TITLE PAGE

Title: A RETROSPECTIVE STUDY ON THE IMPACT OF SIGN GLAUCOMA GUIDELINES ON QUALITY OF REFERRALS FROM COMMUNITY OPTOMETRISTS IN A REGIONAL EYE CENTRE IN SCOTLAND

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SYNOPSIS

Scottish Intercollegiate Guidelines Network (SIGN) 144 was introduced in March 2015 to reduce unnecessary glaucoma referrals from community optometrists. Our study showed that there is a significantly lower first visit discharge rate after guideline implementation.

ABSTRACT

Background: Since the introduction of NICE glaucoma guidelines 2009, the number of referrals from the community optometrists to secondary hospital services(HES) have increased across the UK, resulting in increase in first visit discharge rates(FVDR).

Aim: To assess the impact of SIGN 144 on quality of referrals from community optometrists.

Methodology: A retrospective case study of 256 electronic records from (TRAK) of patients who attended the new glaucoma clinics in Princess Alexander Eye Pavillion(PAEP) was carried out across Oct-Nov 2014 and Sept-Oct 2016.Patients included were aged from 18 years and above, referred to the PAEP glaucoma outpatients clinic for new glaucoma diagnosis. Primary outcome of this study is FVDR. Secondary outcome is the extent of compliance to recommendations by SIGN guidelines.

Results: 104 and 152 patients were included in group 1 and 2 respectively. Our study showed that there is a significant decline in FVDR between these 2 periods.(odds ratio 0.43, p=0.0026). Post-SIGN guideline, 86% of referrals were compliant to SIGN referral criteria while 12.5% remained non-compliant. Main reasons for non-compliance were no repeatable visual field defects (42%) and referrals due to high IOP were either not repeated or not interpreted in the context of age and CCT (36.8%).

Conclusion: Patients referred after the introduction of SIGN guidelines have a 43% less chance of being discharged. Although compliance to most recommendations in SIGN guidelines has improved, there is still a need to improve adherence to referral criteria. Further research should be done to assess barriers of implementing these guidelines in community.

INTRODUCTION

Since the introduction of the National Institute of Clinical Excellence (NICE) guidance on glaucoma in April 2009,[1] patients with an intraocular pressure (IOP) cut-off of at least 21 mmHg or above had been recommended for referral to hospital eye services (HES) for a new diagnosis of glaucoma. While earlier detection of glaucoma is possible, studies have shown that the number of referrals to HES and first visit discharge rates (FVDR) had been rising.[2, 3] As a result, various referral refinement schemes have blossomed throughout the UK[4-7].This article will focus on how the Scottish Intercollegiate Guidelines Network (SIGN) glaucoma guideline was birthed in response to a need for a more refined glaucoma referral guideline in Scotland.

Statement of problem: the glaucoma referral pathway and burden in Scotland

The strength of the referral pathway in Scotland centers upon encouraging public uptake of screening through the existence of General Ophthalmic Service (GOS) where adults aged 1 to 59 are entitled to receive free biennial eye checks.[8] On top of that, the Eyecare Intervention Project launched in 2013[9] enabled electronic referrals from primary care to secondary services. Due to these changes, subsequent to publication of NICE Glaucoma guideline, the numbers of referrals for glaucoma have increased substantially, where in 2013 alone there was an estimated 15,000 referrals for glaucoma to HES.[10] As a consequence, a questionnaire survey was conducted in 2013 among ophthalmologists across Scotland to evaluate the efficiency of the current referral system.[8] The results of this survey found an overwhelming need for a refined glaucoma referral and discharge guideline for Scotland considering above differences from rest of the UK, to reduce the rate of false positive referrals for glaucoma and avoid increasing the burden on HES. A refined guideline, SIGN 144 was introduced in March 2015 which included some major changes(appendix 1).[11] Since its introduction, there has been an increase in provision of pachymeters to community optometrists, in addition to educational programmes and workshops organized for community optometrists to increase awareness on the referral criteria outlined in the guidelines.The details on key recommendations and costs involved in the implementation of this guideline, limited to those pertaining to diagnosis of glaucoma, are included in appendix 1.

AIMS

To find out the impact of SIGN 144 on quality of referrals from community optometrists, measured by first visit discharges and extent of compliance to this guideline after it has been introduced in Scotland.

MATERIALS AND METHODS

Study Design

This study is done in accordance to the core principles laid out in the SQUIRE checklist to assess the impact of SIGN 144 on ‘ Glaucoma Safe Diagnosis and Discharge 2015’as an intervention to reduce first visit discharges. A retrospective analysis comparing pre-SIGN and post-SIGN period is utilized to determine the impact of SIGN 144 on quality of referrals in the region of Edinburgh.

Princess Alexandra Eye Pavilion (PAEP) is a tertiary eye centre which takes referrals from the region of Mid and East Lothian, serving a wide catchment area[12]. Optometrist referrals from the both the online hospital system (TRAK) and notes of patients who attended the glaucoma clinics across two major time periods, Oct-Nov 2014 and Sept-Oct 2016 were chosen to represent periods before and after SIGN 144 respectively. Patients were included in this study if they met the following criteria: aged 18 years and above, referred to the PAEP glaucoma outpatient clinic from community optometrists for new glaucoma, glaucoma suspect or Ocular Hypertension (OHT) diagnosis. Referral letters were sourced through TRAK and patient notes were obtained as a secondary source only if referral letters could not be found on TRAK. Data to be extracted from patient files included the pertinent parameters recommended by SIGN 144 such as intraocular pressure readings, optic disc descriptions, visual fields, Central Cornea Thickness (CCT), usage of Optical Coherence Tomography (OCT), whether photographs were taken, reason for referral, diagnosis and outcome of referrals (discharged on first visit or retained in service). Patients were excluded if they had a pre-existing diagnosis of glaucoma, missing referral letters, referrals not within the time period specified, referrals for diagnoses other than glaucoma, and incomplete data which could not be completed from extensive search in both TRAK and patient notes, or if the same patient appears to be included more than once within the time periods selected. A total of 300 patient files extracted and 44 patient files were excluded.

Sample size power calculation

The final sample size of 256 gives this study a 90% power to detect a difference of 20% difference in discharge rate after SIGN had been introduced (p value 0.05).

Statistical analysis

Data collated from patient files were compiled into Microsoft Excel, statistical analysis was performed on SPSS 22.0. Patients were divided into 2 groups. Group 1 included patients referred before SIGN 144 was introduced (Oct-Nov 2014). Group 2 included patients who were referred after SIGN 144 was introduced (Sept-Oct 2016). The primary outcome measure of this study is first visit discharge rate (FVDR). A secondary outcome measure is the extent of compliance to recommendations by SIGN guidelines. Based on Shapiro-Wilk test (p value 0.314), further statistical analysis is based on a normally distributed data. Differences between groups were demonstrated with Chi-square analysis or Fisher's exact test.

RESULTS

104 patients were included in Group 1 and 152 patients were included in Group 2. Baseline characteristics of both groups are compared in Table 1.

Baseline Characteristics	***Pre-SIGN n=104***	***Post-SIGN n=152***
Age (mean±SD)	*65.37±9.8*	*67.37±11.8*
Gender	*Male 40 (38.5%)* *Female 64 (61.5%)*	*Male 61 (41.1%)* *Female 91 (58.9%)*
Average IOP on referral* (mean±SD)	*19.39±5.81*	*19.21±4.23*$^{+}$
	Diagnosis	
Open Angle Glaucoma	*31 (29.8%)*	*47 (30.9%)*

Normal	*40 (38.5%)*	*32 (21.1%)*
Glaucoma Suspect/OHT	*23 (22.1%)*	*56 (36.8%)*
Angle closure Glaucoma	*9 (8.65%)*	*10 (6.6%)*
Follow up cancelled/DNA	*1 (9.61%)*	*7 (4.6%)*
**** average of worse IOP of left and right eye in referral***		
+ 5 eyes only had IOP measured for either left or right eye		

Table 1 Baseline characteristics and comparisons

Primary Outcome	***PRE-SIGN PERIOD***	***POST-SIGN PERIOD***	***P value***
Discharged on first visit	*40 (38.5%)*	*32 (20.9%)*	*Chi-square p<0.05*
Retention in service (treatment or glaucoma suspect)	*64 (61.5%)*	*120 (79.1%)*	

Table 2 FVDR and retention in service pre and post-SIGN

Primary outcome

FVDR was found to be statistically lower post-SIGN introduction in group 2 (table 2). Our study shows that patients referred during the post-SIGN period had a 43% less chance of being discharged on first visit (odds ratio 0.426, 95%CI 0.2449 to 0.7433, p=0.0026). First-visit discharges during the pre-SIGN period mainly were referrals due to high IOP (40%), abnormal optic disc (25%) and abnormal VF (24%). Post-SIGN guideline implementation, first-visit discharges mainly were referrals due to abnormal optic disc (31%) , abnormal VF (20.9%) , and both abnormal VF and optic disc (19%).

Parameters from SIGN 144	***Pre-SIGN***	***Post-SIGN***	***P value***

A minimum of two intraocular pressure readings on a single occasion using the same tonometer is recommended with type of tonometer specified.			
Number of readings	***n=104***	***n=152***	***<0.05***$^{+}$
Reading taken on 1 occasion only	*64 (61.5%)*	*69 (45.3%)*	
Repeated readings on same occasion or >2 separate occasions	*38 (36.5%)*	*82 (54%)*	
IOP not recorded	*2 (1.92%)*	*1 (0.7%)*	
Type of Tonometry	***n=102***	***n=151***	***P<0.05***
Contact Tonometry (CT)	*60 (58.8%)*	*121 (79.6%)*	
Non-contact Tonometry (NCT)	*29 (28.4%)*	*25 (16.4%)*	
Both	*4 (3.92%)*	*0*	
Not specified	*9 (8.8%)*	*5 (3.3%)*	
The Van Herick method or gonioscopy may be used to detect narrow anterior chamber angles in patients with ocular hypertension or suspected angle-closure.			
Angle assessment	***n=104***	***n=152***	***P<0.05***
Yes	*15 (14.4%)*	*50 (32.9%)*	
No	*89 (85.6%)*	*102 (67.1%)*	
Central corneal thickness should be measured in patients with ocular hypertension or suspected glaucoma			
Central Cornea Thickness(CCT)	***n=104***	***n=152***	***P<0.05***
Yes	*3 (2.88%)*	*76 (50%)*	
No	*101 (97.1%)*	*76 (50%)*	
The narrowest rim/disc ratio and disc size should be recorded and considered alongside additional indicators of glaucoma, such as optic disc nerve fibre layer haemorrhage and cup/disc ratio asymmetry			
Disc Diameter	***n=104***	***n=152***	***P<0.05***
Yes	*4 (3.84%)*	*30 (80.6%)*	
No	*100 (96.2%)*	*123 (19.4%)*	
Rim disc ratio	***n=104***	***n=152***	***P=0.636***
Yes	*3 (2.88%)*	*3 (2%)*	
No	*101 (97.1%)*	*149 (98%)*	
Cup Disc Ratio	***n=104***	***n=152***	***P<0.05***

Table 3 Compliance to recommendations in SIGN 144 pre and post-SIGN

Yes	*61 (58.7%)*	*127 (83.6%)*	
No	*43 (41.3%)*	*25 (16.4%)*	
Recording of optic disc appearance**	***n=104***	***n=152***	***P=0.829***
Yes	*50 (48.1%)*	*71(46.7%)*	
No	*54 (51.9%)*	*81(53.3%)*	
Image attached	***n=104***	***n=152***	***P<0.05***
Yes	*8 (7.7%)*	*56 (36.8%)*	
No	*96 (92.3%)*	*96 (63.2%)*	
Standard automated perimetry is recommended for visual field testing - a minimum of two visual field tests with consistent findings			
Attachment of perimetry	***n=98***	***n=132***	***P<0.05***
Yes	*97(99%)*	*101 (80.2%)*	
No	*1 (1%)*	*31(33.6%)*	
Number of visual fields done	***n=104***	***n=152***	***P<0.05***
1 visual field test	*65 (62.5%)*	*67 (44.1%)*	
2 or more/ repeatable visual field tests	*33 (31.7%)*	*65 (42.8%)*	
No information on visual fields	*6 (5.77%)*	*20 (13.2%)*	
The optic discs should be photographed and the images transmitted with the electronic referral letter			
Disc photograph taken	***n=104***	***n=152***	***P<0.05***
Yes	*15 (14.4%)*	*59 (38.8%)*	
No	*89 (85.6%)*	*93 (61.2%)*	

[+] Fisher's exact test is used as <80% have expected cell counts <5

** p value for comparison of CT and NCT only*

*** Includes indicators like hemorrhage, NRR thinning, etc*

[$] Perimetry not attached however mentioned as "abnormal visual fields" etc in referrals

Secondary Outcomes

i) Compliance to key recommendations in SIGN 144

As shown in table 3, there is a statistically significant improvement in compliance with repeated IOP measurements, CCT, cup disc ratio, disc diameter measurements, usage of contact tonometer, evidence of repeatable field defect,attachment of visual fields, angle assessments, and having disc photographs attached. However, comparing both periods, there is no significant difference in compliance with rim disc ratio measurements and including optic disc appearance in referral letters.

ii) Compliance to criteria for referral to HES

Comparing against SIGN 144 criteria for referral to HES[11],86% of referrals post-SIGN implementation were found to be compliant, whilst 14% were non-compliant. Reasons for non-compliance include referrals for "*abnormal visual fields*" without a repeatable defect (42%), referrals for "*high IOP*" but only single measurement obtained or not within referral criteria of age and CCT (36.8%), and referrals for "*narrow angles*" but Van Herrick's grades not recorded (21.2%).

There were 35 cases of referrals from both periods in total which were based on high IOP only as shown in figure 1. IOP data in this study was grouped into <21mmHg, 21-25mmHg and >25mmHg. Post-SIGN period, 71.4% of patients were referred only if IOP was 26mmHg and above, as per recommendation, whilst 21.6% were referred with IOP range of 21-25mmHg. This is a significant improvement in compliance to IOP criteria for referral compared to the pre-SIGN period.

[figure 1]

DISCUSSION

To our knowledge, this study is the third analysis of glaucoma referrals from optometrists in Scotland after the study by Ang et al[13] which examined the impact of the new GOS and El-Assal

et al [8] which assessed the impact of both GOS and NICE in 2010. SIGN 144 recommends a higher cut off IOP criteria of 26mmHg and above for referrals based on IOP alone. This is based on some recent evidence by Burr et al[14] which showed that the risk of glaucoma among patients with ocular hypertension was thought to be overestimated. Recommendation to raise IOP threshold among patients who are above 65 years old was also endorsed by the Joint College Group(JCG) revised guidance.[4]

Repeated IOP measurement was also recommended in the SIGN 144 to reduce variability in IOP. Measurement with Goldmann applanation tonometry (GAT) has been shown to be affected by various factors including CCT, type of prism used, presence of astigmatism, pressing on lid, breath-holding and tear film quality.[15] Based on this understanding, referral refinement schemes with repeated IOP measurements were endorsed by the Royal College of Ophthalmologists to reduce variability in IOP measurement in the community[3]. SIGN 144 is unique in that it recommends referrals based on IOPs to be interpreted within the context of CCT even though the strongest evidence for this is usage among corneas with chronic disease.[17] It is beyond the scope of this paper to justify the evidence behind this recommendation.

Primary outcome measure of study - FVDR

FVDR in our study is 20.9% during the post-SIGN period. In contrast, FVDR for referrals from community optometrists in a multicenter study was found to be as high as 43% across UK and Europe, in a study published this year.[18] Our FVDR is similar to studies done by El-Assal et. al[8] and Trikha et. al[19]. El-Assal et al[8] examined the impact of the GOS and electronic referrals in Fife, Scotland, whereas Trikha et al[19] examined the efficacy of the referral refinement scheme in Portsmouth. Both studies published FVDR of 24.1 and 22% respectively.

In our study, the highest contributor to first visit discharges pre-SIGN 144 was high IOP without other evidence of glaucoma.This is similar to a large scale audit by Ratnarajan et al[5] where referrals due to IOP alone was found to be the cause of 45-53% of discharges within England.[4] Post-SIGN guidelines, there is a significant decrease in patients who are referred based on IOP of 25mmHg or less without other evidence of glaucoma (figure 1) This may be one of the possible explanations for lower FVDR in this study. This also agrees with the recent EPIC-Norfolk Eye Study,[16] where IOP values are shown to be directly correlated to specificity, and higher IOP cut-offs for referral result in lesser false positives. This finding is further supported by estimates from

the multicenter study that raising IOP referral threshold to >26mmHg could save the NHS up to an estimated 5.5 million a year by reducing number of outpatient appointments.[18]

Our study showed that referrals due to "abnormal optic disc alone" resulted in 25% and 31% of all discharges during pre-SIGN and post-SIGN respectively. Compared to Ratnarajan et al's study, abnormal optic disc as a reason for referral contributed to one of the lowest rates for discharges which is 19%.[4]. This difference may be due to the fact that disc interpretation is a difficult technical skill[8] which was shared by a substantial number of Optometrists with Specialist Interests (OSIs) in Ratnarajan et al's study[4,5]. Their study also showed OSIs had a higher accuracy in diagnosing based on optic disc findings[5].

In terms of discharges due to "abnormal visual fields alone", this has also decreased from 24% from pre-SIGN to 20.9% in post-SIGN period. This may be due to an increase in measurement of repeatable visual field defects across those time periods, from 31.7% to 42.8%, hence increasing accuracy of diagnosis.

Secondary outcome -Compliance to key recommendations in SIGN 144

i) IOP measurement

At least one IOP measurement was carried out in approximately 99% of referrals in our study across both time periods which was an improvement from approximately 75% found by El-Assal et al[8] in Fife. There is an increase in 17% of referrals with repeated IOP readings across both time periods. In addition, there is an increase in 20.8% of referrals which included measurements of IOP using contact tonometry.

ii) Optic disc assessment

Our study found an increase of 76.9% in referrals which included disc diameter measurement during the post-SIGN period. Across both periods, cup disc ratio measurement increased by 24.9%, and attachment of disc images increased by 29.1%.Post-SIGN guideline, 83% had CD ratio recorded. This is lower than 99% documented by Khan et al[20]. There is also a need to improve measurement of rim disc ratio as these were only included by 2.88% and 2% of referrals pre-SIGN and post-SIGN respectively. Accurate objective measurement of the optic disc using rim disc ratio is important to improve quality of referrals. This is because rim disc measurement based on the

Disc Damage Likelihood Scale was reported to have a high correlation with actual physiological disc damage.[21]

iii) Repeatable visual field defects

Visual field assessment was included in 87-94% across both periods in this study, which is higher in comparison to a study by Khan et al[21] where only 71% has visual field assessments included in referral letters. 80.2% of referrals during this period also have visual fields plots enclosed in referral letters on TRAK which is significantly higher compared to 27% in Khan et al's study[21] where the visual fields had either been held with the GP or not included in the referral. Even though there is a 11.1% increase in referrals with evidence of repeatable field defects during the post-SIGN period, 13.2% of referrals during this period still do not have any information on visual fields included in referral letters.

The clinical significance of this study is in analyzing the changes in referral pattern following the implementation of SIGN 144. Even though SIGN guideline is only applicable within Scotland, evidence based principles embedded within SIGN should be generalizable to the wider UK and rest of the world. One limitation of implementation of SIGN 144 is that it may be difficult to perform all the assessments recommended, recognizing the time constraints optometrists often face.[22] Research should be done to understand potential barriers faced by community optometrists in performing assessments. In addition, we did not manage to show the sensitivity or specificity of interpretation of IOP values within the context of CCT in aiding the diagnosis of glaucoma. For the purpose of this study, the authors had to assume that implementation of SIGN 144 as the only effective variable affecting primary and secondary outcomes in this study. Other limitations include possible misrepresentation of referral letter information in terms of repeated IOP measurements where the single reading recorded in referral letters may actually be the average of a few readings. In addition, this study does not show the false negative rate which is important for any screening tool[23] or proportion of glaucoma suspects which will be retained in hospital in the long term.

In summary, whilst unnecessary referrals to HES can be avoided as a result of this guideline, we recommend further research to consolidate the impact of this guideline in other regions within

Scotland. Further work should be done to shed light on the sensitivity and specificity of CCT guided interpretation of IOP in diagnosis of glaucoma and the potential barriers of performing these assessments among community optometrists. This is to create a robust, cost-effective network of care in the community which will increase patient access to care in the long term.

FOOTNOTES

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