Development of a standardized audit in the electronic health record to evaluate quality indicators for chronic kidney disease in primary care

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ABSTRACT

Background: Chronic kidney disease (CKD) (ICPC-code U99, ICD-10 code N18.9) is a rising public health issue which is associated with a high morbidity and mortality. We know that the available guidelines about detection and follow-up are insufficiently followed by the general practitioners (GPs). Audit & feedback tools can be a solution, but data for CKD is lacking. With our study, we developed a standardized generalizable audit and feedback tool to evaluate the quality of care of CKD patients in primary care.

Methods: We departed from 36 previously described quality indicators and generated simple queries to extract data about these indicators from the electronic medical records of GPs. We made a final selection of indicators and did a first data extraction by using the Intego database, a GP morbidity registry. The 'achievable benchmark of care methodology method' was used to calculate benchmarks for all selected indicators. We thought about a good way to visualize the future feedback report for the GPs.

Results: The total included Intego population consisted of 328 794 patients from 128 practices (after exclusion of 4 practices). The average prevalence of CKD was 6.44%. There was a wide range of performances over the practices for the different indicators. The lowest scores were observed for indicator 2 (screening for CKD in patients with comorbidities) with a mean performance of 2.5%. The highest scores were observed for indicator 15 (screening for hypercholesterolemia in CKD patients), with a mean performance of 74.1%. For indicators with a low overall performance, the best achievable benchmark was also low. For some indicators, the best achievable benchmark was 100%, meaning that the 10% best performing practices all scored 100% on this indicator.

Discussion: When building the audit and feedback tool, there were a few barriers. These barriers were about choosing a threshold to define CKD, but also about data that was unreliable or technically impossible to extract. In conclusion, in this study we built a first feedback barometer in the electronic medical record that was tested in the Intego database. This work forms the base for the final feedback barometer for the GPs.

SAMENVATTING

Achtergrond: Chronische nierinsufficiëntie (CNI) (ICPC-code U99, ICD-10 code N18.9) is een groeiende gezondheidsproblematiek die geassocieerd is met een hoge morbiditeit en mortaliteit. In de huisartsenpraktijk worden de beschikbare richtlijnen omtrent detectie en follow-up onvoldoende gevolgd. Audit & feedback tools kunnen een oplossing zijn, maar data voor CNI ontbreekt tot op heden. Met onze studie willen we een gestandaardiseerde audit en feedback tool ontwikkelen om de zorg van CNI patiënten te evalueren in de eerste lijn.

Methoden: We vertrokken van 36 eerder beschreven kwaliteitsindicatoren en ontwikkelden simpele queries om data over deze indicatoren uit het elektronisch medisch dossier van huisartsen te extraheren. Uiteindelijk maakten we een finale selectie van indicatoren en deden we een eerste data extractie in de Intego databank, een morbiditeitsregister van huisartsen. De 'achievable benchmark care of methodology method' werd gebruikt om voor elke indicator benchmarks te berekenen. We dachten na over een overzichtelijke weergave van het toekomstige feedback rapport voor huisartsen.

Resultaten: De totale geïncludeerde Intego populatie bestond uit 328 794 patiënten van 128 praktijken (na exclusie van 4 praktijken). De gemiddelde prevalentie van CNI was 6.44%. Er was een grote variatie in de prestaties van de praktijken voor de verschillende indicatoren. De laagste scores werden geobserveerd voor indicator 2 (screening naar CNI bij patiënten met comorbiditeiten) met een gemiddelde prestatie van 2.5%. De hoogste scores werden geobserveerd voor indicator 15 (screening naar hypercholesterolemie bij CNI patiënten) met een gemiddelde prestatie van 74.1%. Voor indicatoren met een lage prestatie werd ook een lage best achievable benchmark gerapporteerd. Voor sommige indicatoren was de best achievable benchmark 100%, en dat wijst erop dat de 10% best presterende praktijken allen 100% scoorden voor deze indicator.

Discussie: Bij het bouwen van de audit en feedback tool, waren er enkele moeilijkheden. Deze moeilijkheden hadden te maken met de keuze voor een drempel om CNI te definiëren, maar ook met data die onbetrouwbaar of technisch onmogelijk extraheerbaar was. Samengevat genereerden we in deze studie een feedback barometer in het elektronisch programma die getest werd in de Intego databank. Dit werk zal de basis vormen voor de finale barometer voor de huisartsen.

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INTRODUCTION

Chronic kidney disease (CKD) is a rising public health issue with an increasing prevalence because of aging of the population and rise of chronic diseases as diabetes mellitus and hypertension. (1)(2) These two chronic diseases are the most common causes for CKD, accounting for more than one-half of the cases. CKD is called a 'silent' disease; a lot of patients are not aware of their disease because it is a relatively new concept and it is almost always asymptomatic in the early stages. (3)(4)(5) Nevertheless, CKD is associated with a high morbidity and mortality. Patients with CKD have a decreased quality of life and a higher chance for early cardio-vascular events, hospitalisation, progression to kidney failure and premature mortality. (2)(6)

To prevent this progression to kidney failure, the quality of care is important. Primary care doctors play a crucial role in the detection and follow-up of these patients. (7)(8) In practice, we see that general practitioners insufficiently follow the current evidence-based guidelines, and that correct follow-up of the kidney function and blood pressure is sometimes lacking. (9)(10)(11)

According to a Cochrane review, it was proven that audit and feedback lead to small but potentially important improvements in general practice. (12) A systematic review showed that 76% of the audit and feedback (A&F) interventions are effective for different conditions such as medication safety and preventive medicine. (13) However, there is not much data available about the effect of A&F interventions for the primary care of CKD patients. A population-based cohort study showed that better quality of CKD care was associated with a lower end-stage renal disease incidence in patients with diabetes but not in nondiabetic patients. (14) The study had a lot of limitations; it was an observational study, confounder effects could not be excluded and it was a Japanese database so the results were not generalizable.

When improving the quality of care, the first step is a quality assessment, a thorough evaluation of the current quality of care. In a previous study, 36 quality indicators were determined by using a Rand-modified Delphi method. (2)(15) These indicators assess the quality of care for CKD patients in primary care in terms of diagnosis, screening, follow-up and treatment. All these indicators are based on recent guidelines and extractable from the electronic medical record (EMR).

There are a lot of challenges which arise with the extraction of data. (16) Firstly, there is a lack of data completeness about the diagnosis and other data. (17) Delayed diagnosis was associated with an elevated risk of adverse cardiorenal outcomes, including kidney failure, CKD progression and the composite of myocardial infarction, stroke and hospitalisation for heart failure. (18) The correlation between under-registration and mortality has been studied, but the paper is still 'under review'. Under-registration of the diagnosis makes the further evaluation of quality very difficult. Secondly, there is the diversity of electronic medical record (EMR) systems that general practitioners (GPs) are working with.

The current study aims to develop a standardized generalizable audit tool to evaluate the quality of care of CKD patients. We transformed the earlier described quality indicators into queries to extract data. In our study, we performed a first data extraction on the Integrated computerized network (Intego) database. The final purpose (continuation of this study) is that also GPs can automatically extract data about their own patients and compare their quality of care with a benchmark by receiving a feedback report on a regular base. In this way, a CKD 'barometer' is born. By using this system, the care quality for CKD patients will improve in terms of morbidity and mortality. A similar audit and feedback tool for diabetes (diabetes barometer) has already been developed in Belgium. (19)

METHODS

Ethical approvement

The Intego procedures have been earlier approved by the KU Leuven Ethics Committee (no. ML 1723) and by the Belgian Privacy Commission (no. SCSZG/13/079) (Appendix 1).

Quality indicators

We started from 36 indicators which give a good representation of the current quality of care for CKD patients. These 36 indicators had already been described in a previous study. (2) A first quality indicator checks if these people have been diagnosed with CKD in their problem list in the EMR. Other indicators are about screening, diagnosis, follow-up, treatment, medication, safety, etc.

Development of queries

We transformed these quality indicators into simple queries to automatically extract information about the quality of care (audit). We developed our queries in Intego. The Intego database is a Belgian general practice-based morbidity registration network that contains longitudinal information about patients from 132 practices, corresponding to roughly 5% of the Flemish population representative in terms of age and sex. (20) Each week, structural data from the according practices are collected in the Intego database.

In the future, the plan is to develop a barometer which is uniform for all EMR systems.

Selection of indicators

Feasibility of transformation

We examined the feasibility of the transformation of indicators in queries. We saw that it was not (yet) possible to transform each of the earlier reported indicators into an according query. Therefore, we chose to not include every single indicator. In table 1, we reported the list of indicators. (2) We can make two categories, namely 'included indicators' and 'not included indicators'. For each indicator which was not included, we briefly noted the reason for exclusion. In the following paragraphs, these reasons will be explained more thoroughly.

For each indicator that was included, the detailed query can be found in the Appendix (Appendix 2).

Information technically impossible to extract

There were a few indicators for which the transformation into a query was not possible because of a technical limitation.

Firstly, it is important to mention that information from the EMR can only be extracted on group level and not on patient level. It is not possible to extract information about repetitive measurements in one patient. To make the extraction possible, we did an adjustment of the queries in indicator 1. We give an example to explain. It is not possible to check for a patient with a second measurement of eGFR 45-60 ml/min./1.73 m^2 if there was also a first measurement of eGFR 45-60 ml/min./1.73 m^2. A solution is to change the point of view to group level.

We looked for the group of patients with one measurement of eGFR 45-60 ml/min./1.73 m^2, and then looked in that first group for the sub-group with a second measurement of eGFR 45-60 ml/min./1.73 m^2.

Secondly, extraction of data of vaccination status was very difficult. We give the example of the pneumococcal vaccination. Because it is not possible to extract information about the time between two vaccines in one patient, we could not make a distinction between the group that had been fully vaccinated and the group that had been partly vaccinated. Therefore, we adapted the query to extract only data about the patients that had been fully vaccinated. This is a limitation, because patients which received only one vaccine and did not yet receive the second vaccine, will be excluded in this way. The same is valid for the hepatitis B vaccination.

Thirdly, extraction of information about increasing doses of medicines is quite challenging. Therefore, indicator 14 was difficult to extract.

Fourthly, extraction of information about measurements on specific moments is not possible. In indicator 19, we wanted to evaluate if there had been a blood test of the potassium level and eGFR < 1 month before and < 7 days after the starting date of the Renin-Angiotensin-Aldosterone System (RAAS) or spironolactone medicine. It is currently technically impossible to extract this information. The same is valid for indicator 20, where we wanted to know if there had been a recent eGFR measurement before an examination with contrast medium.

Fifthly, extraction of information about exams with contrast medium (indicator 20) or information about oral phosphate-containing bowel preparations (indicator 23) was not possible. There does not exist a field code to extract in a structured way the number of patients that need an examination with contrast medium, or to extract the number of patients that were prescribed oral phosphate-containing bowel preparations.

Unreliable information

Indicators 24-36 are all about referral behaviour of general practitioners. There is no other way than extracting this information based on the note of referral. In theory, this information can be extracted, but in practice, it is possible that this note is not always made by the GP. Therefore, extraction of this information would generate unreliable data. For this reason, we did not use indicators 24-36 in our final feedback barometer.

There were a few indicators which could be technically transformed into a query, but generated unreliable information. By generating the heat map of the results of the Intego practices (see further), we discovered for a few indicators (indicator 1d, 7c, 10, 12, 17 and 18), that the average percentage of all practices was 0%. This learned us that at this moment, these indicators could not provide us with useful information. Therefore, we excluded these indicators.

For other indicators in the heat map, the average percentage was not 0%, but there was a lack of dispersion in the scores over the practices so that no quartiles could be defined. Too many practices scored either 0%, either 100%. This was the case for indicator 1c, 7a, 7b, 11a, 11b and 22. For indicator 1c, 7a and 7b, respectively 50%, 41% and 42% of the practices scored 100%. The range for these three indicators was 100%. For indicator 11a, 11b and 22, respectively 48%, 48% and 70% of the practices scored 0%. The range for indicator 11a, 11b and 22 was respectively 79%, 60% and 100%. Because of the lack of dispersion, we chose to exclude these indicators.

INDICATOR NO	INDICATOR DESCRIPTION	INDICATOR NAME	INDICATOR TYPE	REASON FOR EXCLUSION
INCLUDED INDICATORS				
1	Percentage of patients with two eGFR measurements < 60 ml/min./1.73 m^2 with at least 3 months in between, diagnosed with CKD	Diagnosis of CKD	Process	
1a	Percentage of patients with two eGFR measurements 45-59 ml/min./1.73 m^2 with at least 3 months in between, diagnosed with CKD G3a (21)	Diagnosis of CKD G3a	Process	
1b	Percentage of patients with two eGFR measurements 30-44 ml/min./1.73 m^2 with at least 3 months in between, diagnosed with CKD G3b (21)	Diagnosis of CKD G3b	Process	
2	Percentage of patients with hypertension, diabetes mellitus, chronic NSAID use or a history of heart- and blood vessel disease, in whom eGFR and albuminuria or proteinuria are determined once a year (22)(23)	Screening for CKD in patients with comorbidities	Process	
3	Percentage of patients with CKD with an eGFR ≥ 60 ml/min./1.73 m^2, whose eGFR is tested annually	Follow-up patients with normal kidney function	Process	
4	Percentage of patients with CKD with an eGFR between 30-59 ml/min./1.73 m^2, who are tested every six months	Follow-up patients stage G3a and G3b	Process	
5	Percentage of patients with CKD with an eGFR between 15-29 ml/min./1.73 m^2, who are tested every three months	Follow-up patients stage G4	Process	
6	Percentage of patients with CKD, in whom the eGFR, albuminuria (for diabetics) and proteinuria (for non-diabetics) are determined at least once a year (24)	Screening for albuminuria and proteinuria	Process	
7d	Percentage of patients with CKD with an eGFR < 45 ml/min./1.73 m^2 and a reduced Hb, in whom ferritin and transferrin saturation is measured at least once a year (25)	Follow-up anemia in CKD patients	Process	
8	Percentage of patients with CKD who are vaccinated with an influenza vaccine annually (26)	Influenza vaccination	Outcome	
9	Percentage of patients with CKD who are fully vaccinated with one or more pneumococcal vaccines following the scheme (27)	Pneumococcal vaccination	Outcome	
11c	Percentage of patients with CKD, who are encouraged to limit alcohol intake (28)	Encourage limit alcohol intake	Process	
13	Percentage of patients with CKD - with diabetes and a strongly increased albuminuria (> 300 mg/g or > 300 mg/24 hours) or moderately increased albuminuria (30-300 mg/g or 30-300 mg/24 hours), OR	Treatment with ARB and ACE inhibitors when	Outcome	

	- without diabetes and proteinuria who are treated with an ARB or an ACE inhibitor (29)(30)(31)(32)(33)(34)	albuminuria + diabetes OR proteinuria + no diabetes		
15	Percentage of patients with CKD in whom a one-time lipid profile (total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides) is determined (35)	Screening for hypercholesterolemia	Process	
16	Percentage of patients with CKD with - proteinuria ≥ 1 g/day or - diabetes mellitus or - strongly increased albuminuria (ACR > 300 mg/g creatinin or > 300 mg/24 hours) or - ACR ≥ 700 mg/g in whom the target BP of < 130/80 mmHg (SBP range 120 - 129 mmHg) is achieved by using the first choice antihypertensive drugs (ACE inhibitors or ARBs)	Hypertension control in patients with proteinuria, diabetes mellitus or strongly increased albuminuria	Outcome	
21	Percentage of patients with CKD with an eGFR < 30 ml/min./1.73 m^2, in whom metformin is prescribed/ is not prescribed (36)	Prescription metformin when G4 or more	Process	

NOT INCLUDED INDICATORS

1c	Percentage of patients with two eGFR measurements 15-29 ml/min./1.73 m^2 with at least 3 months in between, diagnosed with CKD G4 (21)	Diagnosis of CKD G4	Process	Unreliable information – lack of dispersion
1d	Percentage of patients with two eGFR measurements < 15 ml/min./1.73 m^2 with at least 3 months in between, diagnosed with CKD G5 (21)	Diagnosis of CKD G5	Process	Unreliable information – zero score for all practices
7a	Percentage of patients with CKD with an eGFR < 45 ml/min./1.73 m^2, in whom serum Hb is measured at least once a year (37)	Screening for anemia when G3b or more	Process	Unreliable information – lack of dispersion
7b	Percentage of patients with CKD with an eGFR < 30 ml/min./1.73 m^2, in whom serum potassium (on a fresh blood sample), calcium, phosphate, PTH and bicarbonate levels, are measured at least once a year (37)	Screening for electrolytes and hyperparathyroidism when G4 or more	Process	Unreliable information – lack of dispersion
7c	Percentage of patients with CKD with an eGFR < 30 ml/min./1.73 m^2 and an increased PTH, in whom vitamin D is measured at least once a year (38)	Prescription of vitamin D in patients with CKD and increased PTH	Process	Unreliable information – zero score for all practices
10	Percentage of patients with CKD with progressive disease (= increasing proteinuria and/or decreasing eGFR) who are vaccinated with one or more hepatitis B vaccines (HBV) according to the guidelines (39)(40)(41)(42)	Hepatitis B vaccination in progressive CKD patients	Outcome	Unreliable information – zero score for all practices

11a	Percentage of patients with CKD, who are encouraged to undertake physical activity compatible with cardiovascular health and tolerance (aiming for at least 30 minutes 5 times per week) (43)(44)	Encourage physical activity	Process	Unreliable information – lack of dispersion
11b	Percentage of patients with CKD, who are encouraged to stop smoking (45)	Encourage stop smoking	Process	Unreliable information – lack of dispersion
12	Percentage of patients with CKD with a normal albuminuria (< 30mg/g or < 30 mg/24hours) and an office blood pressure consistently > 140 mm Hg systolic and > 90 mm Hg diastolic, for whom blood pressure-lowering drugs were prescribed to maintain a blood pressure that is consistently ≤ 140 mm Hg systolic and ≤ 90 mm Hg diastolic (46)(47)	Blood pressure control with blood pressure-lowering drugs	Process	Unreliable information – zero score for all practices
14	Percentage of patients with CKD with an albuminuria ≥ 300 mg/g creatinin (or ≥ 300 mg/24 hours) or proteinuria ≥ 0.5 g/24 hours, who are treated by increasing ACE inhibitor or ARB dosage if the maximum dose has not yet been reached (29)	Treatment with increasing ACE inhibitor or ARB when high albuminuria	Process	Technically impossible extraction – increasing doses of medicines
17	Percentage of patients with CKD with a reduced serum bicarbonate (< 20 mmol/l), who are treated with oral bicarbonate to keep the serum bicarbonate level within the normal range (48)	Treatment of acidosis by oral bicarbonate	Process	Unreliable information – zero score for all practices
18	Percentage of patients with CKD with a vitamin D deficiency (< 15 ng/ml), who are substituted with vitamin D (49)	Treatment of vitamin D deficiency by vitamin D supplement	Process	Unreliable information – zero score for all practices
19	Percentage of patients with CKD with a RAAS blocker or spironolactone treatment, in whom potassium level and eGFR are measured before initiating this therapy and controlled within 1 week after initiation and after each dose increase (50)	Safety when starting RAAS blocker or spironolactone treatment by checking lab tests	Process	Technically impossible extraction – measurements on specific moments
20	Percentage of patients with CKD who needed an examination with contrast medium and of whom no recent value of eGFR is known, in whom eGFR was determined (51)	Safety when doing examination with contrast medium	Process	Technically impossible extraction – information without field code, measurements on specific moments
22	Percentage of patients with CKD with an eGFR < 30 ml/min./1.73 m^2, in whom bisphosphonate treatment is prescribed/ is not prescribed (52)	Prescription bisphosphonate when G4 or more	Process	Unreliable information – lack of dispersion
23	Percentage of patients with CKD with an eGFR < 60 ml/min./1.73 m^2, in whom oral phosphate-containing bowel preparations are avoided/ are not prescribed	Prescription of oral-phosphate-containing bowel preparations	Process	Technically impossible extraction – information without field code
24	Percentage of patients with CKD who are referred to a specialist, and for whom the referral letter includes active diagnosis of CKD and renal function	Diagnosis in referral letter	Process	Unreliable information – bad registration of referral behaviour
25	Percentage of patients with an eGFR < 30 ml/min./1.73 m^2, who are referred to a specialist	Referral when G4 or more	Process	Unreliable information – bad registration of referral behaviour

26	Percentage of patients with CKD with hypertension who do not respond to medical treatment with 4 or more antihypertensive drugs, who are referred to a specialist (53)	Referral when uncontrollable hypertension	Process	Unreliable information – bad registration of referral behaviour
27	Percentage of patients with CKD who are pregnant or are planning pregnancy, who were referred to a specialist (54)	Referral when pregnant	Process	Unreliable information – bad registration of referral behaviour
28	Percentage of patients with CKD with: - a chronic eGFR < 30 ml/min./1,73 m2 - an eGFR between 30-45 ml/min./1,73 m2 and an albumin creatinin ratio (ACR) > 200 mg/g for men or 300 mg/g for women , and/or proteinuria > 1000 mg/24h or a protein-creatinin ratio (PCR) > 1000 mg/g who are referred to a specialist for inclusion in a care program	Referral when G4 or more, G3b and albuminuria/proteinuria	Process	Unreliable information – bad registration of referral behaviour
29	Percentage of patients with a confirmed significant albuminuria, meaning albumin creatinin ratio (ACR) ≥ 300 mg/g or albumin excretion rate (AER) ≥ 300 mg/24 hours, who are referred to a specialist (55)	Referral when significant albuminuria	Process	Unreliable information – bad registration of referral behaviour
30	Percentage of patients with hematuria in combination with proteinuria (urine PCR ≥ 500mg/g or ACR ≥ 300 mg/g creatinin), who are referred to a specialist (56)	Referral when hematuria and proteinuria	Process	Unreliable information – bad registration of referral behaviour
31	Percentage of patients with progression of CKD (confirmed decline in eGFR category accompanied by a 25% or greater drop in eGFR from baseline or a sustained decline in eGFR of more than 5 ml/min./1.73 m^2 /year), who are referred to a specialist	Referral when progression CKD	Process	Unreliable information – bad registration of referral behaviour
32	Percentage of patients with persistent microscopic hematuria of unknown origin, who are referred to a specialist (57)	Referral when persistent microscopic hematuria	Process	Unreliable information – bad registration of referral behaviour
33	Percentage of patients with persistent serum potassium abnormalities (potassium < 4.0 mmol/l or potassium > 5.5 mmol/l), who are referred to a specialist (58)	Referral when persistent serum potassium abnormalities	Process	Unreliable information – bad registration of referral behaviour
34	Percentage of patients with recurrent or extensive nephrolithiasis, who are referred to a specialist (59)	Referral when recurrent/extensive nephrolithiasis	Process	Unreliable information – bad registration of referral behaviour
35	Percentage of patients with hereditary kidney disease, who are referred to a specialist	Referral when hereditary kidney disease	Process	Unreliable information – bad registration of referral behaviour
36	Percentage of patients with an arteria renalis stenosis, who are referred to a specialist (60)	Referral when arteria renalis stenosis	Process	Unreliable information – bad registration of referral behaviour

Table 1: Overview of the 36 indicators, as described in the study of dr. Steve Van den Bulck. All indicators are divided into two categories, namely included indicators and not included indicators. For each indicator, we noted a detailed description and a name, the type of the indicator (process or outcome indicator) and the reason for exclusion.

Extraction data from Intego database

After having selected a final set of indicators, we could start doing the first data extraction by using the Intego database.

Selection of practices

By processing the data, the prevalence of CKD could be calculated for each practice. The CKD prevalence is defined as the number of patients with a CKD diagnosis (ICD-10 N18.9) in their problem list, divided by the number of patients > 18y with a GMD in the last 2 years. We based the selection of the practices on this prevalence. The average prevalence for all Intego practices was 6.44%. Therefore, we chose for a prevalence cut-off of 2% and excluded all practices with a prevalence that was lower than 2%. This corresponded to an absolute number of CKD patients below 20.

Data analysis

For each indicator that was tested in the selected Intego practices, we noted a mean performance and a standard deviation (SD). The standard error (SE) was calculated with the following formula ($SE = SD/\sqrt{n}$) where n is the number of the practices.

To define the benchmarks, the Achievable Benchmarks of Care (ABC™) approach was used as a base, because this had already proven to be effective. (61)(62)(63) By using this method, a 'top performance' or 'best achievable benchmark' could be calculated for each indicator. Important here is 'the pared mean', defined as the average performance of the 10% best performing practices (all practices in the 10th upper percentile for performance, whereby at least 10% of the patient pool was selected). (64)

Future: CKD barometer

In the future, we would like to apply this audit tool to the EMR system of GPs (not only Intego practices), so that a 'CKD barometer' can be born. A barometer always consists of two principles: audit and feedback. (19) This means that the extracted data about the different indicators (=audit) has to be collected in an electronically frequently delivered report for the GPs (=feedback). This feedback report should allow GPs to compare their performance with peers.

Feedback report for the GPs

Based on earlier described studies, four criteria should be taken in account when generating the feedback report. (16)

Low cognitive load

There are many possible ways to visualize feedback (Appendix 3). Simplicity should be central. The effectiveness of A&F interventions is higher when as few graphs as possible are used, and when the content is focused on the most important behaviours. (65)(66)

Use of benchmarks

Setting benchmarks is an important process of A&F systems, as it allows to compare your performance with the performance of other practices. (67)

Frequency

Feedback should be repetitively given, so that a GP has the possibility to positively change his/her behaviour. (12)

Evidence-based

A link to the guidelines has to be added, to provide the GP with on-the-spot correct information.

RESULTS

Results from Intego database

Characteristics of population

Table 2 describes the characteristics of the population which was evaluated. The total included Intego population consisted of 328 794 patients from 128 practices. This was after the exclusion of four practices which had a prevalence < 2% or < 20 CKD patients in their practice.

In this population, 21 185 patients were diagnosed with CKD, leading to a prevalence of 6.44% or 64 patients / 1000 EMR patients. There were 9 172 male and 12 013 female patients. We made a division into different age categories. 49.5% patients were older than 75 years. Co-existence of hypertension was seen in 9 058 patients, and diabetes in 4 523 patients.

CHARACTERISTIC	N (%)
Patients in Intego	328 794
Practices in Intego	128
Patients with CKD (ICD-10 code N18.9)	21 185
Patient sex	
Male	9 172 (43.3)
Female	12 013 (56.7)
Patient age	
18-24	347 (1.6)
25-34	844 (4.0)
35-44	1 080 (5.1)
45-54	1 497 (7.1)
55-64	2 697 (12.7)
65-74	4 235 (20.0)
> 75	10 485 (49.5)
Patients with comorbidity	
Hypertension	9 058 (42.8)
Diabetes	4 523 (21.4)

Table 2: Characteristics of described Intego population. 128 practices and 328 794 patients were included. Four practices were excluded because of a too low prevalence.

Visualization of quality of care

We made a heat map, in which we visualized the quality of care for the final set of indicators in the selected 128 Intego practices in Flanders (Appendix 4). There was a wide range of performances over the practices for the different indicators. With the colors that represent quartiles, the performances of the practices can be compared with each other. We noted that not for every indicator four distinct quartiles could be defined. Sometimes, because of a lack of dispersion, only three categories could be formed (instead of four). This is the case for indicator 5, 6, 7d, 11c, 13, 16 and 21.

The lowest scores were observed for indicator 2, 6, 9, 11c and 16 with a mean performance of respectively 2.5%, 5.9%, 6.8%, 7.5%, 7.0%. The highest scores were observed for indicator 1, 1b, 3, 13 and 15 with a mean performance of respectively 46%, 66.8%, 46.6%, 52.6% and 74.1%.

Visualization of benchmarks

In table 3, we listed for each indicator the overall performance of all practices as a mean, a standard deviation and a 95% confidence interval (CI). We also reported the 'best achievable benchmark' for each indicator. Like described earlier, we used The Achievable Benchmarks of Care (ABC^{TM}) approach to define these benchmarks. For each indicator, the number of practices that reached the benchmark is reported.

For indicators with a low overall performance, the best achievable benchmark was also low. For example, the best achievable benchmark for indicator 2 is only 6.7 %. For some indicators, the best achievable benchmark was 100%, meaning that the 10% best performing practices all scored 100% on this indicator.

INDICATOR	AVERAGE ALL PRACTICES				BENCHMARK	
	Mean (%)	SD (%)	SE (%)	95% CI (%)	ABC™ (%)	Number of practices at or above the ABC™ benchmark
indicator_1	46.0	22.9	2.0	42.1 – 50.0	87.9	6
indicator_1a	38.2	24.6	2.2	33.9 – 42.4	86.4	6
indicator_1b	66.8	33.4	3.0	61.0 – 72.6	100.0	32
indicator_2	2.5	1.9	0.2	2.2 – 2.8	6.7	5
indicator_3	46.6	24.6	2.2	42.4 – 50.9	91.5	6
indicator_4	40.5	23.5	2.2	36.5 – 44.6	81.6	4
indicator_5	21.1	24.7	2.2	16.8 – 25.4	73.6	5
indicator_6	5.9	7.5	0.7	4.6 – 7.2	23.2	3
indicator_7d	30.6	34.7	3.1	24.6 – 36.7	100.0	14
indicator_8	33.9	19.1	1.7	30.6 – 37.2	66.3	3
indicator_9	6.8	7.7	0.7	5.4 – 8.1	24.7	3
indicator_11c	7.5	12.0	1.1	5.4 – 9.6	36.6	3
indicator_13	52.6	37.7	3.3	46.0 – 59.1	100.0	26
indicator_15	74.1	21.9	1.9	70.3 – 77.9	100.0	14
indicator_16	7.0	9.7	0.9	5.4 – 8.7	28.6	4
indicator_21	27.3	27.9	2.5	22.5 – 32.1	89.7	8

Table 3: Visualization of benchmarks. Firstly, the overall performance of all practices is reported as a mean and a 95% CI. Secondly, the benchmarks for each indicator are reported. The ABC^{TM} benchmark was calculated as the mean of the 10% best performing practices. For each indicator, the number of practices that reached the benchmark is reported.

Distribution of eligible patient volume

Table 4 shows for each indicator the number of eligible patients. The eligible patients are defined as the patients to which the indicator was applicable (denominator of query). This number of patients was included in the calculation of the benchmark.

For each indicator, the eligible number of patients per practice varies strongly. For indicator 2, the high mean number of patients in each practice can be easily explained. The denominator of the query for this indicator consisted of all patients with hypertension, diabetes, a history of heart- and vessel disease or chronic NSAID use, and that is a large group of patients. The lowest mean number of patients was seen for indicator 7d. This indicator searches for patients with a low eGFR value (< 45 ml/min./1.73 m^2) and a low Hb value in the last blood test. Because these two conditions have to be fulfilled together, this group of patients is lower.

	N	MEAN	MEDIAN	RANGE	IQR
indicator_1	4 753	37.1	24	261	38.8
indicator_1a	3 596	28.1	17	220	28
indicator_1b	1 540	12	8	83	14
indicator_2	103 719	810.3	692	3 704	828.8
indicator_3	2 750	21.5	11	205	24.3
indicator_4	2 917	22.8	15	161	25.5
indicator_5	912	7.1	4	57	10
indicator_6	5 409	42.3	28.5	281	53.3
indicator_7d	504	3.9	2	41	5
indicator_8	5 409	42.3	28.5	281	53.3
indicator_9	7 867	61.5	41.5	359	68.5
indicator_11c	5 409	42.3	28.5	281	53.3
indicator_13	701	5.5	3	45	6.3
indicator_15	5 409	42.3	28.5	281	53.3
indicator_16	1 387	10.8	7	77	13.3
indicator_21	810	6.3	4	53	8

Table 4: Descriptive statistics of the eligible patient volume for each indicator. For each indicator, the total number of patients (N), the mean number of patients per practice, the median, the range and the interquartile range (IQR) were reported.

Feedback report for the GPs

Low cognitive load

We chose for a simple visualization of each indicator in three bar charts. The individual performance is shown in the first bar. The different benchmarks to compare the performance with, are visualized in the other bar charts. Again, we worked with the color codes as previously explained.

Use of benchmarks

There are two benchmarks to compare the performance with. Firstly, the mean of the individual performances of other GPs of Belgium or a specific region (province, primary care zone, …) and secondly, the mean of the 10% best performing GPs of Belgium or a specific region.

In the following figure, we made a representation of these bar charts based on the earlier described Intego database. For each practice and each indicator, this figure can be generated on the following website: https://cristianfrigolett.shinyapps.io/barometer_ckd_app/.

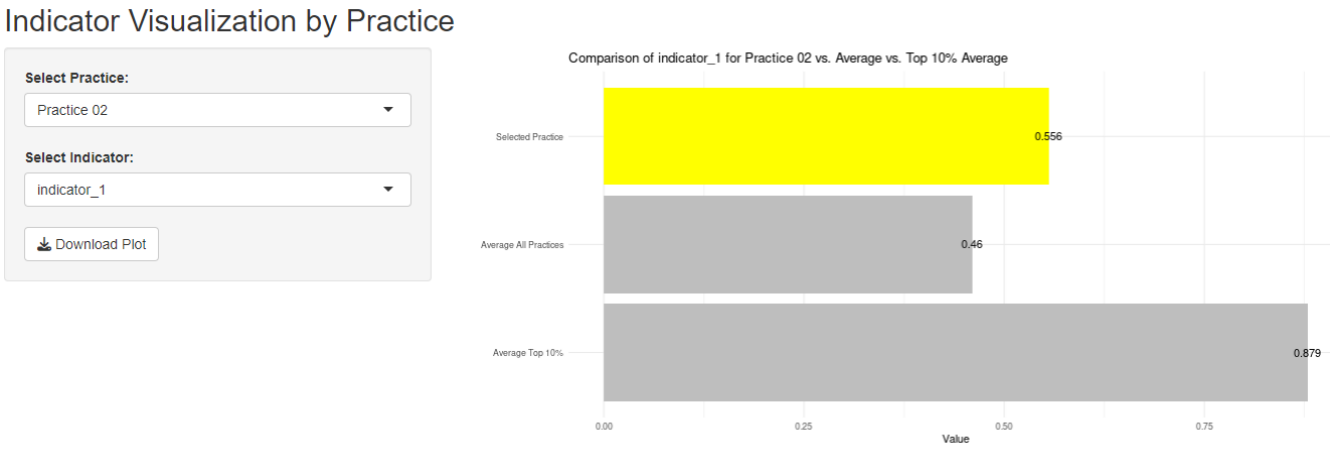


Figure 1: Visualization of indicator 1 for Intego practice 2 in three bar charts.

Frequency

The feedback will be given on four different occasions, each 3 months, since giving feedback in a repetitive way has been described as an important factor. (12) We give an example. The individual performance level is '40% correctly vaccinated persons on day X'. Because of the received feedback, a general practitioner can change his/her behaviour and more patients will be vaccinated for the next evaluation. For example, on day X + 3 months, the same general practitioner has 50% correctly vaccinated patients. We can visualize this in a graph.

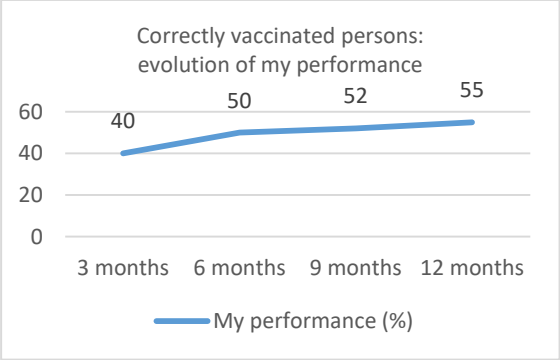


Figure 2: Visualization of evolution of performance during a period of 12 months. The performance is noted on the y-axis (in %), in function of time on the x-axis (in months). We see a positive evolution in performance during a period of 12 months.

Evidence-based

We will add a link to the guidelines for each indicator. In this way, general practitioners can get on-the-spot evidence-based information about the indicators.

Example

In the following figure, we constructed a possible visualization of the final feedback barometer for the GPs.

List of indicators

Definition and classification
- 1: Diagnosis CKD
- 1a: Diagnosis CKD G3a
- 1b: Diagnosis CKD G3b

Screening and diagnosis
- 2: Screening for CKD in patients with comorbidities

Follow-up
- 3: Follow-up eGFR when normal kidney function
- **4: Follow-up eGFR when stage G3a and G3b**
- 5: Follow-up eGFR when stage G4
- 6: Screening albuminuria and proteinuria
- 7d: Follow-up anemia in CKD patients

Vaccination
- 8: Influenza vaccination
- 9: Pneumococcal vaccination

Healthy lifestyle
- 11c: Encourage limit alcohol intake

Correct treatment of patients
- 13: Treatment ARB and ACE-I when albuminuria or proteinuria
- 15: Screening hypercholesterolemia
- 16: Hypertension control in patients with proteinuria, DM or high albuminuria

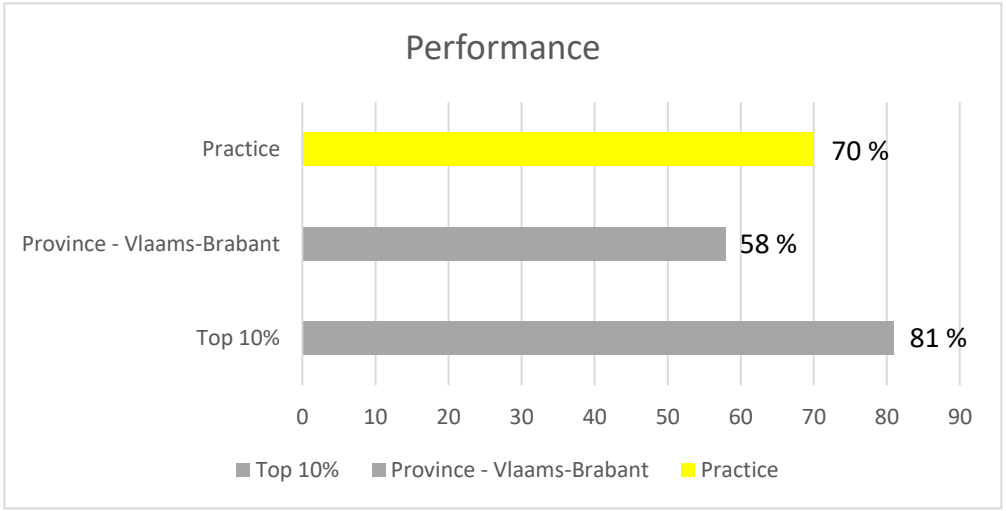
Medication and safety
- 21: Prescription metformin when G4 or more

CKD barometer

Follow-up eGFR when stage G3a and G3b

On this page, you see the proportion (in %) of patients > 18 y old, with a GMD in your practice, diagnosed with CKD and with an eGFR 30-59 ml/min./1.73 m^2, whose eGFR was determined in the past 6 months, regard to the total number of patients > 18y old with a GMD in your practice, diagnosed with CKD and with an eGFR 30-59 ml/min./1.73 m^2.

Benchmark	Province	District	First line zone



P0-25
P26-50
P51-75
P76-100

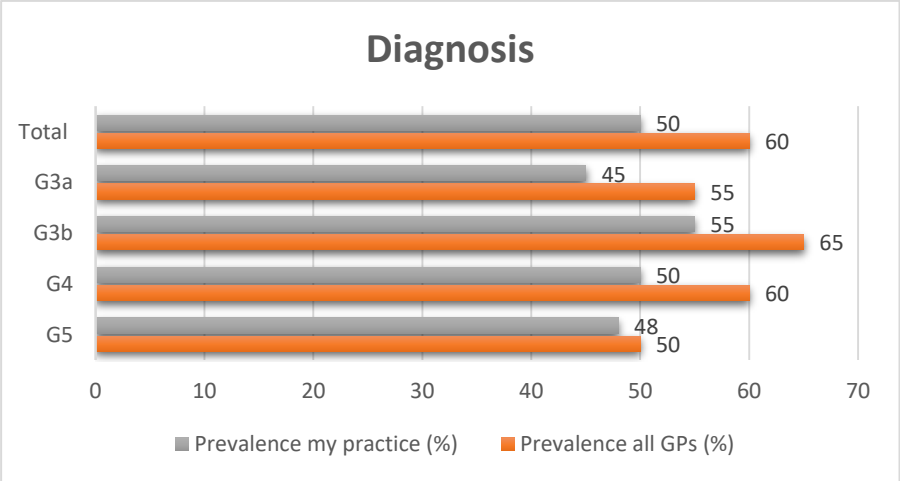
> Link to the guidelines: click here

Figure 3: Possible visualization of feedback report for GPs.

In the left column of the figure, we see an overview of the indicators, divided by categories, where we can scroll through the indicators.

- Feedback about definition and classification (indicator 1, 1a and 1b)
- Feedback about screening and diagnosis (indicator 2)
- Feedback about follow-up (indicator 3-6 and 7d)
- Feedback about vaccination (indicator 8-9)
- Feedback about healthy lifestyle (indicator 11c)
- Feedback about correct treatment of patients (indicator 13 and 15-16)
- Feedback about medication and safety (indicator 21)

The first category is different from the other categories, because the indicator is not really about a performance, but is rather a visualization of the registration of the diagnosis.
We can visualize this indicator as following:



	Prevalence of CKD registration for my practice (%)	Prevalence of CKD registration for all GPs of Belgium (%)
Total	50	60
G3a	45	55
G3b	55	65
G4	50	60
G5	48	50

Figure 4: Visualization of first indicator, namely 'registration of diagnosis'. In this figure, we see that there is a general under-registration of the diagnosis in our practice when compared to other practices in Belgium. Only 50% of the patients that should have a CKD diagnosis (two values of eGFR < 60 ml/min/1.73 m²), have a registered CKD diagnosis in their EMR.

DISCUSSION

Barriers in the study

This is the first study to introduce the CKD feedback barometer for general practitioners. A&F systems have proven to have beneficial effects in the literature but it had never been studied for CKD patients earlier. (12)(13) In this study, we did not study the effect of the barometer yet, but we did the first steps to the building of this feedback barometer. When doing this, there were a few barriers. We will discuss this in the next paragraphs.

Definition of CKD: another threshold for older patients?

CKD is strictly defined as an eGFR 60 ml/min./1.73 m² or less, for a minimum of 3 months. However, by following this definition, many older people (> 55 years old), will be classified as CKD patients. (68)(69)(70)

Not only the normal age-related decrease in eGFR but also the underestimation of eGFR in healthy older patients leads to a CKD overdiagnosis in older people. Firstly, when implementing an absolute (not corrected for age) cut-off for the CKD definition, we will unsurprisingly give more older adults a CKD diagnosis. (68) Glomerular filtration rate declines at a rate of 6.3 ml/min./1.73 m^2 per decade in healthy adults. (71) Secondly, the eGFR equations were adapted to CKD patients (all CKD patients in MDRD equation and mostly CKD patients in CKD-EPI equation) and not to healthy persons. (68) Because healthy persons have a higher muscle mass than CKD patients, their eGFR will also be higher for the same serum creatinin as CKD patients. By using the equations in healthy patients, there will be an important underestimation of the eGFR, causing an inflation in the prevalence of CKD. (68)(72)

In the Nijmegen biomedical study of Wetzels et al., it was confirmed that 60 ml/min./1.73 m^2 is not a good threshold to define a population with CKD. An eGFR of 60 ml/min./1.73 m^2 is a very frequent value for men > 60 years and women > 50 years. (69) In another recent study, the implementation of a universal threshold of 60 ml/min./1.73 m^2 independent of age, was discussed. To choose a correct threshold, it is important to know the effect on mortality risk. Using an American database that contained data of predominantly male patients, an association was found between an eGFR of 50–59 ml/min./1.73 m^2 and a higher mortality risk, but only in younger adults (age 18–54 years). For the elderly , we can better choose lower threshold values to define CKD. (70)

Unless data have proven that there is a difference between young and old persons, data about exact thresholds for older people are lacking. In this study, we chose to follow the previously described validated indicators (by dr. Steve Van den Bulck) and used the same threshold of 60 ml/min./1.73 m² for all people, independent of the age of the patient. In the future, when implementing the barometer on the EMR systems of the GPs, we can make the reflection if it is not better to choose for a threshold of 45 ml/min./1.73 m² to avoid this overdiagnosis in older people. This cut-off of 45 ml/min./1.73 m² is based on the Riziv 'Zorgtraject' for CKD patients in Belgium. (73) There exists already a diagnostic audit in the EMR system to give people that have not yet been diagnosed as a CKD patient in the past, a CKD diagnosis.

Unreliable information and information technically impossible to extract

As we discussed earlier, not every indicator could be easily transformed into a query. The technical limitations in the EMR on the one hand and the bad registration by GPs on the other hand, were the main challenges to cope with.

The indicators that were possible to transform into queries, did not always provide us with reliable information. For some indicators, all practices scored 0% (or almost 0%), which learned us that the information of these indicators was not yet extractable at this moment in a reliable way.

The technical limitations of the EMR could not be easily overcome at this moment, but with the growing technical innovations, also the EMR systems will become more advanced in the future. Information which can not be extracted in the current systems, will be possibly extractable in the future.

Apart from that, the human factor will always keep playing an important role. A good performance on the feedback barometer starts with a good registration of important measurements in the EMR. We should motivate GPs to fill in their EMR in a structured way. Because the knowhow of GPs about these correct registrations is often limited, education and training programs should be provided. Behavioural changes require a lot of courage and perseverance.

The choice of the benchmarks

In the feedback system of the GPs, it will be possible to filter on the province/district/first line zone where your practice is situated. On a scientific level, it could be interesting to have a possibility to filter on practice type (solo practice, group practice, community health center, …). On the other hand, it will not change anything in the feedback that will be given. Therefore, we chose to not have this possibility.

The danger of an A&F system

An important reason for the good effect of an A&F system is the fact that general practitioners have a quite perfectionist character that makes them strive for 'the best'. (74) When a GP sees that his/her performance is not as good as the average performance of the other GPs, he/she will be motivated to do better next time. This competition between general practitioners is a good thing, because it can produce better outcomes. The biggest danger is that this competition takes too large dimensions. (75) This can lead to totally wrong purposes, namely aiming at being the best general practitioner, instead of aiming at improving the care of CKD patients. The A&F system could result in 'gaming', where GPs manipulate their data to artificially improve their performance. (76) Another danger is the 'tunnel vision', where GPs are too much focused on the disease of the A&F system, so that not enough attention is given to other diseases. (77)

Another important note is that an A&F system can never contain a reward or punishment. An A&F system is meant to support a good performance, not to punish a bad performance. (75) Giving rewards can conflict with the intrinsic motivation of the GP to take part in the A&F system. (78) Moreover, A Cochrane review showed that the use of financial rewards is not linked with a statistical significant improvement of the quality of primary health care. (79)

CONCLUSION

With this study, we built a first version of a CKD feedback barometer . We saw that not every indicator could be transformed into a query due to human and technical limitations. The final list of indicators was tested on the selected Intego practices to generate a first version of a feedback report.

The final purpose is that this barometer will also be tested by general practitioners in their EMR. The A&F system is a complex intervention, so it will be essential to do a process evaluation. (80) Therefore, general practitioners should have the possibility to critically evaluate the feedback system by the use of a survey. (81) In this way, a user's centered design will be created where users can give their feedback on the reliability, quality and benefit of the feedback system. A 34-question questionnaire was developed by Ine Van den Wyngaert et al., but the paper is still 'under review'. After the necessary adjustments of the GPs, it should be possible to generate an optimal feedback barometer that can be used by general practitioners to self-evaluate the care they are giving to their CKD patients.

In this way, this barometer forms a base for the future care we will be delivering to our patients. The final purpose of the barometer is improving the care for our CKD patients. Studies in the future will learn if there is an effect on the outcome of these patients in terms of morbidity and mortality.

CONFLICT OF INTEREST

The authors have declared that no competing interests exist.

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APPENDICES

Appendix 1: Ethical approval

SCONE is het platform voor stages, masterproeven en keuzevakken van de KU Leuven Groep Biomedische Wetenschappen

Geachte professor Bert Vaes,
Beste student Laurien Paredis,

Betreffende masterproef "Ontwikkeling van een gestandaardiseerde audit in het EMD ter evaluatie van de indicatoren voor kwaliteit van zorg bij patiënten met chronische nierinsufficiëntie in de eerste lijn" (MP022773)

De verstrekte informatie toont aan dat het onderzoek in het kader van de masterproef integraal deel uitmaakt van een studie die reeds werd goedgekeurd door een erkend ethisch comité.

U hoeft bijgevolg geen nieuw dossier in te dienen in het kader van uw masterproef. Wel dient u het UZ/KU Leuven toe te voegen als nieuw deelnemend centrum aan het huidige dossier indien dit nog niet het geval was. Gelieve u bij het betreffende comité te informeren en u te conformeren aan de daar geldende procedures en hun adviezen te volgen.

Onder voorbehoud van de volledigheid en correctheid van de door u verstrekte gegevens, krijgt u hierbij de goedkeuring om het onderzoek in het kader van de masterproef te starten.

Wij willen u erop attent maken dat u zelf verantwoordelijk blijft voor uw onderzoek. Bovendien doet elke wijziging aan de door u verstrekte gegevens omtrent de onderzoeksopzet elke eerdere goedkeuring vervallen. U dient in dat geval een amendement te maken aan uw huidig dossier bij het comité dat eerder uw dossier goedkeurde.

Veel succes!

Appendix 2: List of final indicators and according queries

We used the ICD-10 classification for medical diseases and the ATC classification for medication and vaccines. (82)(83)

INDICATOR NO	INDICATOR DESCRIPTION	ACCORDING QUERY
1	Percentage of patients with two eGFR measurements < 60 ml/min./1.73 m^2 with at least 3 months in between, diagnosed with CKD	DENOMINATOR - AND GMD belonging to one of the active users in the practice in the last 2y (verify that the most recent GMD is belonging to the practice); - AND patient status active; - AND age > 18y; - AND all patients with at least one measurement of eGFR (CKD-EPI formula) < 60 ml/min./1.73 m^2 in the 2 years until 2 weeks before the index date (=eGFR1). If there are more measurements, note than the most recent measurement; - AND second measurement of eGFR < 60 ml/min./1.73 m^2, at least 3 months and maximum 2 years before the date of eGFR1. NUMERATOR Denominator AND all patients with the diagnosis of CKD as an active care element in their EMR (ICD-10 N 18.9).
1a	Percentage of patients with two eGFR measurements 45-59 ml/min./1.73 m^2 with at least 3 months in between, diagnosed with CKD G3a	DENOMINATOR - AND GMD belonging to one of the active users in the practice in the last 2y (verify that the most recent GMD is belonging to the practice); - AND patient status active; - AND age > 18y; - AND all patients with at least one measurement of eGFR (CKD-EPI formula) 45-59 ml/min./1.73 m^2 in the 2 years until 2 weeks before the index date (=eGFR1) . If there are more measurements, note than the most recent measurement; - AND second measurement of eGFR 45-59 ml/min./1.73 m^2, at least 3 months and maximum 2 years before the date of eGFR1. NUMERATOR Denominator AND all patients with the diagnosis of CKD G3a as an active care element in their EMR (ICD-10 N 18.3).
1b	Percentage of patients with two eGFR measurements 30-44 ml/min./1.73 m^2 with at least 3 months in between, diagnosed with CKD G3b	DENOMINATOR - AND GMD belonging to one of the active users in the practice in the last 2y (verify that the most recent GMD is belonging to the practice); - AND patient status active; - AND age > 18y; - AND all patients with at least one measurement of eGFR (CKD-EPI formula) 30-44 ml/min./1.73 m^2 in the 2 years until 2 weeks before the index date (=eGFR1) . If there are more measurements, note than the most recent measurement; - AND second measurement of eGFR 30-44 ml/min./1.73 m^2, at least 3 months and maximum 2 years before the date of eGFR1. NUMERATOR Denominator AND all patients with the diagnosis of CKD G3b as an active care element in their EMR (ICD-10 N 18.3).
2	Percentage of patients with hypertension, diabetes mellitus, chronic NSAID use or a history of heart- and blood vessel disease, in whom eGFR and albuminuria	DENOMINATOR - AND GMD belonging to one of the active users in the practice in the last 2y (verify that the most recent GMD is belonging to the practice); - AND patient status active; - AND age > 18y;

	or proteinuria are determined once a year	- AND all patients with * OR 1 of the following diagnoses as an active care element in their EMR, with the first date of diagnosis > 1 year before the index date (today - 1y) Hypertension (ICD-10 I10-I15) Diabetes mellitus (ICD-10 E10-E14) History of heart- and blood vessel disease (ICD-10 I20-I25, I26-I28, I30- I52, I60-I69, I70-I79, I80-I89, I95-I99); * OR chronic NSAID use: NSAID (both 200mg and 400mg) present in the medication list as an 'active' and 'chronic' medicine (ATC M01A and M01B). NUMERATOR Denominator AND [- AND all patients with an eGFR measurement in the last year (today - 1y); - AND all patients with: OR an albuminuria (for diabetics) OR a proteinuria (for non-diabetics) measurement in the last year (today - 1y)].
3	Percentage of patients with CKD with an eGFR ≥ 60 ml/min./1.73 m^2, whose eGFR is tested annually	DENOMINATOR - AND GMD belonging to one of the active users in the practice in the last 2y (verify that the most recent GMD is belonging to the practice); - AND patient status active; - AND age > 18y; - AND diagnosis of CKD as an active care element in the EMR for > 1y (today -1y); - AND all patients with at least one eGFR value ≥ 60 > 1y before the index date (today - 1y). If there are more measurements, note than the most recent measurement. NUMERATOR Denominator AND all patients with an eGFR measurement in the last year (today - 1y).
4	Percentage of patients with CKD with an eGFR between 30-59 ml/min./1.73 m^2, who are tested every six months	DENOMINATOR - AND GMD belonging to one of the active users in the practice in the last 2y (verify that the most recent GMD is belonging to the practice); - AND patient status active; - AND age > 18y; - AND diagnosis of CKD as an active care element in the EMR for > 1y (today -1y); - AND all patients with at least one eGFR value 30-59 > 6 months before the index date (today - 6 months). If there are more measurements, note than the most recent measurement. NUMERATOR Denominator AND all patients with an eGFR measurement in the last 6 months (today - 6 months).
5	Percentage of patients with CKD with an eGFR between 15-29 ml/min./1.73 m^2, who are tested every three months	DENOMINATOR - AND GMD belonging to one of the active users in the practice in the last 2y (verify that the most recent GMD is belonging to the practice); - AND patient status active; - AND age > 18y; - AND diagnosis of CKD as an active care element in the EMR for > 1y (today -1y). - AND all patients with at least one eGFR value 15-29 > 3 months before the index date (today - 3 months). If there are more measurements, note than the most recent measurement.

		NUMERATOR Denominator AND all patients with an eGFR measurement in the last 3 months (today - 3 months).
6	Percentage of patients with CKD, in whom the eGFR, albuminuria (for diabetics) and proteinuria (for non-diabetics) are determined at least once a year	DENOMINATOR - AND GMD belonging to one of the active users in the practice in the last 2y (verify that the most recent GMD is belonging to the practice); - AND patient status active; - AND age > 18y; - AND diagnosis of CKD as an active care element in the EMR for > 1y (today -1y). NUMERATOR Denominator AND [- AND all patients with an eGFR measurement in the last year (today - 1y); - AND all patients with: OR an albuminuria (for diabetics) OR a proteinuria (for non-diabetics) measurement in the last year (today - 1y)].
7d	Percentage of patients with CKD with an eGFR < 45 ml/min./1.73 m^2 and a reduced Hb, in whom ferritin and transferrin saturation is measured at least once a year.	DENOMINATOR - AND GMD belonging to one of the active users in the practice in the last 2y (verify that the most recent GMD is belonging to the practice); - AND patient status active; - AND age > 18y; - AND diagnosis of CKD as an active care element in the EMR for > 1y (today -1y); - AND all patients with an eGFR value < 45 in the last blood sample, > 1y before the index date (today - 1y); - AND all patients with a reduced Hb in the last blood sample, > 1y before the index date (today - 1y). NUMERATOR Denominator AND all patients with a measurement of ferritin and transferrin saturation in the last year (today -1y).
8	Percentage of patients with CKD who are vaccinated with an influenza vaccine annually	DENOMINATOR - AND GMD belonging to one of the active users in the practice in the last 2y (verify that the most recent GMD is belonging to the practice); - AND patient status active; - AND age > 18y; - AND diagnosis of CKD as an active care element in the EMR for > 1y (today -1y). NUMERATOR Denominator AND all patients with an influenza vaccination in the last year (today - 1y).
9	Percentage of patients with CKD who are fully vaccinated with one or more pneumococcal vaccines following the scheme	DENOMINATOR - AND GMD belonging to one of the active users in the practice in the last 2y (verify that the most recent GMD is belonging to the practice); - AND patient status active; - AND age > 18y; - AND diagnosis of CKD as an active care element in the EMR for > 1y (today -1y). NUMERATOR Denominator AND [- OR all patients that have received PCV20; - OR all patients that have received PCV15 as first vaccination and that have been vaccinated with a PPV23 vaccine after minimum 8 weeks; - OR all patients that have received PPV23 as first vaccination and that have been vaccinated with a PCV20 vaccine minimum 1 year after the last PPV23 vaccine;

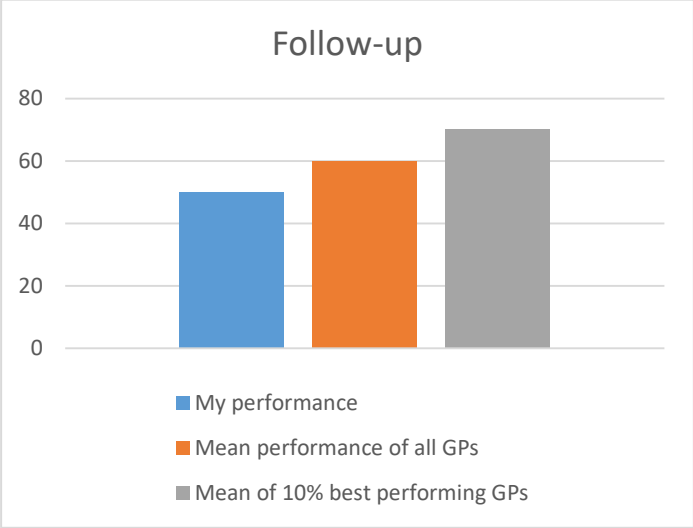
		- OR all patients that have received PCV13 as first vaccination and that have been vaccinated with a PPV23 vaccine after minimum 8 weeks (ATC for all pneumococcal vaccines: J07AL)]. Note: This scheme is based on the 2022 (August) recommendations of the 'Hoge Gezondheidsraad'. (27)
11c	Percentage of patients with CKD, who are encouraged to limit alcohol intake	DENOMINATOR - AND GMD belonging to one of the active users in the practice in the last 2y (verify that the most recent GMD is belonging to the practice); - AND patient status active; - AND age > 18y; - AND diagnosis of CKD as an active care element in the EMR for > 1y (today -1y). NUMERATOR Denominator AND all patients for whom the alcohol intake was electronically registered in the last year (today - 1y).
13	Percentage of patients with CKD - with diabetes and a strongly increased albuminuria (> 300 mg/g or > 300 mg/24 hours) or moderately increased albuminuria (30-300 mg/g or 30-300 mg/24 hours), OR - without diabetes and proteinuria who are treated with an ARB or an ACE inhibitor	DENOMINATOR - AND GMD belonging to one of the active users in the practice in the last 2y (verify that the most recent GMD is belonging to the practice); - AND patient status active; - AND age > 18y; - AND diagnosis of CKD as an active care element in the EMR for > 1y (today -1y). - AND all patients with * OR diabetes mellitus as an active care element in their EMR (ICD-10 E10-E14) AND strongly or moderately increased albuminuria (replaced by a measurement of ACR in the last urine sample of > 300mg/g and 30-300 mg/g respectively, > 6 months before the index date; * OR without diabetes mellitus as an active care element in their EMR AND proteinuria of > 0.5g/day (replaced by a measurement of TPCR in the last urine sample of 500 mg/g, > 6 months before the index date. NUMERATOR Denominator AND all patients with ARB or ACE-I present as an 'active' and 'chronic' medicine in their EMR (ATC C09). Note: We will use proteinuria for non-diabetics and albuminuria for diabetics. This is according to the guidelines of Domus Medica (37)
15	Percentage of patients with CKD in whom a one-time lipid profile (total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides) is determined	DENOMINATOR - AND GMD belonging to one of the active users in the practice in the last 2y (verify that the most recent GMD is belonging to the practice); - AND patient status active; - AND age > 18y; - AND diagnosis of CKD as an active care element in the EMR for > 1y (today -1y). NUMERATOR Denominator AND all patients with a one-time lipid profile measurement in their EMR (total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides).
16	Percentage of patients with CKD with - proteinuria ≥ 1 g/day or - diabetes mellitus or - strongly increased albuminuria	DENOMINATOR - AND GMD belonging to one of the active users in the practice in the last 2y (verify that the most recent GMD is belonging to the practice); - AND patient status active; - AND age > 18y;

	(ACR > 300 mg/g creatinin or > 300 mg/24 hours) or - ACR ≥ 700 mg/g in whom the target BP of < 130/80 mmHg (SBP range 120 - 129 mmHg) is achieved by using the first choice antihypertensive drugs (ACE inhibitors or ARBs)	- AND diagnosis of CKD as an active care element in the EMR for > 1y (today -1y); - AND all patients with: * OR proteinuria ≥ 1 g/day (TPCR of 1000 mg/g creatinin in the last urine sample > 6 months before the index date); * OR diabetes mellitus as an active care element in the EMR (ICD-10 10-E14); * OR strongly increased albuminuria (ACR > 300 mg/g creatinin in their last urine sample > 6 months before the index date); * OR ACR ≥ 700 mg/g creatinin in their last urine sample > 6 months before the index date. NUMERATOR Denominator AND all patients with: - AND blood pressure < 130/80 mmHg, meaning that the most recent value for SBP (in the 6 months before the index date) is between 120-129 mmHg; - AND first-choice antihypertensivum ACE-I or ARB (ATC C09) as an 'active' and 'chronic' medicine in the EMR.
21	Percentage of patients with CKD with an eGFR < 30 ml/min./1.73 m^2, in whom metformin is prescribed/ is not prescribed	DENOMINATOR - AND GMD belonging to one of the active users in the practice in the last 2y (verify that the most recent GMD is belonging to the practice); - AND patient status active; - AND age > 18y; - AND diagnosis of CKD as an active care element in the EMR for > 1y (today -1y); - AND all patients with an eGFR value < 30 in the last blood sample, > 6 months before the index date (today - 6 months). NUMERATOR Denominator AND all patients with metformin or combination products as an 'active' and 'chronic' medicine in their EMR (ATC A10BA02, A10BD17, A10BD13, A10BD16, A10BD15, A10BD20, A10BD23, A10BD22, A10BD18, A10BD11, A10BD26, A10BD05, A10BD14, A10BD03, A10BD10, A10BD07, A10BD02, A10BD08, A10BD27, A10BD25).

Appendix 3: Possible ways to give feedback

Diagram

A first way of giving feedback, is by using a diagram. It gives a good visual representation of the necessary information.



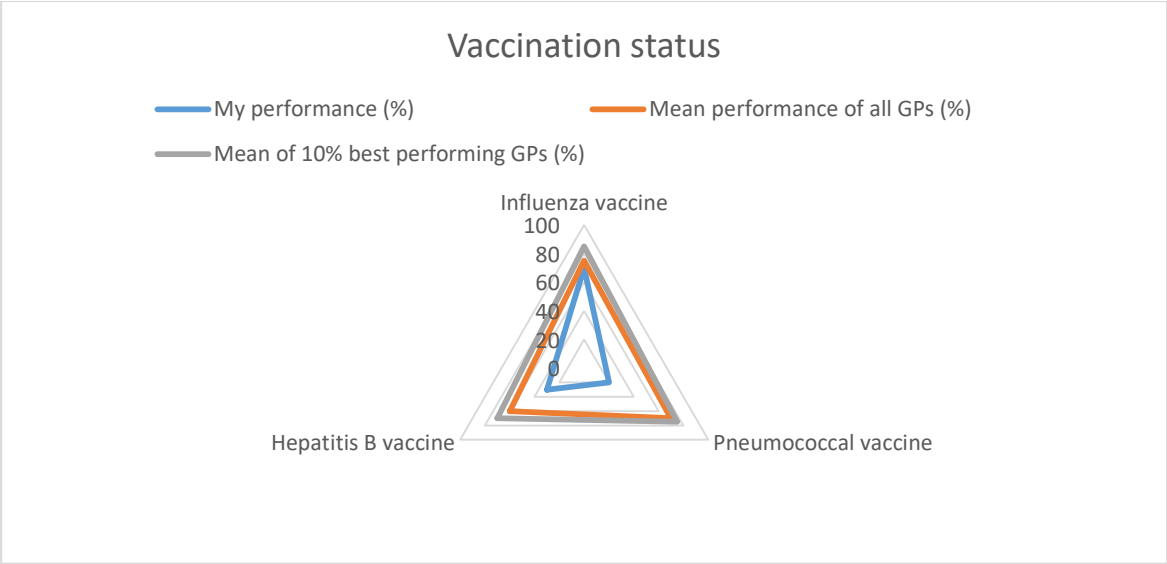
Table

Another possibility of visualizing, is by using a table. The big advantage of a table, is that you can see the exact percentages. A disadvantage is that it is less visual for the reader.

	My performance (%)	Mean performance of all GPs of Belgium or first line zone (%)	Mean of 10% best performing GPs (%)
Follow-up	50	60	70

Radar diagram

A third way of giving feedback is by using a radar diagram. This provides a visual overview of your strengths and limitations in comparison with the benchmark. In the following image, we give an example about the vaccination status. This practice has a good performance concerning influenza vaccination, but has a lower score on pneumococcal and hepatitis B vaccination in comparison with the benchmarks.



	My performance (%)	Mean performance of all GPs (%)	Mean of 10% best performing GPs (%)
Influenza vaccine	70	75	85
Pneumococcal vaccine	20	70	75
Hepatitis B vaccine	30	60	70

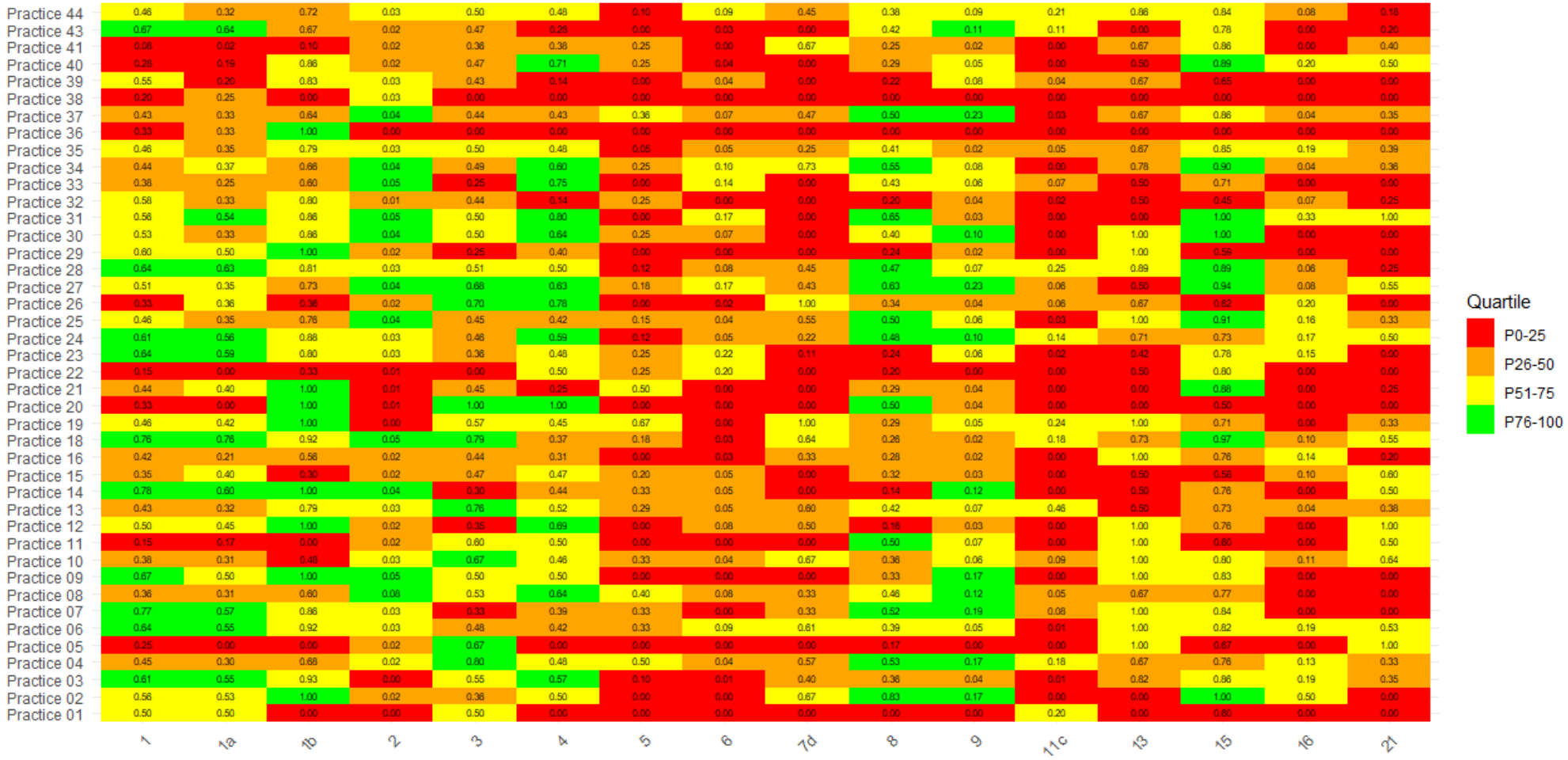
Circle diagram

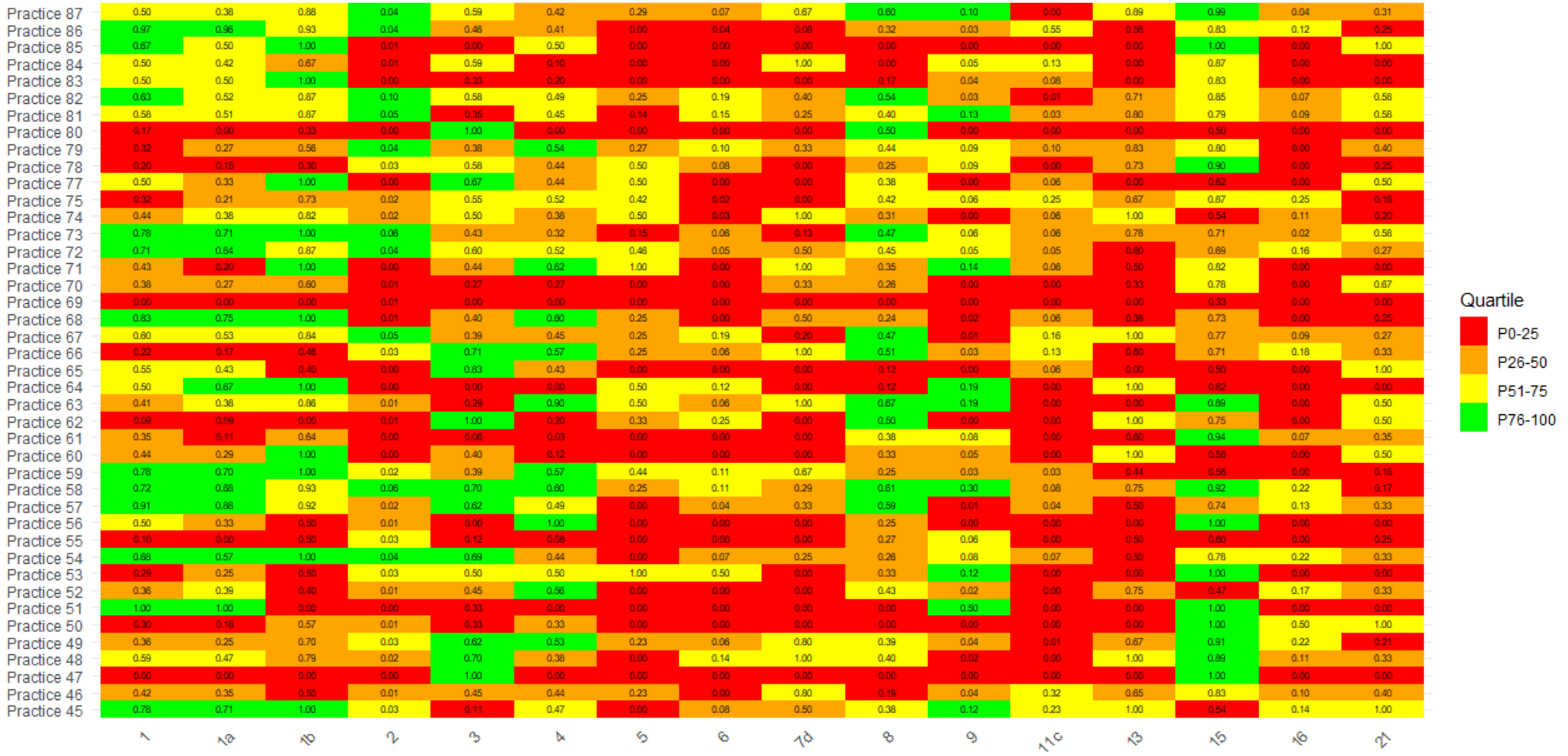
A last possibility is a circle diagram. A big disadvantage of a circle diagram, is that you cannot compare your performance with a benchmark.



Appendix 4: Heat map of performances of Intego practices

Visualization of results in 128 Intego practices. Each row presents one practice, each column presents one quality indicator. For each practice, the performance on each indicator is represented in a decimal notation. The color codes represent percentiles in which the performance of the practice is situated in regard to the other practices.




Practice 87 0.50 0.36 0.88 0.04 0.59 0.42 0.29 0.07 0.67 0.60 0.10 0.00 0.89 0.99 0.04 0.31
Practice 86 0.97 0.96 0.93 0.04 0.46 0.41 0.00 0.04 0.06 0.32 0.03 0.55 0.56 0.83 0.12 0.25
Practice 85 0.67 0.50 1.00 0.01 0.00 0.50 0.00 0.00 0.00 0.00 0.00 0.00 0.00 1.00 0.00 1.00
Practice 84 0.50 0.42 0.67 0.01 0.59 0.10 0.00 0.00 1.00 0.00 0.05 0.13 0.00 0.87 0.00 0.00
Practice 83 0.50 0.50 1.00 0.00 0.33 0.20 0.00 0.00 0.00 0.17 0.04 0.06 0.00 0.83 0.00 0.00
Practice 82 0.83 0.52 0.87 0.10 0.58 0.49 0.25 0.19 0.40 0.54 0.03 0.01 0.71 0.85 0.07 0.58
Practice 81 0.58 0.51 0.87 0.05 0.35 0.45 0.14 0.15 0.25 0.40 0.13 0.03 0.80 0.79 0.09 0.58
Practice 80 0.17 0.00 0.33 0.00 1.00 0.00 0.00 0.00 0.00 0.50 0.00 0.00 0.00 0.50 0.00 0.00
Practice 79 0.32 0.27 0.56 0.04 0.38 0.54 0.27 0.10 0.33 0.44 0.09 0.10 0.83 0.80 0.00 0.40
Practice 78 0.20 0.15 0.30 0.03 0.58 0.44 0.50 0.06 0.00 0.25 0.09 0.00 0.73 0.90 0.00 0.25
Practice 77 0.50 0.33 1.00 0.00 0.67 0.44 0.50 0.00 0.00 0.38 0.00 0.06 0.00 0.82 0.00 0.50
Practice 75 0.32 0.21 0.73 0.02 0.55 0.52 0.42 0.02 0.00 0.42 0.06 0.25 0.67 0.87 0.25 0.18
Practice 74 0.44 0.38 0.82 0.02 0.50 0.38 0.50 0.03 1.00 0.31 0.00 0.06 1.00 0.54 0.11 0.20
Practice 73 0.78 0.71 1.00 0.06 0.43 0.32 0.15 0.06 0.13 0.47 0.06 0.06 0.78 0.71 0.02 0.58
Practice 72 0.71 0.64 0.87 0.04 0.60 0.52 0.46 0.05 0.50 0.45 0.05 0.05 0.60 0.69 0.16 0.27
Practice 71 0.43 0.20 1.00 0.00 0.44 0.62 1.00 0.00 1.00 0.35 0.14 0.06 0.50 0.82 0.00 0.00
Practice 70 0.38 0.27 0.60 0.01 0.27 0.27 0.00 0.00 0.33 0.26 0.00 0.00 0.33 0.78 0.00 0.67
Practice 69 0.00 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.33 0.00 0.00
Practice 68 0.83 0.75 1.00 0.01 0.40 0.60 0.25 0.00 0.50 0.24 0.02 0.06 0.38 0.73 0.00 0.25
Practice 67 0.60 0.53 0.84 0.05 0.39 0.45 0.25 0.19 0.20 0.47 0.01 0.16 1.00 0.77 0.09 0.27
Practice 66 0.22 0.17 0.46 0.03 0.71 0.57 0.25 0.06 1.00 0.51 0.03 0.13 0.60 0.71 0.18 0.33
Practice 65 0.55 0.43 0.40 0.00 0.83 0.43 0.00 0.00 0.00 0.12 0.00 0.06 0.00 0.50 0.00 1.00
Practice 64 0.50 0.67 1.00 0.00 0.00 0.00 0.50 0.12 0.00 0.12 0.19 0.00 1.00 0.62 0.00 0.00
Practice 63 0.41 0.38 0.86 0.01 0.29 0.90 0.50 0.06 1.00 0.67 0.19 0.00 0.00 0.89 0.00 0.50
Practice 62 0.09 0.09 0.00 0.01 1.00 0.20 0.33 0.25 0.00 0.50 0.00 0.00 1.00 0.75 0.00 0.50
Practice 61 0.35 0.11 0.64 0.00 0.06 0.03 0.00 0.00 0.00 0.38 0.08 0.00 0.60 0.94 0.07 0.35
Practice 60 0.44 0.29 1.00 0.00 0.40 0.12 0.00 0.00 0.00 0.33 0.05 0.00 1.00 0.58 0.00 0.50
Practice 59 0.78 0.70 1.00 0.02 0.39 0.57 0.44 0.11 0.67 0.25 0.03 0.03 0.44 0.58 0.00 0.18
Practice 58 0.72 0.68 0.93 0.06 0.70 0.60 0.25 0.11 0.29 0.61 0.30 0.08 0.75 0.92 0.22 0.17
Practice 57 0.91 0.88 0.92 0.02 0.62 0.49 0.00 0.04 0.33 0.59 0.01 0.04 0.50 0.74 0.13 0.33
Practice 56 0.50 0.33 0.50 0.01 0.00 1.00 0.00 0.00 0.00 0.25 0.00 0.00 0.00 1.00 0.00 0.00
Practice 55 0.10 0.00 0.50 0.03 0.12 0.08 0.00 0.00 0.00 0.27 0.06 0.00 0.50 0.60 0.00 0.25
Practice 54 0.68 0.57 1.00 0.04 0.69 0.44 0.00 0.07 0.25 0.26 0.08 0.07 0.50 0.78 0.22 0.33
Practice 53 0.29 0.25 0.50 0.03 0.50 0.50 1.00 0.50 0.00 0.33 0.12 0.00 0.00 1.00 0.00 0.00
Practice 52 0.36 0.39 0.40 0.01 0.45 0.56 0.00 0.00 0.00 0.43 0.02 0.00 0.75 0.47 0.17 0.33
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Practice 50 0.30 0.18 0.57 0.01 0.33 0.33 0.00 0.00 0.00 0.00 0.00 0.00 0.00 1.00 0.50 1.00
Practice 49 0.36 0.25 0.70 0.03 0.62 0.53 0.23 0.06 0.80 0.39 0.04 0.01 0.67 0.91 0.22 0.21
Practice 48 0.59 0.47 0.79 0.02 0.70 0.38 0.00 0.14 1.00 0.40 0.02 0.00 1.00 0.89 0.11 0.33
Practice 47 0.00 0.00 0.00 0.00 1.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 1.00 0.00 0.00
Practice 46 0.42 0.35 0.50 0.01 0.45 0.44 0.23 0.00 0.80 0.19 0.04 0.32 0.65 0.83 0.10 0.40
Practice 45 0.78 0.71 1.00 0.03 0.11 0.47 0.00 0.08 0.50 0.38 0.12 0.23 1.00 0.54 0.14 1.00
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Quartile
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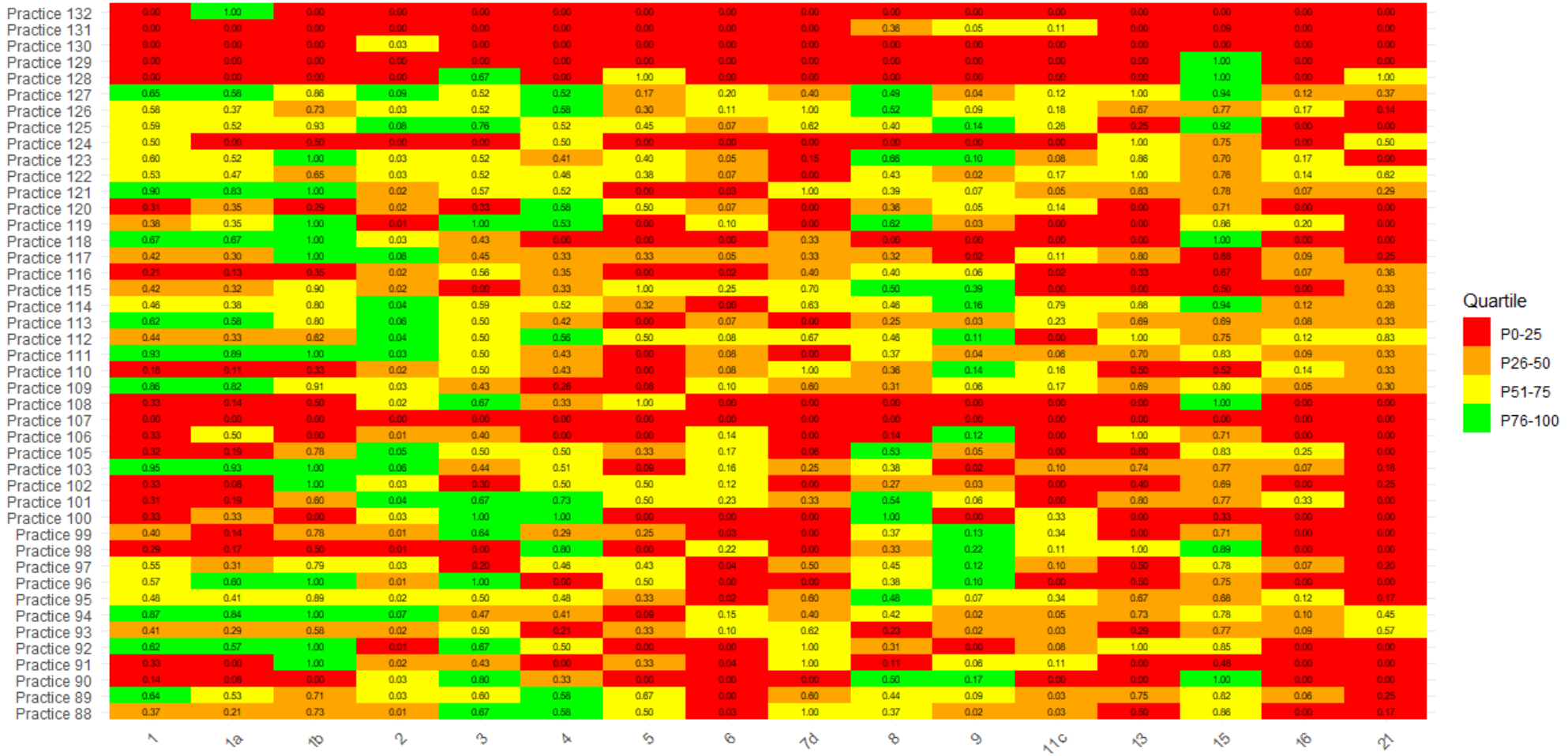
P76-100


Practice 132 0.00 1.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
Practice 131 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.36 0.05 0.11 0.00 0.09 0.00 0.00
Practice 130 0.00 0.00 0.00 0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
Practice 129 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 1.00 0.00 0.00
Practice 128 0.00 0.00 0.00 0.00 0.67 0.00 1.00 0.00 0.00 0.00 0.00 0.00 0.00 1.00 0.00 1.00
Practice 127 0.65 0.58 0.86 0.09 0.52 0.52 0.17 0.20 0.40 0.49 0.04 0.12 1.00 0.94 0.12 0.37
Practice 126 0.58 0.37 0.73 0.03 0.52 0.58 0.30 0.11 1.00 0.52 0.09 0.18 0.67 0.77 0.17 0.14
Practice 125 0.59 0.52 0.93 0.08 0.76 0.52 0.45 0.07 0.62 0.40 0.14 0.28 0.25 0.92 0.00 0.00
Practice 124 0.50 0.00 0.50 0.00 0.00 0.50 0.00 0.00 0.00 0.00 0.00 0.00 1.00 0.75 0.00 0.50
Practice 123 0.60 0.52 1.00 0.03 0.52 0.41 0.40 0.05 0.15 0.66 0.10 0.08 0.86 0.70 0.17 0.00
Practice 122 0.53 0.47 0.65 0.03 0.52 0.46 0.38 0.07 0.00 0.43 0.02 0.17 1.00 0.76 0.14 0.62
Practice 121 0.90 0.83 1.00 0.02 0.57 0.52 0.00 0.03 1.00 0.39 0.07 0.05 0.83 0.78 0.07 0.29
Practice 120 0.31 0.35 0.29 0.02 0.33 0.58 0.50 0.07 0.00 0.38 0.05 0.14 0.00 0.71 0.00 0.00
Practice 119 0.38 0.35 1.00 0.01 1.00 0.53 0.00 0.10 0.00 0.62 0.03 0.00 0.00 0.86 0.20 0.00
Practice 118 0.67 0.67 1.00 0.03 0.43 0.00 0.00 0.00 0.33 0.00 0.00 0.00 0.00 1.00 0.00 0.00
Practice 117 0.42 0.30 1.00 0.06 0.45 0.33 0.33 0.05 0.33 0.32 0.02 0.11 0.80 0.68 0.09 0.25
Practice 116 0.21 0.13 0.35 0.02 0.56 0.35 0.00 0.02 0.40 0.40 0.06 0.02 0.33 0.67 0.07 0.38
Practice 115 0.42 0.32 0.90 0.02 0.00 0.33 1.00 0.25 0.70 0.50 0.39 0.00 0.00 0.50 0.00 0.33
Practice 114 0.46 0.38 0.80 0.04 0.59 0.52 0.32 0.00 0.63 0.46 0.16 0.79 0.88 0.94 0.12 0.28
Practice 113 0.62 0.58 0.80 0.06 0.50 0.42 0.00 0.07 0.00 0.25 0.03 0.23 0.69 0.69 0.08 0.33
Practice 112 0.44 0.33 0.62 0.04 0.50 0.56 0.50 0.08 0.67 0.46 0.11 0.00 1.00 0.75 0.12 0.83
Practice 111 0.93 0.89 1.00 0.03 0.50 0.43 0.00 0.08 0.00 0.37 0.04 0.06 0.70 0.83 0.09 0.33
Practice 110 0.18 0.11 0.33 0.02 0.50 0.43 0.00 0.08 1.00 0.36 0.14 0.16 0.50 0.52 0.14 0.33
Practice 109 0.86 0.82 0.91 0.03 0.43 0.28 0.08 0.10 0.60 0.31 0.06 0.17 0.69 0.80 0.05 0.30
Practice 108 0.33 0.14 0.50 0.02 0.67 0.33 1.00 0.00 0.00 0.00 0.00 0.00 0.00 1.00 0.00 0.00
Practice 107 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
Practice 106 0.33 0.50 0.00 0.01 0.40 0.00 0.00 0.14 0.00 0.14 0.12 0.00 1.00 0.71 0.00 0.00
Practice 105 0.32 0.19 0.78 0.05 0.50 0.50 0.33 0.17 0.08 0.53 0.05 0.00 0.80 0.83 0.25 0.00
Practice 103 0.95 0.93 1.00 0.06 0.44 0.51 0.09 0.16 0.25 0.38 0.02 0.10 0.74 0.77 0.07 0.16
Practice 102 0.33 0.08 1.00 0.03 0.30 0.50 0.50 0.12 0.00 0.27 0.03 0.00 0.40 0.69 0.00 0.25
Practice 101 0.31 0.19 0.60 0.04 0.67 0.73 0.50 0.23 0.33 0.54 0.06 0.00 0.80 0.77 0.33 0.00
Practice 100 0.33 0.33 0.00 0.03 1.00 1.00 0.00 0.00 0.00 1.00 0.00 0.33 0.00 0.33 0.00 0.00
Practice 99 0.40 0.14 0.78 0.01 0.64 0.29 0.25 0.03 0.00 0.37 0.13 0.34 0.00 0.71 0.00 0.00
Practice 98 0.29 0.17 0.50 0.01 0.00 0.80 0.00 0.22 0.00 0.33 0.22 0.11 1.00 0.89 0.00 0.00
Practice 97 0.55 0.31 0.79 0.03 0.20 0.46 0.43 0.04 0.50 0.45 0.12 0.10 0.50 0.78 0.07 0.20
Practice 96 0.57 0.60 1.00 0.01 1.00 0.00 0.50 0.00 0.00 0.38 0.10 0.00 0.50 0.75 0.00 0.00
Practice 95 0.48 0.41 0.89 0.02 0.50 0.48 0.33 0.02 0.60 0.48 0.07 0.34 0.67 0.68 0.12 0.17
Practice 94 0.87 0.84 1.00 0.07 0.47 0.41 0.09 0.15 0.40 0.42 0.02 0.05 0.73 0.78 0.10 0.45
Practice 93 0.41 0.29 0.58 0.02 0.50 0.21 0.33 0.10 0.62 0.23 0.02 0.03 0.29 0.77 0.09 0.57
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Practice 91 0.33 0.00 1.00 0.02 0.43 0.00 0.33 0.04 1.00 0.11 0.06 0.11 0.00 0.48 0.00 0.00
Practice 90 0.14 0.08 0.00 0.03 0.80 0.33 0.00 0.00 0.00 0.50 0.17 0.00 0.00 1.00 0.00 0.00
Practice 89 0.64 0.53 0.71 0.03 0.60 0.58 0.67 0.00 0.60 0.44 0.09 0.03 0.75 0.82 0.06 0.25
Practice 88 0.37 0.21 0.73 0.01 0.67 0.58 0.50 0.03 1.00 0.37 0.02 0.03 0.50 0.86 0.00 0.17
1 1a 1b 2 3 4 5 6 7d 8 9 11c 13 15 16 21
Quartile
P0-25
P26-50
P51-75
P76-100

Appendix 5: Contacts with promotor

- 7th January 2022: group meeting with promotor (Zoom)
  - Introduction to promotor and other students
  - Explanation of possible thesis topics
- 19th January 2022: group meeting with promotor (Zoom)
  - Definitive choice of topic by each student
- 16th March 2022: individual meeting with promotor (Zoom)
  - Explanation of first steps in the process: reading literature and writing an introduction, think about methods and first steps in creating the barometer
- 29th April 2022: individual meeting with promotor (Zoom)
  - Discussion of introduction and first version of methods
  - Explanation of next step in process: writing queries to do the data extraction in the EMR, searching for evidence for each query
- 17th August 2022: live meeting with promotor (St. Rafael's hospital)
  - Discussion of first version of queries
  - Explanation of next step in process: writing queries more in detail
- August 2022 – February 2023
  - Feedback by mail: feedback on the first version of queries by different readers
  - Next step: thinking about way of giving feedback
- 24th February 2023: individual meeting with promotor (Zoom)
  - Discussion of queries more in detail
  - Discussion of way of giving feedback to the general practitioners
  - Explanation of next step in process: writing an Excel document as a base for the statistician
  - Introduction to Justine Soetaert
- 28th February 2023: individual meeting with Justine Soetaert (Skype)
  - Introduction in current project of Justine (diabetes barometer)
  - Explanation of the different steps in building feedback
- 29th June 2023: individual meeting with promotor and Justine Soetaert (Zoom)
  - Discussion possibilities and limitations of extraction, based on the experience of Justine
  - Discussion differences in extraction from Intego data versus EMR software
- 17th August 2023: individual meeting with dr. Van den Bulck (Teams)
  - Discussion about the right way of giving feedback to the general practitioners
- 14th September 2023: individual meeting with Justine Soetaert (Teams)
  - Discussion about first data extraction from Intego
  - Discussion about necessary adjustments in queries to generate a percentage for each indicator
  - Discussion of lay-out of feedback report
- 20th December 2023: group meeting with the whole research team together (Teams)
  - Discussion about further steps in the CKD barometer: reporting Intego data, defining benchmarks
  - Discussion about long-term planning of the different barometers

    - Introduction to Cristián Frigolett, who will help with the statistical analysis of the data from Intego
- 15th February 2024: group meeting with the whole research team together (Teams)
    - Discussion about defining the benchmark of '10% best'; becoming a consensus with the team
- 21st March 2024: individual meeting with promotor (Zoom)
    - Discussion about written part of thesis (results, methods, discussion)
    - Discussion about extra tables/figures to report in thesis: characteristics of population, benchmarks and eligible patient volume for each indicator
    - Discussion about heat map and necessary adjustments
- March – April 2024
    - E-mails with Cristián Frigolett and promotor, about the Intego data and the construction of the tables and heat map
    - Discussion about final choice of indicators and practices based on Intego data