

openheart Implementation of NICE Clinical Guideline 95 for assessment of stable chest pain in a rapid access chest pain clinic reduces the mean number of investigations and cost per patient

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ABSTRACT

Objective: In 2010, the National Institute for Health and Care Excellence (NICE) in the UK published Clinical Guideline 95 (CG95) advocating risk stratification of patients using 'CADScore' to guide appropriate cardiac investigations for chest pain of recent onset.

Implementation of the guideline in the University College London Hospitals NHS Foundation Trust was evaluated to see if it led to a reduction in the average cost of the diagnostic journey per patient and fewer investigations per patient in order to confirm a diagnosis.

Methods: This was a single centre study at a Tertiary Centre in Central London. The investigative journey for each patient presenting to the Rapid Access Chest Pain Clinic (RACPC) at University College London Hospitals NHS Foundation Trust was recorded. Retrospective analysis on this data was performed.

Results: Data for 4968 patients presenting to the RACPC from 2004 to 2012 was analysed and a size-matched cohort of 1503 patients preimplementation and postimplementation of the guidelines was compared. The mean cost of investigations postimplementation was £291.83 as compared to £319.54 preimplementation of the guidelines despite higher costs associated with some of the recommended initial investigations. The mean number of tests per patient postguidelines was 0.78 compared to 0.97 for preguidelines. An approximate twofold increase in patients not requiring tests was seen post-CG95 implementation (245 pre-CG95 vs 476 post-CG95).

Conclusions: The implementation of the NICE guidelines in our trust has reduced the average cost of the investigative journey and the number of investigations required per patient.

INTRODUCTION

Coronary artery disease (CAD) remains the biggest cause of mortality in the UK, causing around 80 000 deaths each year.¹ Accurate

KEY MESSAGES

What is already known about this subject?

▶ Previous reports looking at the economic impact of implementing National Institute for Health and Care Excellence (NICE) Clinical Guideline 95 (CG 95) in assessing pain of suspected cardiac origin have suggested either cost neutrality or an increase in costs postimplementation.

What does this study add?

▶ This report presents findings from the largest cohort of patients seen so far in the literature, representative of a large teaching hospital covering patients of a wide range of ethnicities and backgrounds. This study suggests that implementation of the guideline leads to lower average costs per patient, with a reduction in number of tests required per patient.

How might this impact on clinical practice?

▶ These observations suggest that implementation of NICE CG95 Guideline in Rapid Access Chest Pain Clinics in the UK have led/will lead to a faster diagnosis, an increase in patient safety and also in cost savings.

diagnosis of CAD in patients presenting with stable recent onset chest pain is important to aid the management of this disease. Advances in diagnostic technologies, such as myocardial perfusion imaging, stress echocardiography, MRI and cardiac CT have increased the investigative options available to aid the diagnosis of CAD. Nevertheless, selecting the appropriate investigations to aid cost-effective and accurate diagnosis of CAD remains a challenge.

In 2010, the National Institute for Health and Care Excellence (NICE) published Clinical Guideline 95 (CG95),² advocating risk stratification of patients using 'CADScore'

to guide appropriate cardiac investigations for chest pain of recent onset. This risk score is calculated based on the symptoms, age, sex, risk factors (including diabetes, smoking and hyperlipidaemia) and ECG findings of the patient. The NICE guideline proposes that for people without confirmed CAD, in whom stable angina cannot be diagnosed or excluded based on clinical assessment alone, further diagnostic testing would be recommended as follows:

1. If the pretest likelihood for CAD is high (61–90%), consider invasive coronary angiography as the first-line diagnostic investigation, if appropriate.
2. If the pretest risk is intermediate (30–60%), consider functional imaging.
3. If the pretest risk of CAD is low (10–29%), offer cardiac CT as the first-line diagnostic investigation.

The guideline also recommends the depreciation of exercise ECG as a diagnostic test and the elimination of screening tests for the lowest risk patients or those with non-cardiac chest pain. The recommended investigations according to the guideline is summarised in [table 1](#).

In the UK, the Rapid Access Chest Pain Clinic (RACPC) is a cardiologist-led service assessing patients with recent onset chest pain. CG95 was implemented in July 2010 in the RACPC at the University College London Hospitals NHS Foundation Trust in London, a tertiary cardiology centre. The impact of the implementation of the guideline on service provision in this RACPC, in terms of number of investigations and the cost consequence, was evaluated. Despite the higher costs of the new recommended initial investigations compared to previous first-line investigations, such as exercise ECG, it was hypothesised that the implementation of the guideline would reduce average cost of the patient's diagnostic journey and would reduce the number of investigations per patient due to better diagnostic accuracy, thus allowing for better patient safety.

MATERIALS AND METHODS

Data collection

This was a single centre study at the University College London Hospitals NHS Foundation Trust. Institutional approval was obtained for the study and ethical approval was not required. The investigative journey for each patient was recorded and this included calculating a risk

Table 1 Recommended investigations for stable chest pain according to CADscore

CADscore, risk	Recommended diagnostic testing
10–29%, low	CT calcium scoring followed by CT angiography if calcium score >0
30–60, intermediate	Functional imaging (dobutamine stress echocardiography, myocardial perfusion scan, cardiac MRI)
61–90, high	Invasive coronary angiography

score based on symptoms, age, sex, risk factors and ECG findings. Retrospective analysis of this data was performed.

The cost of each tests is summarised in [table 2](#) and is based on the 2011 costing report that accompanies the CG95 clinical guideline.³

Data analysis

Retrospective analysis was performed on all 4968 patients presenting to the RACPC from 2004 to 2012. Analysis for comparison was performed on size-matched cohorts (1503 patients) preimplementation and postimplementation of CG95, excluding a number of patients (335 patients) peri-implementation when some early shift in practice occurred. The number of cardiac investigations per patient was summed up and cost of all cardiac investigations for each patient from presentation to discharge was calculated. Investigations were priced as per NICE CG95 'Costing Report' 2011. Mean cost per patient was derived for size-matched cohorts preimplementation and postimplementation of CG95. The Mann-Whitney U Test was used to assess statistical significance between groups, assuming non-normal distributions.

The number of investigations for each patient's investigative journey was compared in size-matched cohorts preimplementation and postimplementation of CG95, and assessed for statistical significance using the Mann-Whitney U Test and Pearson's χ^2 test.

Microsoft Excel was used to aid data collection. Microsoft Excel and Graphpad Prism were used for statistical analysis and production of graphs.

RESULTS

[Table 3](#) shows the baseline characteristics of size-matched cohorts (1503 patients) preimplementation and postimplementation of CG95, excluding 335 patients' peri-implementation when some early shift in practice occurred.

[Table 4](#) summarises the number of patients, the percentage undergoing each test for each year and the mean number of investigations per patient.

Table 2 Costs of each diagnostic investigation according to NICE CG95 costing report

Test	Cost
Exercise treadmill test	£75
CT angiography	£173
CT calcium scoring	£113
Stress MRI	£313
Echocardiography	£86
Stress echocardiography	£236
Myocardial perfusion imaging	£293
Invasive coronary angiography	£1052

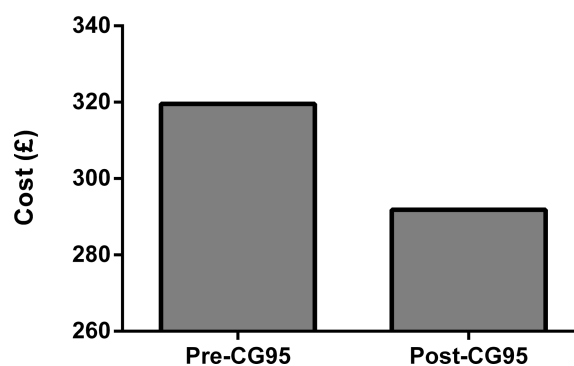
CG95, Clinical Guideline 95; NICE, National Institute for Health and Care Excellence.

Table 3 Baseline characteristics of patients

	Pre-CG95 (2007–2009)	Post-CG95 (2010–2012)
Total patients	1503	1503
Mean age±SD (years)	56.8±13.4	57.3±13.0
Male (%; not routinely recorded before 2009)	195 (54.9)	816 (54.3)
Female (%; not routinely recorded before 2009)	160 (45.1)	686 (45.6)
Type 1 diabetes mellitus (%)	22 (1.5)	15 (1.0)
Type 2 diabetes mellitus (%)	235 (15.6)	243 (16.2)
Hyperlipidaemia (%)	604 (40.2)	634 (42.2)
Current smoker (%)	355 (23.6)	322 (21.4)
Ex-smoker (%)	347 (23.1)	393 (26.1)

A total of 1503 patients were seen postimplementation of CG95 and they were compared with a size-matched cohort of 1503 consecutive patients seen preimplementation. The mean cost of all investigations for the patient postimplementation was £291.83 compared to £319.54 preimplementation of the guidelines (figure 1). This difference was statistically significant (Mann-Whitney U, $p<0.001$). Based on this cohort, this approximates a cost reduction to the clinic of about £15 300 per year.

Next, it was investigated to determine if within the same cohort of patients, there was a reduction in the number of investigations per patient. A total of 1503 patients investigated postimplementation of CG95 were looked at and the mean number of tests per patient was 0.78. In the size-matched cohort of 1503, consecutive patients were seen preimplementation and the mean number of tests per patient was 0.97, and again the difference was statistically significant (Mann-Whitney U, $p<0.001$; figure 2).

Mean Costs of Investigations per Patient**Figure 1** Mean costs of investigations per patient pre-CG95 (Clinical Guideline 95) and post-CG95.

Three hundred and thirty-five patients were excluded from the preimplementation cohort due to some early shift in practice prior to the introduction of the guidelines. If these patients were included in the preimplementation cohort, the mean costs would decrease from £319.54 to £305.80, and the mean number of tests would decrease from 0.97 to 0.83. This is largely due to the huge decrease in the number of exercise tolerance tests performed in the peri-implementation group (2010 pre-CG95, table 4).

Post-CG95 there was a reduction in the number of patients needing one or more tests. The difference in proportion of patients requiring none, one or more than one test preimplementation and postimplementation of CG95 was statistically significant (χ^2 test, $p<0.000$; figure 3), with an approximate twofold increase in patients requiring no tests post-CG95 implementation (245 pre-CG95 vs 476 post-CG95).

Next the total number of investigations within each risk category was evaluated for the post-CG95 cohort.

Table 4 Number of tests and breakdown of investigations per year for the years 2004 to 2012

Year	Exercise testing (%)	Myocardial perfusion scan (%)	Dobutamine stress echo (%)	MRI (%)	Angiogram (%)	CT angiogram (%)	CT calcium scoring (%)	Mean number of tests per patient	Number of patients
2004	47.6	40.2	NA	NA	22.0	NA	NA	1.1	378
2005	29.3	50.8	NA	NA	19.5	NA	NA	1.0	437
2006	29.4	55.5	NA	NA	17.8	NA	NA	1.0	472
2007	30.8	50.7	NA	NA	17.8	NA	NA	1.0	600
2008	29.3	54.7	NA	NA	15.9	NA	NA	1.0	618
2009	17.0	51.3	16.4	0.1	7.0	NA	NA	0.9	684
2010	5.4	53.6	12.7	0.0	6.9	NA	NA	0.8	276
pre-CG95									
2010	6.9	44.7	9.1	0.3	7.2	0.6	5.0	0.7	318
post-CG95									
2011	3.2	40.2	8.4	1.7	16.2	5.4	8.4	0.8	634
2012	3.1	37.6	7.1	3.1	10.9	6.0	6.7	0.7	551

Mean Number of Investigations per Patient

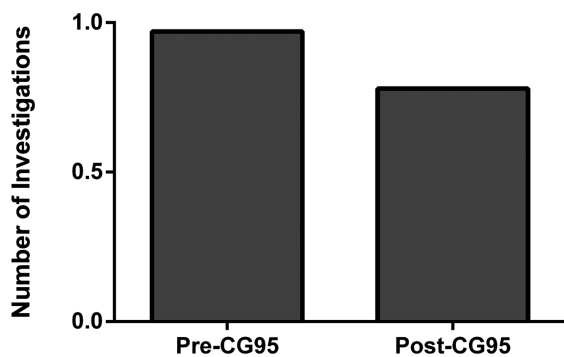


Figure 2 Mean number of investigations per patient preimplementation and postimplementation of CG95 (Clinical Guideline 95).

Table 5 shows that the lower the risk, the higher the proportion of patients who did not require any investigations. The proportion of patients requiring increasing number of tests increased with the risk category.

Table 6 reports the numbers of each test required, divided by NICE risk category. A total of 106 patients underwent CT calcium scoring, of which 30 patients then went on to have a CT angiogram. CT angiograms were directly requested in 39 patients.

In total 57.2% of patients in the low-risk category did not undergo investigations. The characteristics of these patients were interrogated to better understand why the majority of the patients did not undergo a test. Within this group of 162 patients, 88 (54.3%) had a CAD risk of <10 and 74 (45.7%) had a CAD risk of >10. Table 7 looks at the type of pain these patients presented with and reveals that the majority of these patients (96.9%) had either non-anginal chest pain or atypical angina.

Number of Tests per Patient Pre- and Post- CG95

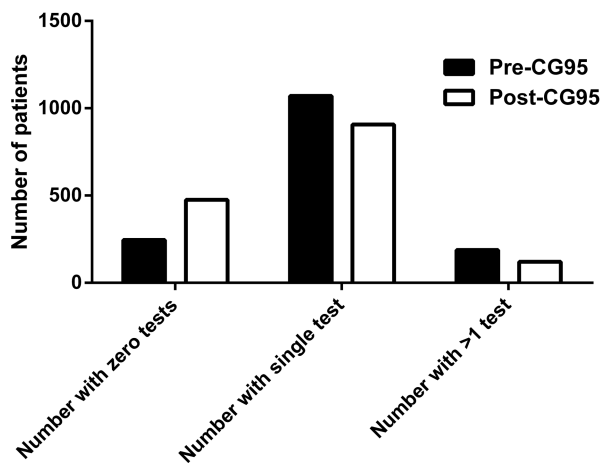


Figure 3 Number of tests per patient preimplementation and postimplementation of CG95 (Clinical Guideline 95).

Finally, the effect of the implementation of CG95 on the time taken by each patient on their investigative journey from first presentation to the RACPC to their final investigation, was evaluated. In patients requiring investigations, the average time from presentation to final investigation was 18 days pre-CG95 compared to 20.7 days post-CG95 ($p=0.63$), representing a small but non-statistically significant increase in the time taken for the total investigative journey.

DISCUSSION

In this analysis, the clinical and economic implications that implementing the NICE CG95 guideline would have on tertiary referral centre RACPCs have been evaluated. As per the CG95 guidelines, a reduction in Exercise Tolerance Tests (ETTs) performed on patients in this trust has been observed and this is consistent with evidence showing that ETTs have limited additional diagnostic value over clinical judgement.⁴ However, we acknowledge that ETTs were still used in our trust. This may reflect clinicians' familiarity with this test. Additionally, the NICE CG95 guidelines state that for people with confirmed CAD (including previous myocardial infarction, revascularisation and previous angiography), ETTs may be used when there is uncertainty about whether chest pain is caused by myocardial ischaemia.

One hundred and six patients underwent CT calcium scoring, of which 30 patients then went on to have a CT angiogram. This was consistent with the CG95 guideline regarding the assessment of low-risk patients where a CT angiogram is to be requested if the CT calcium score is positive. However, CT angiograms were directly requested in 39 patients without initially requesting a CT calcium score. This may reflect the clinician's preference and also the influence from the British Society of Cardiovascular Imaging, who advise that despite the NICE CG95 guidelines, CT calcium scoring is to be used only as a fall back if a patient is unsuitable for full CT angiography.⁵ Studies comparing CT calcium scores with CT coronary angiography suggest that the use of a CT calcium score of 0 to exclude further additional testing would result in a significant proportion of patients being misdiagnosed or requiring further testing⁶⁻⁸ even in low-risk groups, suggesting that CT angiography may be more cost-effective in the longer term compared to CT calcium scoring alone.

A reduction in the mean number of tests per patient was observed. This is important as it may help to alleviate anxiety in patients as less tests are required to confirm or exclude a diagnosis of CAD. After the implementation of the current NICE guidelines, there was a higher proportion of patients who did not require any further investigations after presenting to the RACPC. This is important as it avoids unnecessary tests that may entail risk or lead to additional worry for patients. This also suggests that good clinical acumen still plays a key role

Table 5 Number and percentage of patients requiring zero, one or more than one investigations, divided by NICE CG95 risk category

	0 Investigations (%)	1 Investigation (%)	>1 Investigations (%)
Low	162 (57.2)	116 (41.0)	5 (1.8)
Intermediate	124 (34.9)	212 (59.7)	19 (5.4)
High	179 (21.0)	578 (67.8)	96 (11.3)

CG95, Clinical Guideline 95; NICE, National Institute for Health and Care Excellence.

in the assessment of CAD under the new guidelines. Implementation of CG95 gives physicians more confidence to not order unnecessary tests for patients while still thoroughly assessing a patient for CAD.

A total of 4968 patients were analysed and a size-matched cohort of 1503 patients, preimplementation and postimplementation of CG95, were compared. This represents the largest published analysis of changes following the implementation of CG95 in this country. However, several limitations of this study must be acknowledged. First, this was a single-site study and the findings may be limited in application to this trust. Local tariffs vary and this may result in differences in the cost of investigations at a different centre. Second, while efforts have been made to provide a NICE-compliant service, not all individual clinicians in the RACPC have been completely adherent to the guidelines. This may reflect the role of the guidance as advice for clinicians and not a replacement for a clinician's individual judgement that must be employed for each patient who presents to clinic. The data presented reflects a real world implementation of these guidelines and how the practice changed in relation to the guidelines. The proportion of patients within each risk category may also differ from year to year, and this may cause the economic costs to change accordingly from year to year. However, it was demonstrated that the patient characteristics pre-CG95 and post-CG95 were similar in this trust, suggesting true economic savings.

This analysis builds on previous reports looking at the impact of implementing NICE CG95 on economics costs. Previous studies have suggested either cost neutrality or an increase in costs postimplementation^{9 10} However, this report presents findings from the largest cohort presented to date. Furthermore, the data obtained from this cohort is representative of a large teaching hospital covering patients of a wide range of ethnicities and backgrounds.

It is interesting to see that despite using costlier initial investigations postimplementation of NICE CG95, there was a significant overall cost reduction resulting from fewer overall referrals for investigations. A reduction in average costs for the investigation of each patient was demonstrated. This is probably due to the combination of eliminating ETTs as a diagnostic test, a higher proportion of patients not requiring any tests and fewer mean number of investigations. A reduction in the number of patients undergoing coronary angiograms and an increase in non-invasive and less expensive tests, such as CT angiograms, was seen, reflecting the increase in investigative options available to the clinician and guidance from NICE on the appropriate investigations to use. Despite the introduction of tests such as CT calcium scoring and MRI which were associated with longer waiting time in this trust, the average length of the investigative journey for patients has remained almost the same postimplementation of CG95.

Although a reduction in the number of tests and cost per patient was seen, the effects of implementing NICE CG95 on the clinical outcomes of patient with regards to mortality and morbidity has yet to be investigated. Investigating the clinical outcomes of patients and the longer term economic impact of implementing these NICE guidelines would be an ideal follow-up. This could be used to confirm the evidence used by NICE in developing the current clinical guidelines and to help shape revisions of the guideline.

CONCLUSIONS

Progress towards a NICE CG95-compliant RACPC service at the Heart Hospital, University College London Hospitals has been made. When used in the RACPC, CG95 demonstrated clear cost benefits. This is likely explained by patients having the most appropriate first-line investigation and requiring fewer second-line tests. Many patients did not require unnecessary tests following clinical assessment. A potential reduction in patient

Table 6 Number of investigations, divided by NICE CG95 risk category

	Exercise testing	CT calcium scoring	CT angiogram	Myocardial perfusion scan	Dobutamine stress echo	MRI	Angiogram
Low	12	20	12	58	22	2	1
Intermediate	14	35	13	141	34	5	10
High	33	51	44	396	65	22	175

CG95, Clinical Guideline 95; NICE, National Institute for Health and Care Excellence.

Table 7 Number and percentage of patients in low risk NICE CG95 category requiring zero, investigations, divided by type of chest pain

	Number of patients (%)
Non-anginal	92 (56.8)
Atypical angina	65 (40.1)
Typical angina	5 (3.1)

CG95, Clinical Guideline 95; NICE, National Institute for Health and Care Excellence.

morbidity from common cardiac investigations is surmised, particularly invasive angiography. CG95 offers a concise and objective method for diagnosing cardiac chest pain. It is hoped that these observations prove that implementation of NICE CG95 Guidelines RACPCs in the UK have led/will lead to a faster diagnosis, an increase in patient's safety and also cost savings.

Contributors AJXL prepared the manuscript with contribution from all coauthors. All authors contributed to study design, data collection and data analysis.

Competing interests None declared.

Provenance and peer review Not commissioned; externally peer reviewed.

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REFERENCES

1. British Heart Foundation Health Promotion Research Group. Coronary heart disease statistics. 2012. <http://www.bhf.org.uk/publications/view-publication.aspx?ps=1002097> (accessed Nov 2014).
2. National Institute for Health and Care Excellence. CG95 Chest pain of recent onset. 2010. <http://guidance.nice.org.uk/CG95> (accessed Nov 2014).
3. National Institute for Health and Care Excellence. CG95 Chest pain of recent onset: costing report 2011. <http://www.nice.org.uk/guidance/cg95/resources/cg95-chest-pain-of-recent-onset-costing-report2> (accessed Nov 2014).
4. Sekhri N, Feder GS, Junghans C, *et al*. Incremental prognostic value of the exercise electrocardiogram in the initial assessment of patients with suspected angina: cohort study. *BMJ* 2008;337:a2240.
5. British Society of Cardiovascular Imaging (BSCI). CT coronary angiography service specification. 2012. <http://www.bcsi.org.uk/downloads/category/6-bcsi-documents?download=22:ctca-service-specification-document> (accessed Nov 2014).
6. Villines TC, Hulten EA, Shaw LJ, *et al*. Prevalence and severity of coronary artery disease and adverse events among symptomatic patients with coronary artery calcification scores of zero undergoing coronary computed tomography angiography: results from the CONFIRM (Coronary CT angiography evaluation for clinical outcomes: an international multicenter) registry. *J Am Coll Cardiol* 2011;58:2533–40.
7. Kwon SW, Kim YJ, Shim J, *et al*. Coronary artery calcium scoring does not add prognostic value to standard 64-section CT angiography protocol in low-risk patients suspected of having coronary artery disease. *Radiology* 2011;259:92–9.
8. Cademartiri F, Maffei E, Palumbo A, *et al*. Diagnostic accuracy of computed tomography coronary angiography in patients with a zero calcium score. *Eur Radiol* 2010;20:81–7.
9. Ashrafi R, Raga S, Abdool A, *et al*. NICE recommendations for the assessment of stable chest pain: assessing the early economic and service impact in the rapid-access chest pain service. *Postgrad Med J* 2013;89:251–7.
10. Patterson C, Nicol E, Bryan L, *et al*. The effect of applying NICE guidelines for the investigation of stable chest pain on out-patient cardiac services in the UK. *QJM* 2011;104:581–8.