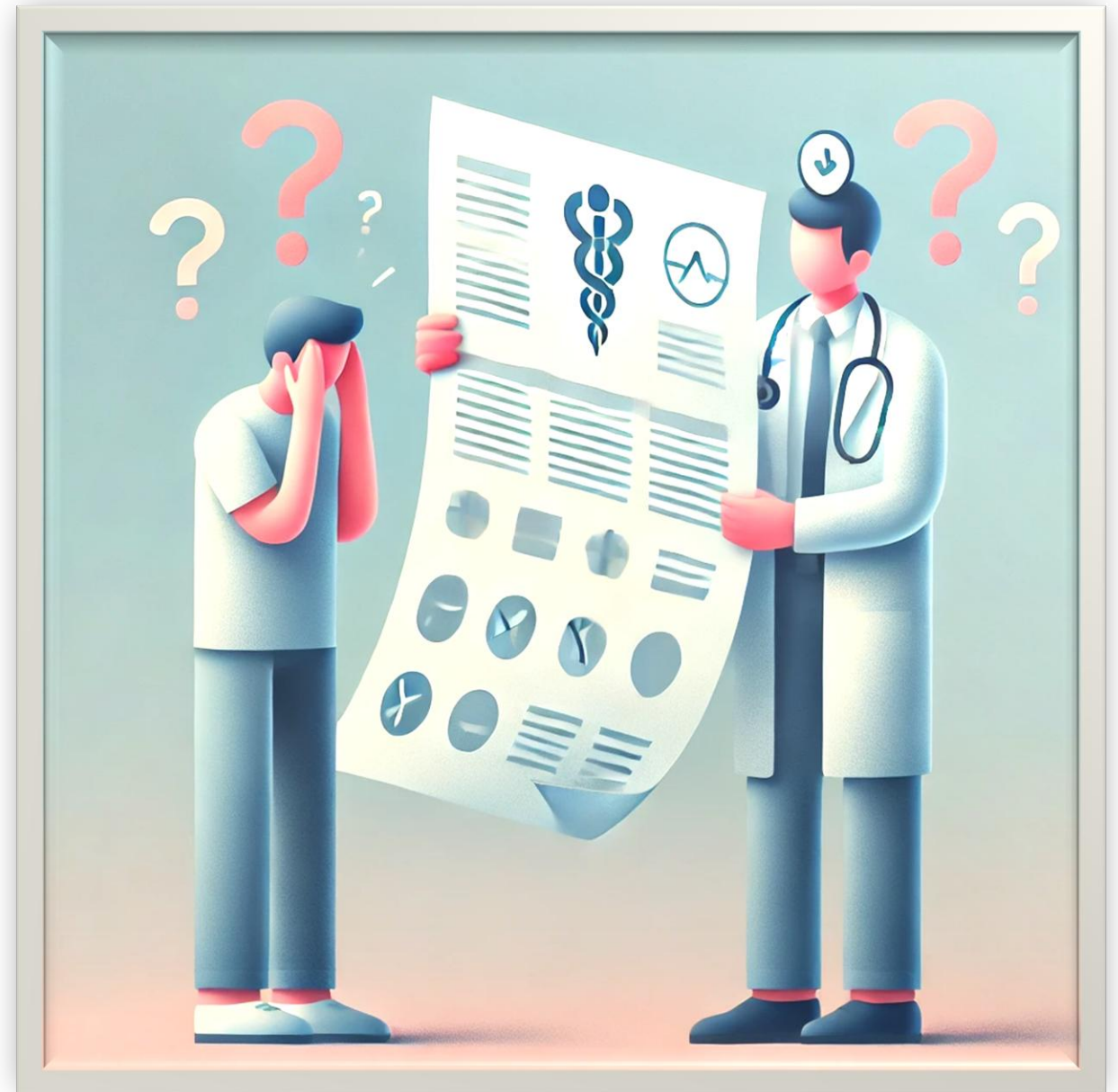
Mark Helbert

ZAS, Antwerp, Belgium



Problem ?

Medical letters are full of
Medical Jargon
and their Structure is not
Patient-Friendly



Problem ?

Medical letters are full of
Medical Jargon
and their Structure is not
Patient-Friendly

ZAS_NEFRO_KLT_4.docx

Pt 1005184476

Dit betreft een definitieve ontslagbrief.

04 december 2023

Geachte collega

PATIENT was opgenomen van 22-11-2023 tot en met 04-12-2023 op de afdeling Nefrologie in ZNA Middelheim in verband met **PJP** bij niertransplant.

Reden van komst / Verwijzing

Opname vanuit raadpleging nefrologie wegens algemene **malaise**.

Actieve diagnoses

1/12/2023 anemie - multifactorieel

24/11/2023 **pneumocystose door Pneumocystis jiroveci**

12/07/2023 **hypomagnesiëmie** - (multifactorieel oa PPI - doch nood aan PPI ivm **maaglast -> Mg substitutie**)

2015 niertransplantatie - derde niertransplantatie

2010 diabetes mellitus - **NODAT**

2016 uitslag van biopsie van nier **borderline** afwijkend - **Beperkt oplopende DSA klasse II HLA AS gericht tegen laatste donor 157286 [anti-DPB1*04, 01 MFI 700, vroeger MFI 300]. R/ lom Tx-centrum opdrijven Tacrolimus dalstreefwaarde van 7-8 µg/L naar 9-10 µg/L en opdrijven MMF van 250 mg 2x/d naar 250 mg 3x/d onder strikte CMV PCR opvolging.**

2016 **viremie** door cytomegalovirus - **CMV reactivatie met pancytopenie ww Valcyte** zonder daling virale load **ww Ganciclovir IV** via thuis therapie. Labo toont **geen Ganciclovir resistentie**. Nadien nabehandeling met Valcyte.

2013 **getransponeerde arterioveneuze fistel** tussen arteria brachialis en vena basilica

2010 afstoting van niertransplantaat - **humorale rejectie**. Geen response op anti-rejectietherapie

2010 infectie door polyomavirus - Sterk positieve polyoma BK **viremie**, bij zwakkere **virurie**. Niet bevestigd bij controle 11/05/2010.

2010 niertransplantatie - tweede lijkenniertransplantatie. Rechter nier in rechter **fossa**. **Mismatchen 0 in A, 1 in B, 1 in DR. CMV D+, R-**. Initiële

immunosuppressie: **ATG (PRA 80%), corticosteroiden, cyclosporine en MMF**. **Onderhoudstherapie cyclosporine, MMF, corticosteroiden.**

2009 **nefrectomie** van getransplanteerde nier

2008 immunosuppressietherapie voor transplantaat - **Switch van Sirolimus/Cellcept** naar **Imuran/Cyclosporine** gezien kinderwens

Problem ?

Medical letters are full of Medical Jargon and their Structure is not Patient-Friendly

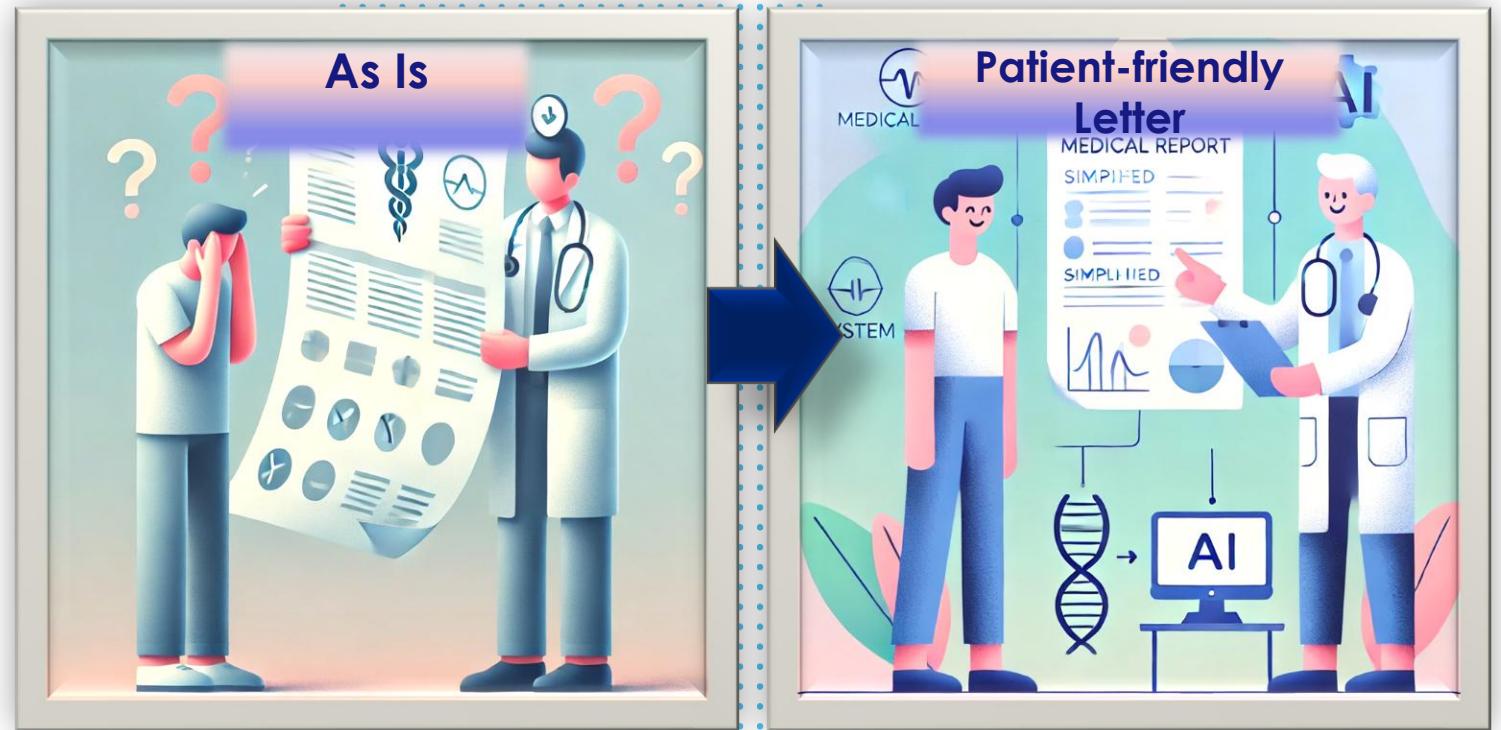
A lack of understanding impacts both individual patients and the broader (macro) level

	Patient	Population
• Therapy Compliance	⊘	⊘
• Preventive Measures	⊘	⊘
• Health Literacy	⊘	⊘
• Effectiveness of Care	⊘	⊘

Solution ?

“Patient Friendly Letter”

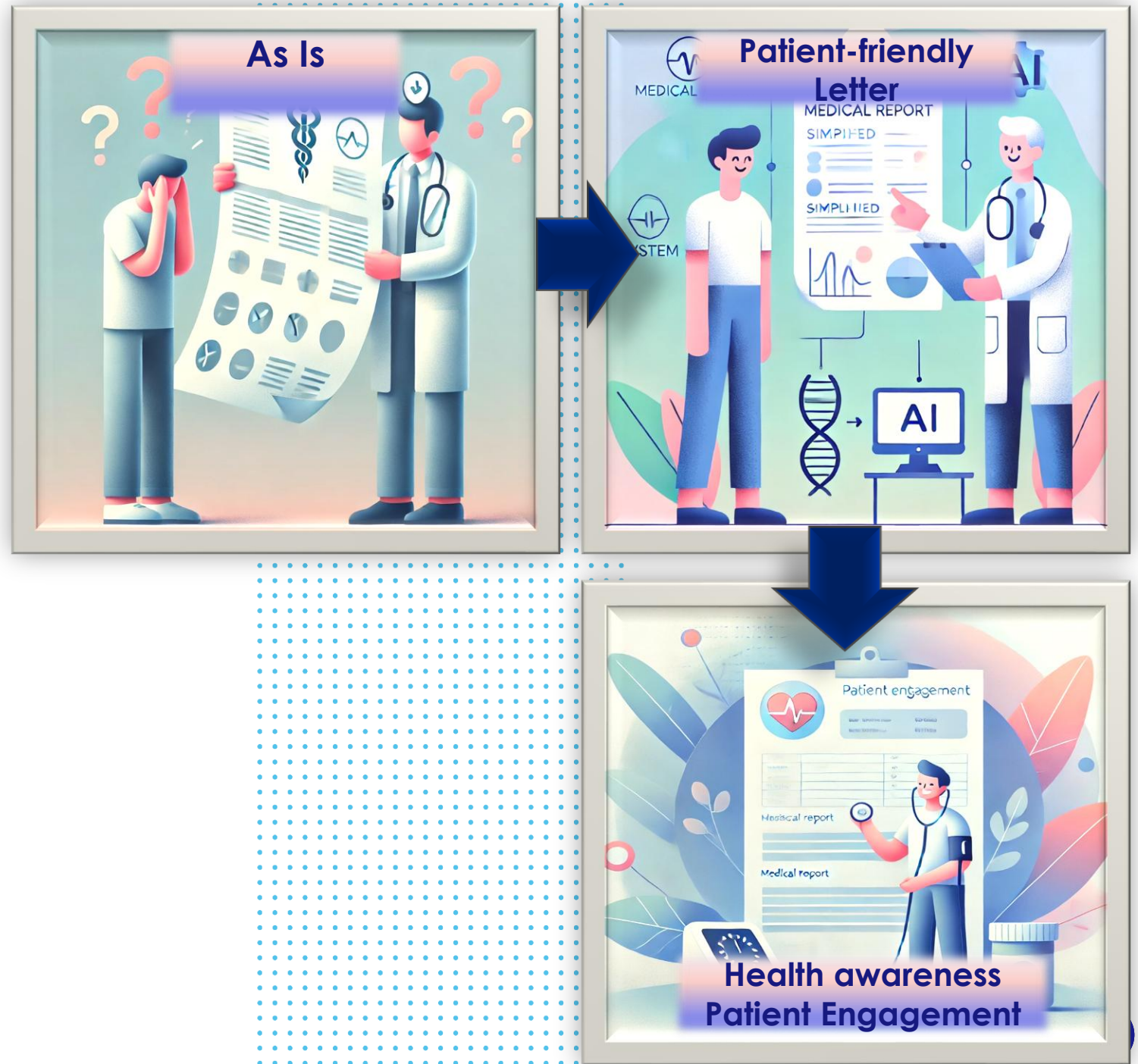
- Translation into patient-centered language
- Safe-by-design
- Fully embedded within the Health Ecosystem



Solution ?

“Patient Friendly Letter”

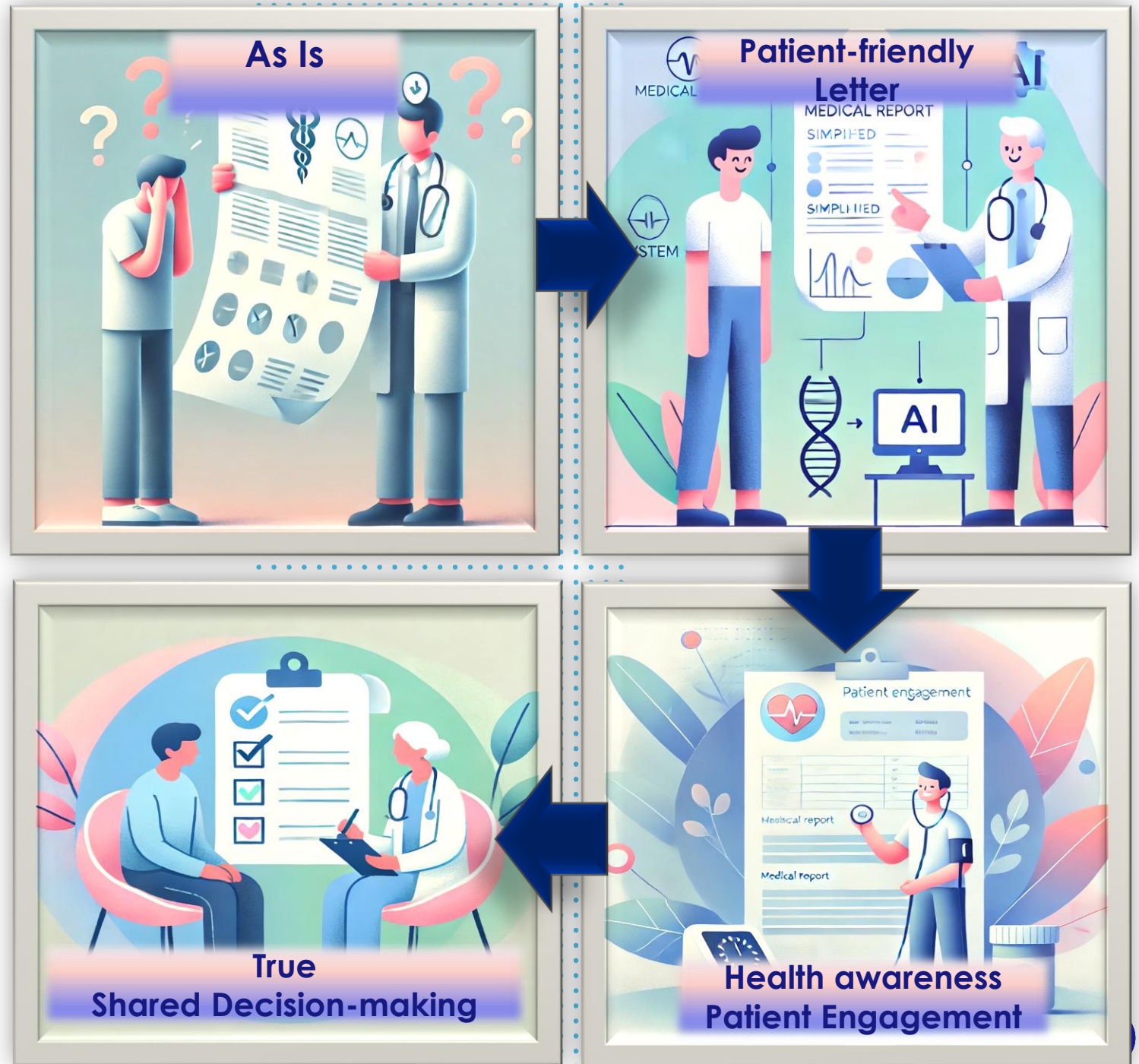
- Health Awareness
- Patient Engagement



Solution ?

“Patient Friendly Letter”

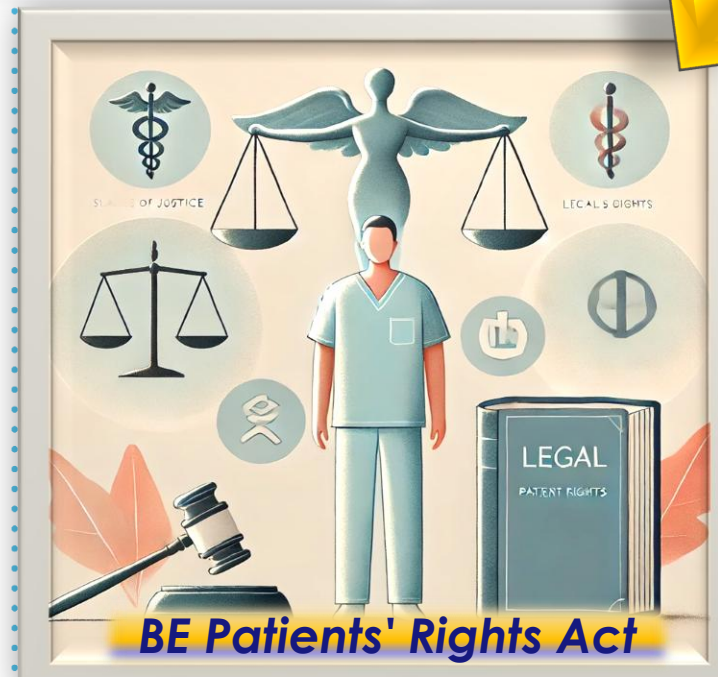
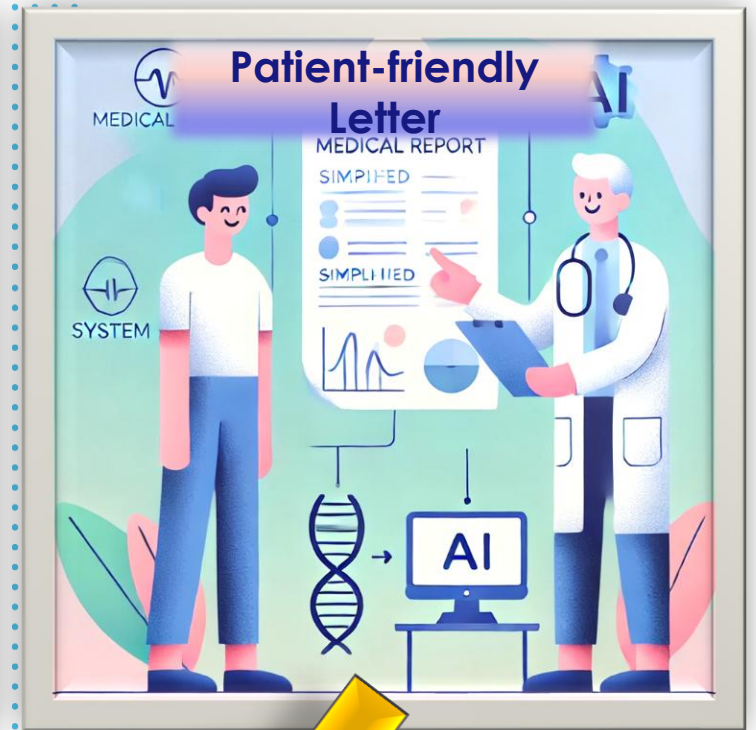
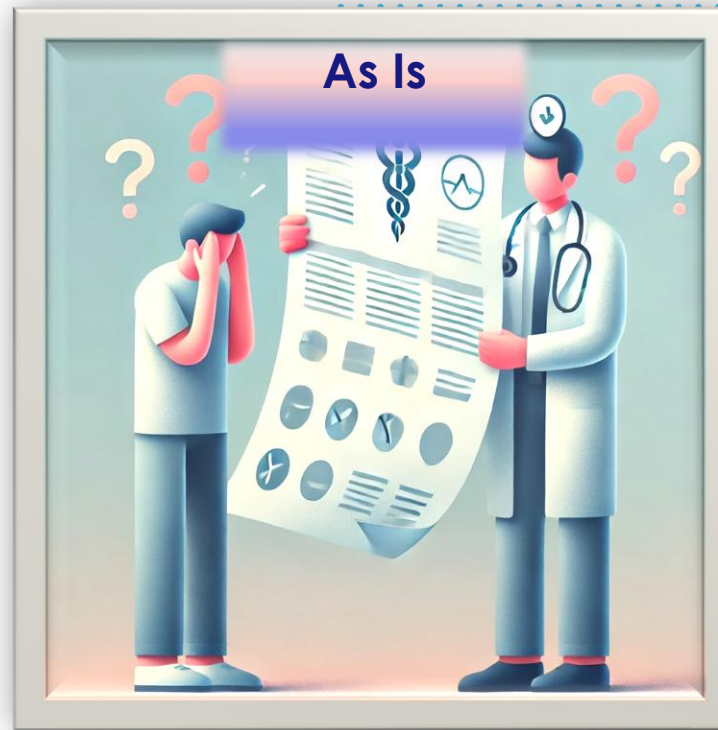
- Health Awareness
- Patient Engagement
- Shared Decision Making



Solution ?

“Patient Friendly Letter”

- Health Awareness
- Patient Engagement
- Shared Decision Making
- Compliance with Be. Patient Rights Act



Pathway – Project 5 Tracks & 3 BE Hospitals



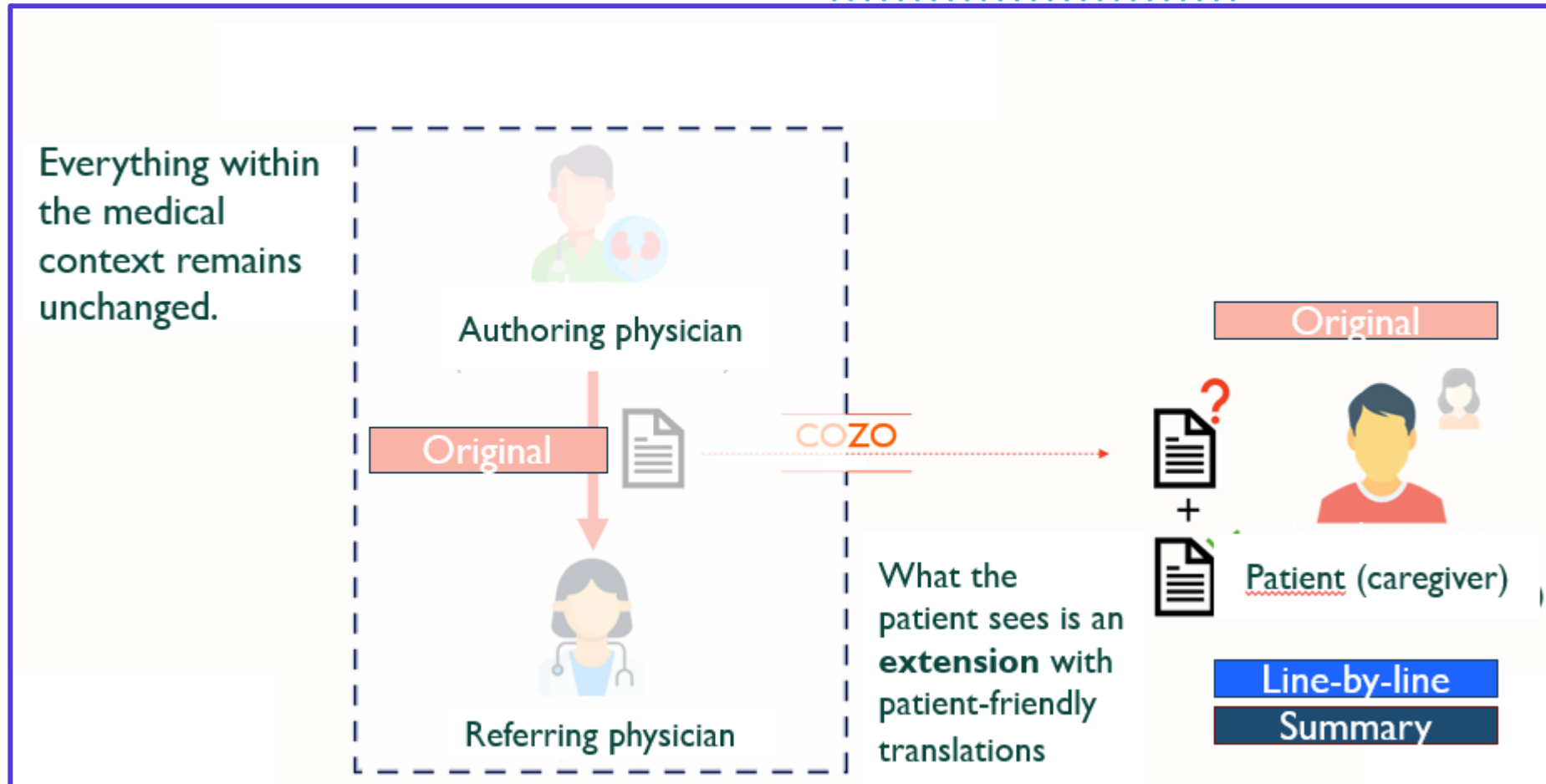
Solution Design?

Requirements defined
by multidisciplinary
team

- Patient representatives
- Language experts
- Physicians
- Technology experts

- **Gen. AI solution** that converts medical documents (consultation/discharge letters) into patient-friendly language, i.e. **CERF-B1 language level** (80% inclusion)
- **2 translation variants** (Line-by-Line, Summary), supplemented with list of complex medical terms and Medications + explanations
- **Three languages** (Dutch, French, English) – according to patient preference
- Solution applicable **to different medical specialities**
- Translations can be found via **(public) health portals**
- **Solution Compliant with Legislation** (GDPR, MDR and AI act) & evaluated against an AI-Ethical Framework

Conceptual Set Up



Solution Design?

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Solution Output

The image displays a sequence of five document thumbnails, each representing a different level of text simplification for a patient-friendly letter. Below each thumbnail is a colored label indicating the type of output:

- Original:** The first thumbnail shows the original, dense text of the letter.
- Line-by-line:** The second thumbnail shows the text with line-by-line simplifications, where complex sentences are broken down into simpler ones.
- Summary:** The third thumbnail shows a summary of the letter's key points.
- Glossary/:** The fourth thumbnail shows a glossary of terms used in the letter.

Solution Output



Transparency Obligation

- Transparency on the use of AI
- Transparency on limitations and risks



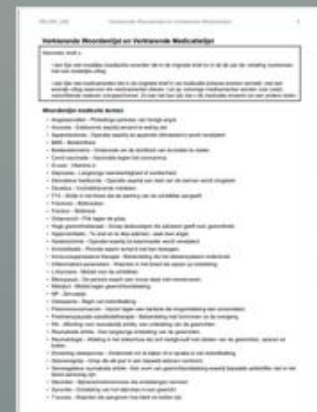
Original



Line-by-line

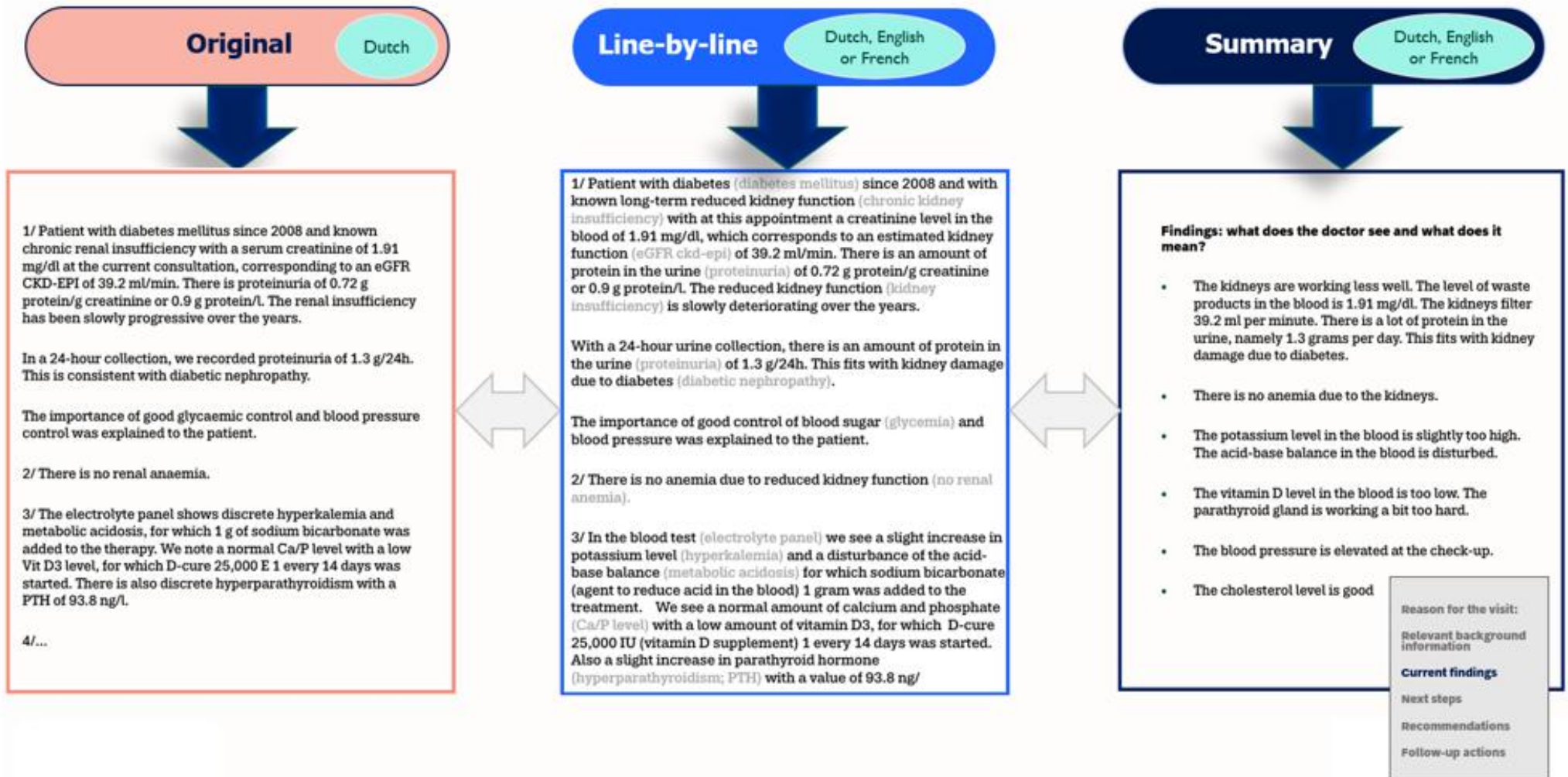


Summary



Glossary/Meds

Solution Output



Line-by-line

Dutch, English
or French

Solution Output

1/ Patient with diabetes (*diabetes mellitus*) since 2008 and with known long-term reduced kidney function (*chronic kidney insufficiency*) with at this appointment a creatinine level in the blood of 1.91 mg/dl, which corresponds to an estimated kidney function (*eGFR ckd-epi*) of 39.2 ml/min. There is an amount of protein in the urine (*proteinuria*) of 0.72 g protein/g creatinine or 0.9 g protein/l. The reduced kidney function (*kidney insufficiency*) is slowly deteriorating over the years.

With a 24-hour urine collection, there is an amount of protein in the urine (*proteinuria*) of 1.3 g/24h. This fits with kidney damage due to diabetes (*diabetic nephropathy*).

The importance of good control of blood sugar (*glycemia*) and blood pressure was explained to the patient.

2/ There is no anemia due to reduced kidney function (*no renal anemia*).

3/ In the blood test (*electrolyte panel*) we see a slight increase in potassium level (*hyperkalemia*) and a disturbance of the acid-base balance (*metabolic acidosis*) for which sodium bicarbonate (agent to reduce acid in the blood) 1 gram was added to the treatment. We see a normal amount of calcium and phosphate (*Ca/P level*) with a low amount of vitamin D3, for which D-cure 25,000 IU (vitamin D supplement) 1 every 14 days was started. Also a slight increase in parathyroid hormone (*hyperparathyroidism; PTH*) with a value of 93.8 ng/

Solution Output

Summary

Dutch, English
or French

Findings: what does the doctor see and what does it mean?

- The kidneys are working less well. The level of waste products in the blood is 1.91 mg/dl. The kidneys filter 39.2 ml per minute. There is a lot of protein in the urine, namely 1.3 grams per day. This fits with kidney damage due to diabetes.
- There is no anemia due to the kidneys.
- The potassium level in the blood is slightly too high. The acid-base balance in the blood is disturbed.
- The vitamin D level in the blood is too low. The parathyroid gland is working a bit too hard.
- The blood pressure is elevated at the check-up.
- The cholesterol level is good

Reason for the visit:

Relevant background information

Current findings

Next steps

Recommendations

Follow-up actions

Solution Output Evaluation



Findings & Results

Not everything is suitable for patient friendly translation

e.g. Technical Reports (lab, ECG) – often source of error

e.g. Medication Schedules – inherent risk of misinterpretation

both were excluded from the translation (*Safe-by-design principle*)

Bijkomende onderzoeken:
LABO (13/02/2027) - ELECTR ORDER, NON-CONFORMITEITEN, HEMATOLOGIE, CHEMIE, IONOGRAM, IMMUNOLOGIE, HORMONOLOGIE, VITAMINEN, URINE, 24 UURS URINE

[S
ELECTR ORDER
Electronisch order dummy Extra aanvraag ontvangen
NON-CONFORMITEITEN
Non-conformiteit Afname niet conform volgens aanvraag
HEMATOLOGIE

RBC	5.2	4.4-5.5 10 ⁶ /mm ³
Hemoglobine	15.6	13.0-17.0 g/dL
Hematocriet	46	40-50 %
MCV	88	76-96 fL
MCH	30	27-32 pg
MCHC	34	31-37 g/dL
WBC	5.07	3.60-11.82 10 ³ /mm ³
Trombocyten	190	140-440 10 ³ /mm ³
MPV	10.8	9.3-12.7 fL
Formule		
Immature granulocyten	0.2	<2.0 %
Neutrofielen	69.2	36.9-73.3 %
Eosinofielen	2.2	0.2-7.7 %
Basofielen	0.6	0.2-1.1 %
Lymfocyten	18.7	14.5-50.2 %
Monocyten	9.1	4.9-14.3 %
Neutrofielen abs.w	3.51	1.50-8.40 10 ³ /mm ³
Eosinofielen abs.w	0.11	0.02-0.57 10 ³ /mm ³
Basofielen abs.w	0.03	0.01-0.08 10 ³ /mm ³
Lymfocyten abs.w	L 0.95	1.02-3.55 10 ³ /mm ³
Monocyten abs.w	0.46	0.26-1.07 10 ³ /mm ³

Medicatie:
Gevalideerd door Dr. Dr XXX op 6/03/2027 11:15:13

22u		8u	12u	18u
PANTOMED 20 MG (COMPR EC)	elke dag (1)	(*)	(*)	(*)
(*)				
(*)Tijdstippen: 7u:1				
SYMBICORT 160/4,5 MCG (AER120 DOS)	indien nodig			
Indicatie: kortademigheid, Maximum per keer: 1 DOSIS, Maximum: 1 DOSIS				

Findings & Results

Seven types of LLM errors were identified and had to be eliminated through prompt adjustments

(90% reduction)

- **Implicit Clinical Attribution**
- **Medication Misinterpretation**
- **Action-Holder Confusion**
- **Contextual Misframing**
- **Chronological Distortion**
- **Inference from Silence**
- **Correction-Induced Semantic Shift**
- **Content Redundancy**

	Iteration 1 (n = 19)			Iteration 2 (n = 19)			Iteration 3 (n = 31)		
Mean % Letters Affected (Across Categories)			22%			5%			2%

Findings & Results

Insufficient Lay Adaptation

(Mainly abbreviations)

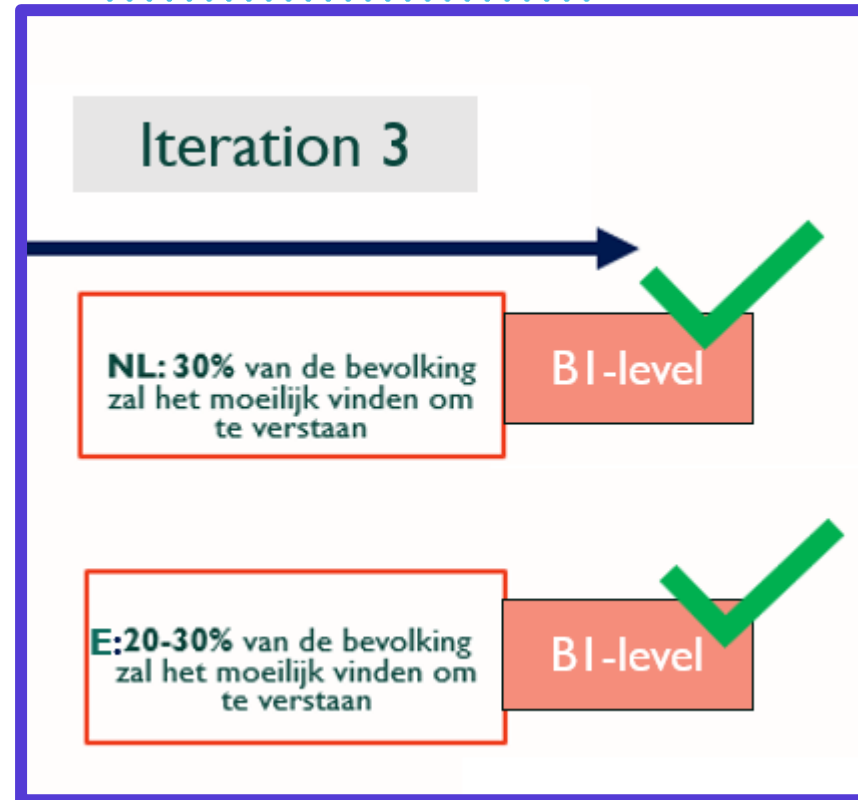
Translation Errors

2.5% suboptimal
0.4% error
(97% correct)

Translation error type	Clinical Term / Abbreviation	Provided Translation
Insufficient Lay Adaptation	PCI	none
	TSH	none
	EEG	none
	conservative management	none
	secondary cause	none
Suboptimal Translations	heart failure	heart weakness
	hemodialysis	blood purification
	obesity	severe overweight
	stent	spring placed in the artery
	antibiogram	sensitivity test
Mistranslations	packyear	number of years someone has been smoking
	bilateral pleural effusion	fluid between both pleurae
	diabetes insipidus	rare form of diabetes with frequent urination
	nephrologist	specialist in kidney diseases
	paroxysmal atrial fibrillation	rapid and irregular heartbeat

Findings & Results

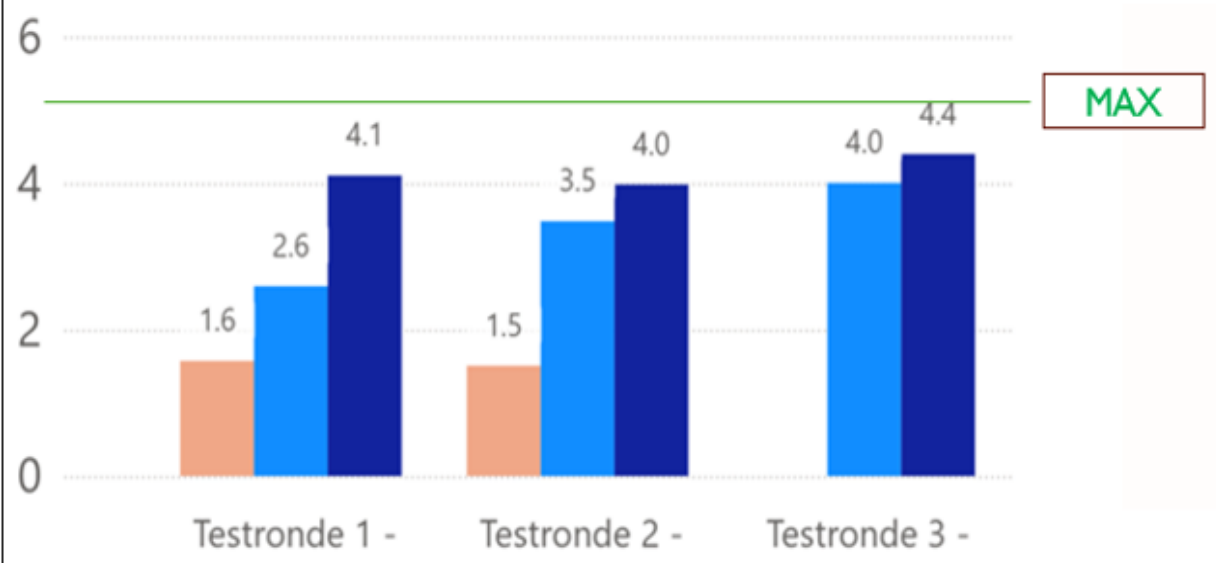
B1 language level



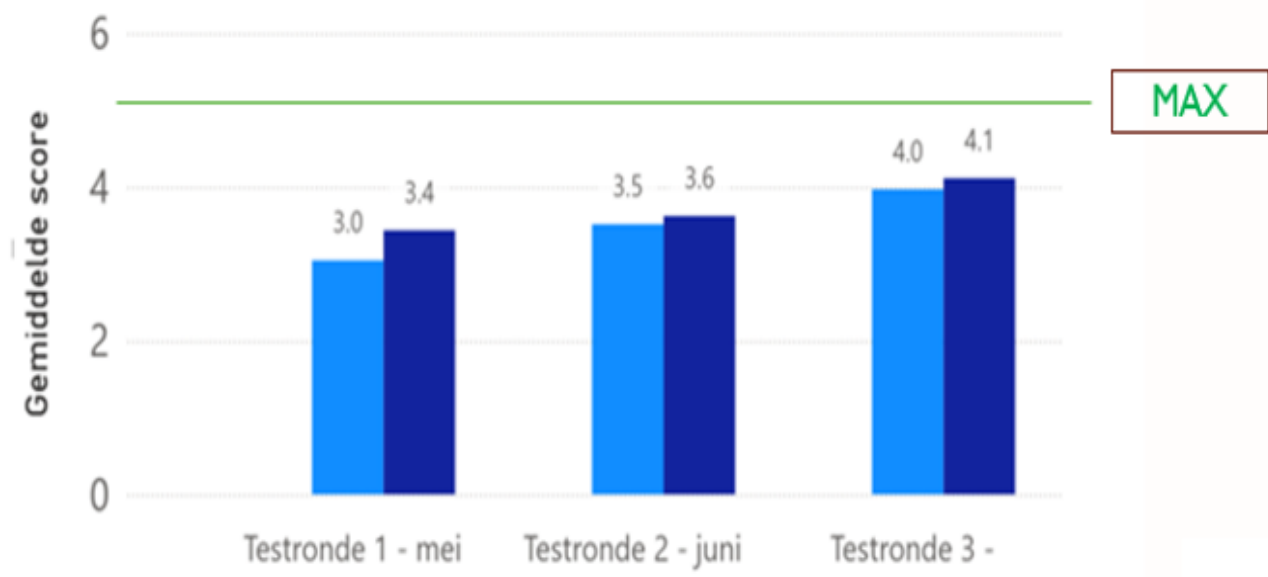
Findings & Results

Meeting Expectations ?

● Original letter ● Line by line ● Summary



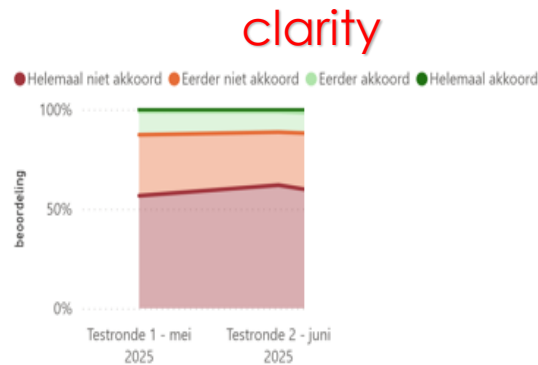
Patients & Language Experts



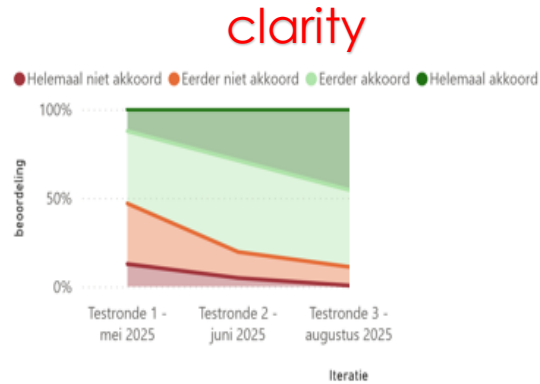
Medical specialists

Findings & Results

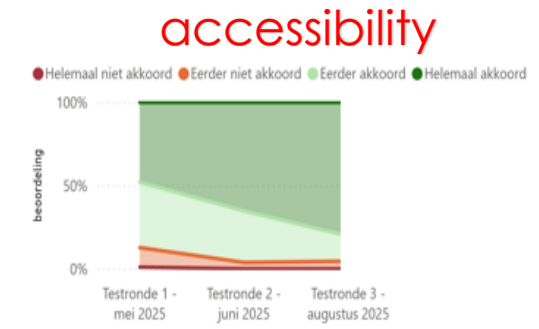
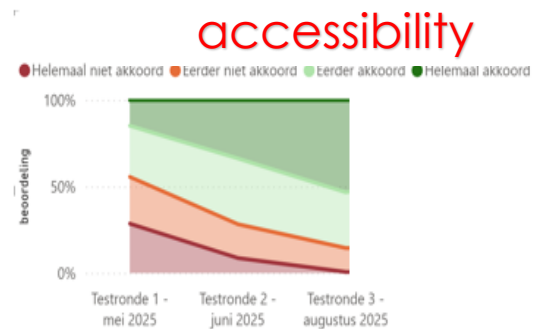
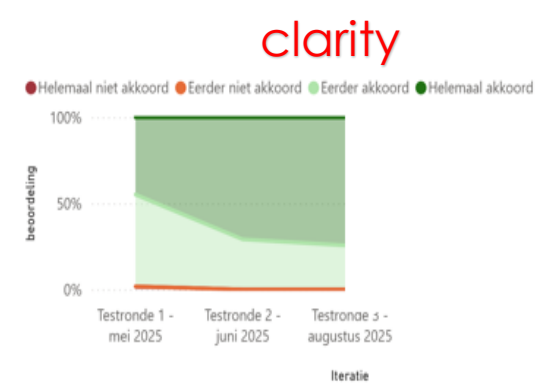
Original



Line-by-line



Summary



Findings & Results

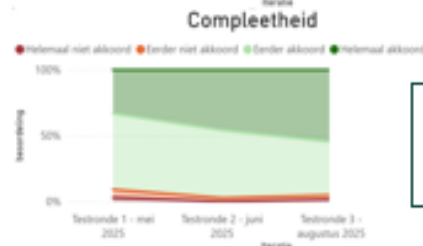
Line by line

correct



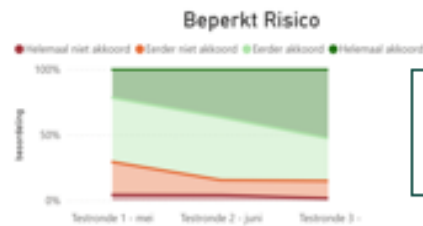
95% good/
all good

complete



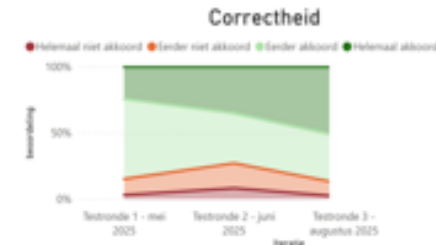
90% good/
all good

safe

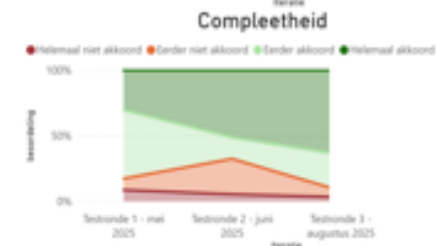


85% good/
all good

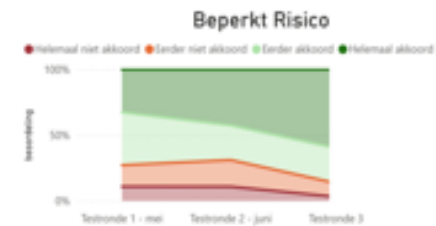
summary



92% good/
all good



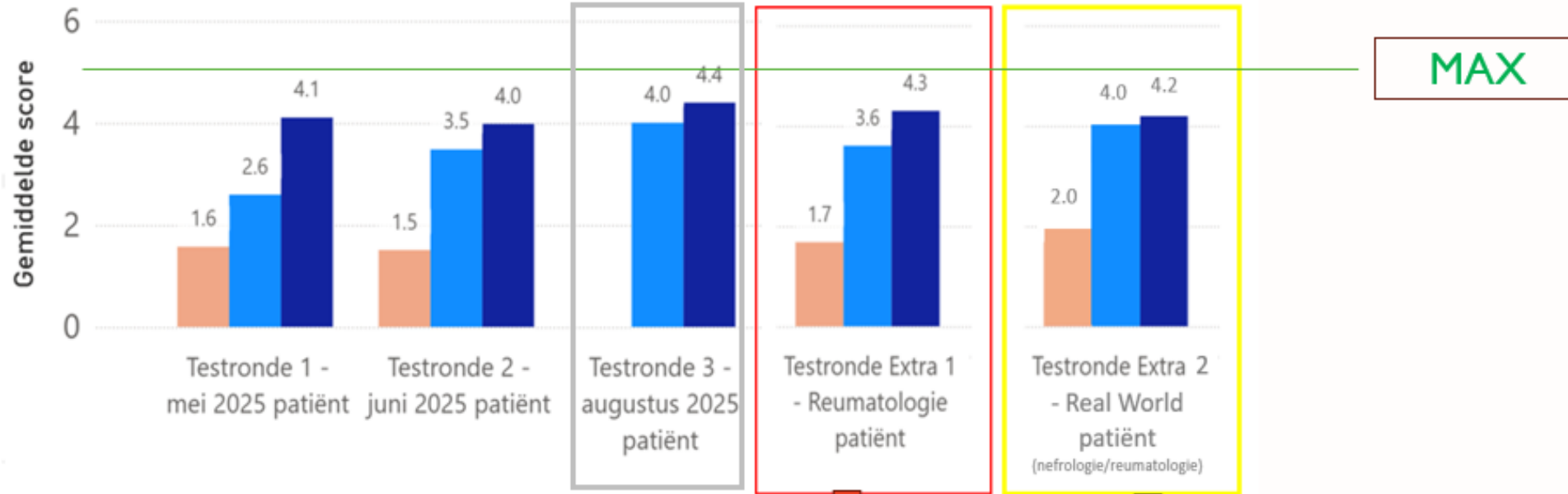
90% good/
all good



87% good/
all good

Generalisability ?

Findings & Results



Solution applied to Letters from another specialty (Rheumatology) [ReumaNet, rheumatologists]

Real-World Patients Reviewing the Translation of their Own Letter