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Consensus among clinicians on referrals' priority and use of digital decision-making support systems

KEYWORDS

Appropriateness; Decision support system; Outpatient services; Prioritization; Referrals; Waiting Lists.

1. INTRODUCTION

1.1. Background

Since the last economic crisis and before the onset of the coronavirus pandemic, health spending as a share of GDP across the OECD countries has remained in line with overall economic growth [1]. According to the most recent projections [2], up to 2030 the growth in health spending is expected to be slower than historical growth, but above the growth in the economy. The projected increase in healthcare costs and demand, fuelled by the COVID-19 pandemic, calls for an increase in efficiency, effectiveness and appropriateness of health care in order to ensure the financial sustainability and resilience of publicly funded health care systems which currently represents a major concern for policy makers [3].

Given the peculiarity of the interaction between the demand and the supply within the health care sector, one viable option to policy makers is to implement "demand management" tools to monitor, direct, or regulate patient referrals from primary care to specialist non-emergency care in hospital [4]. Such strategies include 'internal referrals' within and between general practitioners (GPs), task shifting among professional categories (e.g. between GPs and nurses), telephone triage systems, forms of patients' empowerment and information. In health systems where the GP acts as a gatekeeper and

defines patients' referral to specialist care, general practice is the main area of intervention to optimize the use of productive capacity [5], eventually reducing costly and potentially harmful waiting times [6], [7], [8].

Clinical prioritisation is one of the strategies to improve the management of referrals, and is based on the idea of setting shorter waiting times for patients with higher clinical need, and longer waiting times for patients with lower need [9]. Such a method of priority setting allows services to be planned based on measured patients' need as well as a better targeting of patients with the greatest likelihood of beneficial outcomes, optimizing the allocation of limited health care resources. Furthermore, it may reduce the scope of doctors giving inappropriately higher priority to 'their' patients, leading to a more equitable access to services [9], [10], [11]. Moreover, providing patients in urgent need with prompt access to services prevents the deterioration on health and can improve the effectiveness of the treatment [6].

Other advantages of clinical prioritization relate to the possibility of reducing inappropriate demand and variability in decision making. Finally, transparency in clinical prioritization can lead to better informed patients and encouragement of a truthful doctor-patient relationship [8], [9].

In 2020, the shortage of capacity raised by the COVID-19 pandemic has highlighted even more the need to set shared criteria for establishing clinical priorities in the access to healthcare services, to avoid delays in the diagnostic paths for patients with other diseases than COVID-19, such as cancer [12], [13].

1.2. Related literature

Many studies have focused on factors associated with the variability of GP's specialist referrals. The literature distinguishes between individual and contextual factors. The key

doctor-related individual factors are past experience, knowledge and beliefs whereas patient-related factors are the disease severity as well as the socio-economic status of the patient [14], [15].

Concerning context-related factors, the perception of waiting times and availability of doctors have been shown to affect referral decisions [14]. Thorsen et al. [16] identify the dialogue between GPs and specialists as key factor explaining the quality of referrals. They also found that GPs value the option of relying on templates. According to Liddy et al. [15], both the composition of the team of professionals taking care of the patient and the remuneration of professionals make a difference: in particular, interdisciplinary practices and GPs paid fee for service are negatively associated with referral rates.

Evidence upon the instruments to improve the quality of referrals from primary to secondary care is less compelling. In general, passive dissemination of local referral guidelines appears less effective than discussion and structured referral forms. Working in multidisciplinary teams is usually associated with higher quality referrals [17]. The value of peer review as a powerful tool to improve the quality of referrals, is also confirmed by Blank et al. [14], who identify, through a large review, four relevant strategies such as peer review and training/feedback, specialist consultation before referral, electronic referral, and community provision by specialists.

While the potential role of GPs in reducing unnecessary referrals and therefore enhancing the efficiency of spending on specialty care is well established [18], evidence on their use of decision support tools and, specifically on electronic referral support systems (e-RSS) is still lacking [14], [19].

Clinical priority setting for specialist visits and diagnostic tests, as a tool for gatekeeping, should ideally reduce the demand for referrals, eliminating those deemed inappropriate by

attributing a low priority to potentially inappropriate referrals which are considered deferrable. In doing so, clinical priority works to rationalize demand [8].

1.3. Aims and structure of the study

The effectiveness of clinical prioritisation depends crucially on the criteria that GPs adopt to set referral priorities in daily practice. For clinical prioritisation to be effective in the management of referrals, it is critical that GPs assess patient priority in the same way as specialists. Otherwise discordant referrals might result in duplicative tests, unnecessary treatments, and conflicting recommendations between one physician and another [20], [21], [22]. We however know very little whether this is the case.

This study fills this gap in knowledge. It tested empirically the degree of agreement (DoA) as a measure of consensus between GPs and specialists, using a dataset covering the GP referrals recorded in a Local Health Authority (LHA) in the North-East of Italy during the first six months of 2017.

Our main aim was to investigate the association between the DoA and two independent variables.

First, we hypothesized that the frequent use of an electronic decision support tool by GPs improved the degree of priority agreement with specialists. We therefore tested whether the DoA was positively associated with the use of the e-RSS increases. This hypothesis was in line with previous work [19], [23], [24], which however considered only a small sample of GPs and were focused on referrals for a reduced number of specialties.

Second, we hypothesized that GPs who were too concerned about waiting times regardless of the actual patient's health needs, may tend to systematically assign a high priority to referrals even when this would not have been necessary. We therefore tested if the DoA was negatively associated with the GP utilization of high priority categories.

Finally, the study investigated other GP related factors that could be associated with the DoA (as described in section 2.2).

The paper has the following structure. Section 2 describes the materials and methods of the analysis. Section 3 reports the results. Section 4 discusses them and Section 5 concludes.

2. MATERIALS AND METHODS

2.1. Institutional context

The Italian healthcare system is a National Health Service regionally based. The service is funded by general taxation. The main principles of the system as well as the core basic package of services to be evenly provided across the national territory are defined by the central government [25]. Within this framework, regions are autonomous in defining the organization of care; moreover, being responsible for the actual provision of services, through LHAs, they contract services and volumes with public autonomous and private providers (i.e. specialist physicians and hospitals).

The current study has been run in the LHA of the Autonomous Province of Trento, serving more than 530,000 inhabitants, in North–Eastern Italy. Appointments were scheduled by a centralized booking service in one of the several facilities operating in the catchment area, depending on the patient's place of residence or choice. More than 430 GPs work in the LHA (about 83% for the population aged ≥15 yrs and about 17% for the population aged <15). Complying with the Italian regulations, GPs complete a standard referral form including the patient's clinical details and indicating all specialist visits and diagnostic tests required.

The clinical prioritization approach called 'Homogeneous Waiting Groups' (HWGs) [*Raggruppamenti di Attesa Omogenea* or *RAO* in Italian] [24], [26] was developed by a

steering committee set up in 2000 including GPs' and specialists' representatives, through a 'plan-do-check-act' approach and a 'progressive involvement scheme' [27].

The steering committee identified 5 categories of maximum reasonable waiting times from the clinical standpoint:

- A (maximum waiting time of 3 days),
- B (not more than 10 days),
- C (not more than 30 days),
- P (planned follow-up examinations),
- E or NO LETTER (without a maximum wait).

The first three categories were considered 'high priority categories'.

Each category was defined on the assumption that the waiting time for diagnosis, between GP referral and specialist visit or diagnostic test, would not impair the patient's prognosis [26]. Several subgroups of GPs and specialists were established for each medical specialty to draft guidelines and identify clinical indications for each waiting time category. Where research evidence was available, it was used by the subgroups. In the absence of such evidence, the clinical guidelines were based solely on current, generally accepted clinical practice, according to a methodology based on 'colloquial evidence', which has been described as an informal evidence, used 'where scientific literature is sparse and to also capture the experience of all stakeholders in discussions, including that of experts' [28].

It is important to underline that patients who do not receive a HWG code are considered without priority, although the GP has the option of specifying this explicitly using the letter E. This means that GPs are not required to fill in a referral form if the patient is not considered to belong to any one of the high priority categories.

The final operational handbook, distributed to all GPs and specialists, consisted of referral instructions and guidelines for about one hundred specialist visits and diagnostic tests, which are included within 38 medical specialties, each with the same standardised waiting categories.

Within the LHA, all GPs use an electronic medical record (EMR) for their daily activity in the practice, and specialists use an electronic reporting tool. In the early 2000s, shortly after the writing of the operational handbook, an e-RSS was developed, which included clinical indications of the handbook, with the aim of supporting GPs in choosing priority categories.

It should be highlighted that e-RSS allows all GPs to visualize the list of the “clinical keywords” as they appear in the HWG and so choose signs, symptoms or suspected pathologies related to the patient when prescribing a specialist visit or a diagnostic test. Differently, specialists assign priority ticking the box “HWG” in their electronic reporting tool, without using a drop-down menu, therefore assigning priority only based on their own judgment.

After a pilot period involving small groups of GPs and specialists, the use of e-RSS was extended to the whole population of GPs, and thus also the collection of priority category reassignments by specialists. A decree of the Ministry of Economy and Finance in 2008 on the management of referrals and then the National Plan for Waiting List Management of the Ministry of Health 2010-2012 on referral timing, introduced four levels of priorities at a national level, with maximum waiting time comparing to HWGs, although using different letter codes (A, B, D, P).

2.2. Data

We analyzed about 500.000 referrals, which covered all specialties, prescribed by GPs working in the LHA, and booked by a centralized booking system from 1.1.2017 to 30.6.2017. We restricted the analysis to GPs with patients aged 15 years or older. We therefore excluded pediatricians who are primary care physicians responsible for guaranteeing the first level of care for children aged up to age 14. This led to 365 GPs. Out of these, we excluded 41 GPs for the following reasons: i) they had no referrals over the study period; ii) they did not use the e-RSS tool; iii) information on the age composition of the covered population was missing. One additional GP was excluded from the multivariate analysis because it appeared as a leverage GP (having 32 people served and 55 referrals). This left a sample of 323 GPs responsible for 457,164 referrals.

During the study period, specialist visits and diagnostic tests were performed by over 700 specialists. We focused our attention only on referrals for which the GPs used the e-RSS tool to indicate explicitly a priority level. Consequently, the agreement between GPs and specialists was calculated on 85,553 referrals with HWGs A, B, C, P and E out of 457,164 (19%) referrals.

We used data from three settings: the GP's practice, the specialist clinic and the GP's administrative database. The first dataset from the GP's practice included: the identification number (encrypted) of the GP, number of referrals for each GP (distinguishing between specialist visits and diagnostic tests), HWG reported by the GP for each referral, whether the GP used the e-RSS. The second dataset included HWG reported by specialist in the clinical record. The third dataset included, for each GP: age (years) and gender (dummy equal to one if female), the proportion of patient population aged 61 years and older registered with the GP practice, whether the GP was associated with other GPs on the same premises (dummy), and the geographical location of the GP

according to three health districts of the LHU (two dummy variables). Furthermore, we created a dummy variable “benchmark care” equal to one for GPs working in pilot district, where HWGs started, who could express a greater agreement compared to other GPs of LHA. Finally, considering that GPs use EMR privately acquired, and assuming that differences in effectiveness might arise among different software, we considered as nominal variable the EMR that GP was using. The EMRs used by GPs were of four different IT companies (three dummies using one as reference group).

For each GP, we calculated: the “e-RSS utilization rate”, that is the number of referrals prescribed by each GP through the e-RSS expressed as a percentage of the total number of her/his referrals; the percentage of high priority ABC HWGs, that is the percentage rate of referrals with HWG category A, B or C out of the total number of her/his referrals.

The outcome variable measured the degree of consensus between GP and specialist upon the priority assigned to each referred patient, and it was calculated by the weighted kappa coefficient [29],[30] which evaluates the concordance between GPs and specialists in assigning the HWG category (A, B, C, E or P). Weighted kappa ranges between -1 and 1. Values less than or equal to zero indicate disagreement; values between 0.01–0.20 indicate slight agreement, between 0.21–0.40 fair, between 0.41– 0.60 moderate, between 0.61–0.80 substantial; and between 0.81 and 1.00 indicate high agreement. Table A1 in the Appendix reports the weights used for the calculation of the weighted kappa. Using the weighted kappa has the advantage of accounting for the intensity of agreement or disagreement. The weighted kappa can be interpreted as the proportion of weighted agreement corrected by chance [29]. For ease of exposition, we multiplied the weighted kappa by 100, which can be interpreted as the degree of agreement (disagreement) on a 0-100 scale.

All data was gathered from the Data Warehouse of the IT Department of the LHA of Autonomous Province of Trento.

2.3. Empirical strategy: analysis of the determinants of the agreement between GP and specialist

This study aimed to understand the main determinants of the DoA upon the priority assigned to each referred patient. To this end, we proposed the following specification:

$$y_i = \alpha + X_i \beta + \varepsilon_i$$

where y_i is the outcome of interest of GP *i*, namely the degree of agreement between the priority assigned by i-th GP and the specialist, X_i is a vector of individual GP characteristics (described in section 2.2), and ε_i is an idiosyncratic error term.

2.4. Data analysis

We first computed descriptive statistics for all the analyzed variable together with a Pearson correlation analysis between the independent variables. Then, a multiple linear regression analysis was carried out, with weighted kappa as dependent variable.
Since the correlation analysis between the independent variables identified a high significant correlation between number of referrals and number of patients per GP (correlation coefficient of Pearson = 0.74, p <0.0001), in the multivariate analysis we only included the number of referrals.
SAS 9.1 (SAS Institute Inc.) was used for all analyses. All tests were two-tailed, and a *p* value of less than 0.05 was considered statistically significant.

3. RESULTS

3.1. Descriptive statistics

As reported in Table 1, we analyzed 323 GPs working in Trento LHA: 32.2% of GPs were female. Four per cent of GPs in our sample worked in the pilot district (benchmark area), where HWGs were introduced and 45.8% worked in association with other GPs. The GPs used 4 types of EMRs: two (EMR1 and EMR4) were the most utilized covering 90.1% of GPs. The percentage of patient population aged 61 years and older assisted by GPs was 31.3%.

The GPs mean age was 58.8 years and the mean number of individuals registered with each GP was 1,330. In the first semester of 2017 each GP referred 1,415 patients on average: 21.6 patients with priority A, 126.9 with priority B, 112.7 with priority C, which corresponded to a mean of 260.5 high priority referrals. High-priority referrals (A, B, C) accounted for 18% of all referrals. The e-RSS utilization rate was 45.5%. The mean weighted kappa was 65.7% and indicated, on average, a substantial level of agreement between the priority assigned by the GP and the specialist.

Table 1 about here

Figure 1 shows a histogram of the distribution of the degree of agreement, as measured by the weighted kappa, across deciles (see Table A2 in the Appendix for quantiles).

Figure 1 about here

The HWG categories assigned by GPs against those assigned by specialists are reported in Table 2. Cases of agreement between GPs and specialists are reported on the main diagonal of the table. Focusing on situations of disagreement, Table 2 shows that GPs tended to assign a higher priority than specialists: 21.1% of patients had a higher priority assigned by the GP than by specialist (the ratio between the number of referrals above the

diagonal and total referrals) and, among these, 5.8% concerned categories A, B, C. Conversely, referrals below the main diagonal were those for whom the priority assigned by the GP was lower than that assigned by the specialist. They accounted for only 4.6% of total referrals and 1.8% concerned categories A-B-C. Table 2 also provides the DoA separately by priority level. It suggests that the degree agreement (as measured by the proportion of agreement for a given priority set by the GP) was higher for patients with lower priority: 64.6% for A, 67.1% for B and 76.0% for C.

Table 2 about here

3.2. GP-specialist agreement and level of e-RSS use by the GP

We tested if the DoA between GPs and specialists was higher when GPs used more often the e-RSS. We found that there was a positive correlation between the DoA and e-RSS utilization rate by the GP (correlation coefficient $r = 0.24$, p-value <0.0001, see Table A3 in the Appendix). Although the correlation was low, it was in line with our hypothesis.

3.3. Agreement and use of high priority categories

Next, we tested if the DoA between GPs and specialists was lower when GPs made higher utilization of high-priority categories. We found that there was a negative correlation between the DoA and the percentage of high priority categories utilization (correlation coefficient $r = -0.27$, $p <0.0001$, see Table A3 in the Appendix), which was also in line with our hypothesis.

3.4. Multivariate analysis

In the multivariate analysis, we regressed the DoA, measured with the weighted kappa, on a set of independent variables, namely: GP's gender and age; total number of GP's referrals; GP's rate of high priority referrals; GP's e-RSS utilization rate; type of EMR used by GPs; GP working in association with other colleagues; GP's geographical location; GP belonging to the benchmark area where the pilot usage of HWG system was implemented; proportion of GP's patient population aged older than 61 years; proportion of GP's referrals for specialist visits. We checked for multicollinearity using the variance inflation factor, but none of the included variables required further investigation. The results are reported in Table 3.

Table 3 about here

A higher e-RSS utilization was positively and statistically significantly associated with the DoA: an increase in the usage of e-RSS by 10 percentage points (from 45.5% at the sample mean to 55.5%), increased the weighted kappa by 1.44 percentage points (or 2.19%, given a sample mean of the weighted kappa of 65.7%). Instead, a higher rate of high-priority referrals was negatively associated with the DoA: a percentage point increase in the rate of high-priority referrals (from 18% at the sample mean to 19%) reduced the weighted kappa by 0.48 percentage points or 0.73%.

GP's gender was also found to be significantly associated with the DoA, with female GPs exhibiting a higher DoA by 2.06 percentage points or 3.14%.

GPs working in association with other colleagues had a higher DoA by 2.95 percentage points, compared to those working on their own.

Other variables positively and significantly associated with the DoA were the GP's geographical location, with GPs located in a specific health district (specifically West

Trentino) exhibiting a 2.68 percentage point increase compared to those located in the reference district (Central Trentino), and the type of electronic medical record adopted by the GP: doctors using EMR 2 exhibited an increase in DoA of 5.41 percentage points compared to those adopting EMR 4.

The goodness of the model, measured from R^2 was equal to 0.34, and adjusted R^2 was equal to 0.31.

As a robustness check, to better control for case-mix, we have extended the baseline model by adding 20 independent variables measuring the proportion of the most common referrals by specialty (accounting for 95.8% of total). Our main results, in relation to e-RSS utilization rate and rate of referrals with high priority, still held and remained statistically significant at 1% level, with comparable coefficients (see Table A4 in the Appendix). However, the GP gender effect, which was just significant at 5% level was no longer significant though the coefficient was still positive and equal to 1.27 percentage points. This was likely to be due to the less parsimonious specification, where recall our sample was limited to 323 GPs, or a different composition of patients. As expected, in the extended model the R^2 increased to 0.44 and the adjusted R^2 to 0.38.

We also tested for a non-linear log-log specification of the model but, compared to the baseline model, the R^2 and adjusted R^2 decreased from 0.343 to 0.280 and from 0.313 to 0.247 respectively.

Last, we have run three separate regressions by priority A, B and C measuring the degree of agreement with the simple kappa. The results suggested that the positive association between the e-RSS utilization rate and the DoA was concentrated in priority levels B and C. Instead, negative association between the rate of referrals in high priority was concentrated in priority level B. The association between gender and DoA remained across all priority levels.

4. DISCUSSION

The variability of referrals rate across GPs has been extensively described in the literature [16], [31], [32]. This variability can be attributed to several factors: i) attitude of the decision maker; ii) patient characteristics (for example the increasingly advanced age of the assisted population with the presence of different types of comorbidity); iii) different availability of specialist supply.

We hypothesized that the use of an electronic decision aid tool supporting the GP in the decision-making process, could reduce such variability, having the characteristics of a "nudging" tool: i) shared in the construction with the participatory involvement of all users; ii) easy (concise and quick) to use since the shared clinical "keywords" have been made available through a drop-down menu that can be activated while GP is prescribing a referral; iii) not costly for GPs (made available in the supply contract for their software). Another strength of this management model is that the assignment of every patient to a priority category by specialist was not based on ‘operational handbook’ consultation, but it was holistic and therefore it was only based on specialist’s subjective assessment (the specialist role was not to evaluate the correct use of the handbook by GP but to assign a priority category to each patient). In fact, specialists did not know if the patient was referred by the GP using the ‘operational handbook’ and/or the e-RSS, nor the high priority category referral rate of each GP. Finally, it is relatively easy for the specialists to record each patient's priority category (by ticking the HWG entry) while compiling the medical report, and therefore allow to store the data for continuous monitoring. All these features made our approach acceptable to professionals and contributed to disseminate this tool even when it was not compulsory yet.

The results of our study highlighted that GPs who tended to use more the e-RSS tool had greater agreement with specialists on the level of priority attributed to referrals. A relatively large increase in the usage of e-RSS by 10 percentage points (from 45.5% at the sample mean to 55.5%), increased the weighted kappa by 1.44 percentage points, from 65.68% at the sample mean to 67.12%. This result is perhaps modest but coherent with what was observed in a previous study in the areas of orthopedics and otorhinolaryngology [19]. Moreover, we showed that a higher rate of high-priority referrals was negatively associated with the DoA between GPs and specialists. The result is in line with previous work on digestive endoscopy [23], [33], which highlights that low DoA may be associated with lower appropriateness and excessive use of high-priority categories.

Another result for our baseline specification related to the association between DoA and gender of the GP. Female GPs had higher DoA than male GPs. If higher agreement correlates with greater prescriptive appropriateness, as mentioned above, it should follow that female GPs show a more appropriate referral behavioral pattern than male GPs. The existence of gender-related differences in the organization and provision of services among GPs has been extensively analyzed in several studies [32], [34], [35], [36], but not in relation to referrals agreement with specialists. The result however was not robust to the inclusion of case-mix variables at the specialist level, and this could be explored in future research.

We observed a significantly higher DoA associated with GPs working in association. GPs choosing to work together are more likely to collaborate and to follow the referral guidelines in their practice if a peer effect occurs.

We also found a significant positive association between a type of electronic medical record (EMR2) used by GPs and DoA. Such an association could be related either to the technical feature of the system or to the features of professionals that chose that type of

record. The GP's geographical location (specifically West Trentino) was also positively and significantly correlated with DoA and this may mainly be explained by the fact that EMR2 was more frequently used by the GPs located in this area.

The impact of the other control variables such as being a GP of the benchmark area, the number of referrals, the age of the GP, and the proportion of GP's patients aged 61 years and older was not statistically significant.

Finally, the relatively low value of R^2 emphasized that there is scope for other factors, for example in relation to patients' characteristics, that can explain the remaining variability in the DoA.

Other issues, which deserve further investigation, in particular in relation to the outcome variable are as follows. First, patients were examined by GPs and by specialists at different times, since the appointment with the specialist is subsequent, even several days later, to the GP's visit. Moreover, different amounts of information are available to GPs and specialists: GP as a "family doctor" has a better and wider knowledge of patient's characteristics. Then, GPs and specialists have different clinical expertise: specialist is more expert than GP in the medical specialty required for referral. GPs and specialists have also different points of observation: GPs visit patients with several pathologies and suspected diagnosis whereas specialists visit almost exclusively patients with suspected pathologies of their professional competence. Last, specialists reassigned the HWG only to referrals booked with a priority letter on the standard form and not to referrals booked without any priority (as explained by an almost absent discordance in referrals without priority).

5. CONCLUSION

Our study suggests that the use of an electronic referral support system (e-RSS) was positively associated with the degree of agreement between GPs and specialists. Although the effect was relatively modest, these findings support the idea that electronic referral support systems may be a useful tool to improve the agreement between GPs and specialists in assigning clinical priorities (through Homogeneous Waiting Groups) to their patients.

We also found that higher, possibly excessive, use of high priority referrals (HWGs) is negatively associated with the degree of agreement between GPs and specialists, while female GPs, GPs working in association with others, and GPs using a specific type of electronic medical record show higher agreement with specialists in assigning clinical priorities.

If the level of agreement on clinical prioritization indicates clinical consensus between primary care and secondary care physicians, and if a low degree of agreement is related to a low degree of clinical appropriateness, then public health care systems should collect information on priority categories for every referral also for specialists to enable continuous assessment and to build consensus with GPs. Therefore, there is scope for a public health care system to promote the use of an e-RSS by primary care physicians.

Some authors have suggested that the COVID-19 pandemic may be an opportunity to remodel referral processes, by avoiding unnecessary referrals [37] and improve diagnostic pathways [38], [39]. The use of clinical priorities can reduce the risk of adverse outcomes due to delays. Therefore, the application and diffusion of HWG systems integrated with e-RSS could be an important policy development for public health care systems.

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Table 1. Descriptive statistics on General Practitioners (GPs).

GPs sample size – *no.*	323
GP age - *mean (SD)*	58.8 (7.3)
GP Gender – *no.* (*%*):	
Male	219 (67.8)
Female	104 (32.2)
No. of individuals registered with the GP - *mean* (*SD*)	1329.7 (314.0)
Total no. of GP referrals - *mean* (*SD*)	1415 (456)
No. of referrals in which the HWG A was used - *mean* (*SD*)	21.6 (17.8)
No. of referrals in which the HWG B was used - *mean* (*SD*)	126.9 (74.9)
No. of referrals in which the HWG C was used - *mean* (*SD*)	112.7 (80.9)
No. of referrals in which the HWG ABC was used - *mean* (*SD*)	260.5 (151.6)
Rate of referrals in high priority (ABC) groups - *mean* (*SD*)	18.00 (7.6)
e-RSS utilization rate – *mean %* (*SD*)	45.5 (31.6)
Type of electronic medical record (EMR) – *no.* (*%*):	
EMR1	177 (54.8%)
EMR2	25 (7.7%)
EMR3	7 (2.2%)
EMR4	114 (35.3%)
GPs working in association with other GPs – *no.* (*%*)	148 (45.8%)
GP's geographical location: West Trentino – *no. (%)*	86 (26.6%)
GP's geographical location: Central Trentino – *no. (%)*	163 (50.5%)
GP's geographical location: East Trentino – *no. (%)*	74 (22.9%)
GPs in benchmark area - *no. (%)*	13 (4.0%)
Proportion of population served aged 61 years and older (*%)*	31.3
Proportion of referrals for specialist visits (%)	52.9
Proportion of referrals for diagnostics tests (%)	47.1
Weighted kappa - % *(SD)*	65.68 (9.25)

Table 2. Priority groups assigned by GPs (rows) against assignments by specialists (columns).

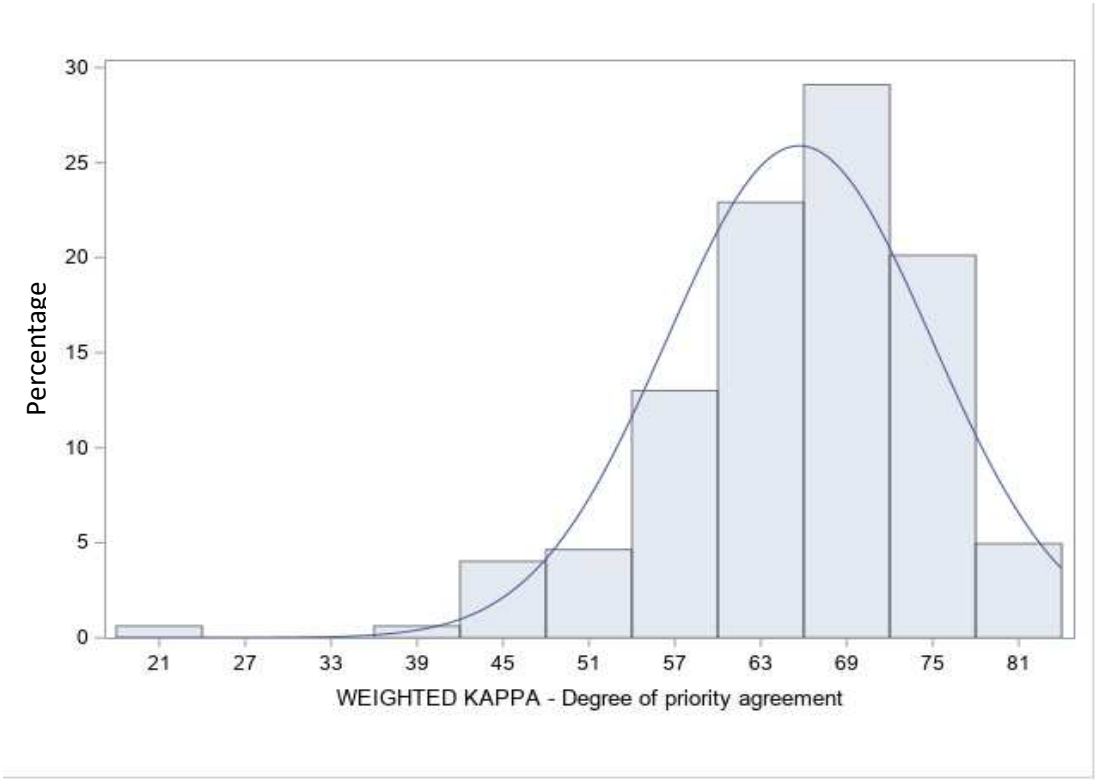
Priority assigned by GPs	Priority assigned by specialist						% of agreement with specialist for a given GP priority
	A	B	C	E	P	Total	
A	3857	904	376	718	116	5971	64.6%
B	385	21167	3674	5422	908	31556	67.1%
C	99	1017	20854	4397	1070	27437	76.0%
E	58	477	552	10423	466	11976	87.0%
P	37	160	217	950	7249	8613	84.2%
Total	4436	23725	25673	21910	9809	85553	74.3%

Table 3. Parameters estimation of the multiple linear regression of the degree of agreement between GP and specialist.

Variable	Parameter estimate	Standard error	T value	Pr > |t|	95% - confidence limits of parameter estimate	
GP Age	-0.06977	0.06734	-1.04	0.301	-0.2023	0.06274
Gender 0=M, 1=F	**2.05709**	**1.01069**	**2.04**	**0.0427**	**0.06836**	**4.04581**
Total no. of GP referrals	0.00184	0.00104	1.77	0.0784	-0.0002	0.00389
Rate of referrals in high priority (ABC)	**-0.47879**	**0.06823**	**-7.02**	**<.0001**	**-0.613**	**-0.3445**
e-RSS utilization rate	**0.14427**	**0.01789**	**8.07**	**<.0001**	**0.10908**	**0.17947**
EMR 1	-1.34969	1.1618	-1.16	0.2462	-3.6358	0.93639
EMR 2	**5.40616**	**1.88167**	**2.87**	**0.0043**	**1.70362**	**9.10871**
EMR 3	1.28633	3.18259	0.4	0.6864	-4.976	7.54869
GP working in association	**2.9508**	**0.99014**	**2.98**	**0.0031**	**1.00251**	**4.89909**
GP geographical location: East Trentino	-1.14198	1.14297	-1	0.3185	-3.391	1.10704
GP geographical location: West Trentino	**2.68469**	**1.14883**	**2.34**	**0.0201**	**0.42414**	**4.94524**
GP in benchmark area	1.78707	2.28395	0.78	0.4346	-2.707	6.28118
Population served aged 61 years and older	0.08651	0.07305	1.18	0.2372	-0.0572	0.23024
Proportion of referrals for specialist visits	-0.01705	0.06437	-0.26	0.7912	-0.1437	0.1096
Intercept	65.21125	5.92724	11	<.0001	53.5483	76.8742

Notes. Significant parameters in bold. Geographical area: Central Trentino omitted category; Type of electronic medical record (EMR): EMR 4 omitted category.

Figure 1. Weighted kappa deciles histogram.



Appendix

Table A1. Weights used for the calculation of the weighted kappa.

Priority assigned by GPs	Priority assigned by specialist				
	A	**B**	**C**	**E**	**P**
A	1.00	0.75	0.50	0.25	0.00
B	0.75	1.00	0.75	0.50	0.25
C	0.50	0.75	1.00	0.75	0.50
E	0.25	0.50	0.75	1.00	0.75
P	0.00	0.25	0.50	0.75	1.00

Note.

The table reports the computed Cicchetti-Allison kappa coefficient weights as: $\boldsymbol{w_{ij} = 1 - |C_i - C_j|/(C_C - C_1)}$, where C_i is the score for column *i* and *C* is the number of categories or columns.
See: Cicchetti DV and Allison T. A new procedure for assessing reliability of scoring EEG sleep recordings. *Am J EEG Technol,* 1971; 11: 101-110.

Table A2. Weighted kappa quantiles for normal distribution.

Percentages	Quantiles	
	Observed	Estimated
10	54.8	53.8
20	58.7	57.9
30	62.4	60.8
40	64.8	63.3
50	66.9	65.7
60	69.5	68.0
70	71.2	70.5
80	72.8	73.5
90	76.2	77.5

Table A3. Pearson correlation matrix of weighted kappa, utilization rate of e-RSS, degree of utilization of high priority categories.

	Utilization rate of e-RSS	**Rate of referrals in high priority (ABC)**	**Weighted kappa**
Utilization rate of e-RSS	1	0.42962 <.0001	0.23756 <.0001
Rate of referrals in high priority (ABC)	0.42962 <.0001	1	-0.27073 <.0001
Weighted kappa	0.23756 <.0001	-0.27073 <.0001	1

Table A4. Extended model. Significant parameters in bold. Geographical area: Trentino center omitted category. Type of electronic medical record (EMR): EMR 4 omitted category.

Variable	Parameter estimate	Standard error	T value	Pr > |t|	95% - confidence limits of parameter estimate	
Gender 0=M, 1=F	1.27379	1.00702	1.26	0.2069	-0.70823	3.25581
Age	-0.12682	0.06723	-1.89	0.0602	-0.25914	0.0055
Total number of GP referrals	0.00182	0.00107	1.69	0.0915	-0.00029535	0.00393
Rate of referrals in high priority	**-0.61924**	**0.07641**	**-8.1**	**<.0001**	**-0.76963**	**-0.46886**
e-RSS utilization rate	**0.11548**	**0.01949**	**5.93**	**<.0001**	**0.07712**	**0.15383**
EMR 1	-2.0036	1.27441	-1.57	0.117	-4.51189	0.5047
EMR 2	**6.58029**	**2.05038**	**3.21**	**0.0015**	**2.54472**	**10.61586**
EMR 3	0.29257	3.2256	0.09	0.9278	-6.05606	6.64121
GP working in association	**2.26584**	**0.98313**	**2.3**	**0.0219**	**0.33084**	**4.20084**
Geographical area: Trentino Est	2.97624	1.5462	1.92	0.0552	-0.067	6.01947
Geographical area: Trentino West	**4.02467**	**1.42499**	**2.82**	**0.0051**	**1.22**	**6.82934**
Population served aged 61 years and older	0.06591	0.0775	0.85	0.3958	-0.08662	0.21845
GP in benchmark area	1.98386	2.27486	0.87	0.3839	-2.49352	6.46125
Echography (imaging)	-0.12037	0.23395	-0.51	0.6073	-0.5808	0.34009
Radiology (imaging)	0.30273	0.23439	1.29	0.1975	-0.1586	0.76406
Orthopaedics (visit)	-0.17132	0.23838	-0.72	0.4729	-0.6405	0.29787
Dermatology (visit)	-0.04496	0.2462	-0.18	0.8552	-0.5295	0.43961
Otolaryngology (visit)	0.15638	0.26389	0.59	0.5539	-0.363	0.67578
Cardiology (visit)	0.04532	0.27349	0.17	0.8685	-0.493	0.58361
Oculistics (visit)	0.04236	0.24055	0.18	0.8604	-0.4311	0.51581
Physiatry (visit)	-0.31639	0.26687	-1.19	0.2368	-0.8417	0.20887
Vascular sugery (visit)	0.12221	0.29627	0.41	0.6803	-0.4609	0.70533
Magnetic resonance (imaging)	-0.30648	0.27817	-1.1	0.2715	-0.854	0.24101
Computed tomography (imaging)	-0.20802	0.35863	-0.58	0.5623	-0.9139	0.49784
Gynaecology (visit)	0.18786	0.32096	0.59	0.5588	-0.4439	0.81957
Surgery (visit)	0.04502	0.37241	0.12	0.9039	-0.688	0.77801
Digestive endoscopy (imaging)	-0.36016	0.30367	-1.19	0.2366	-0.9578	0.23752
Neurology (visit)	-0.13951	0.32795	-0.43	0.6709	-0.785	0.50596
Urology (visit)	-0.0592	0.32567	-0.18	0.8559	-0.7002	0.58178
Rheumatology (visit)	-0.40104	0.46533	-0.86	0.3895	-1.3169	0.51481
Eendocrinology (visit)	0.69995	0.48974	1.43	0.154	-0.264	1.66386
Internal medicine (visit)	**-0.98243**	**0.31956**	**-3.07**	**0.0023**	**-1.6114**	**-0.3535**
Pneumology (visit)	-0.87944	0.4912	-1.79	0.0744	-1.8462	0.08734

Intercept	78.00647	20.32065	3.84	0.0002	38.01123	118.0017