# Hearts and Budgets: Cost-Benefit Analysis of Guideline Directed Rejection Strategies for NT-proBNP

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## Introduction

Current guidelines (RCPath[1], NICE NG106[2] and CG187[3]) recommend that N-Terminal pro-B type Natriuretic Peptide (NT-proBNP) be measured once in a patient's lifetime unless there is new clinical suspicion of heart failure (HF) when previously excluded.

HF is a progressive and complex condition whereby the heart has difficulty pumping blood at a rate needed to maintain homeostasis[4]. It affects ~2% of the UK's population, with increasing incidence and prevalence in people over 65 years. Diagnosis is complicated by non-specific symptomology and although incurable, progression can be slowed and prognosis improves with the correct treatment[5]. Initial testing using NT-proBNP measurement is recommended to rule in/rule out (RI/RO) HF.

For primary care, results below 400 ng/L rule out HF, results between 400 and 2000 ng/L prompt routine referral (6 weeks) for echocardiogram, or urgent referral (2 weeks) above 2000 ng/L[3]. In the emergency department acute presentation of HF symptoms trigger referral for echocardiogram if NT-proBNP is greater than 300 ng/L[2].

At ESNEFT, the cost of an NT-proBNP test is £29.30 and we do not currently reject repeat requests for NT-proBNP for the same patient. The aim of this audit is to ascertain the extent and appropriateness of replicate testing and to assess potential rejection strategies to reduce the workload and cost of inappropriate requesting without compromising patient safety or clinical care.

## Methodology

From 30,234 unique patients analysed for NT-proBNP at ESNEFT over a 1 year period up to September 2024, a total of 400 patients were reviewed for previous and subsequent NT-proBNP requests along with their clinical notes. Rejection strategies (3, 6 and 12-month minimum retesting intervals (MRI)) were retrospectively applied to the data to determine potential cost savings and missed diagnosis rate.

## Results

**Table 1 -** *Summary of NT-proBNP Requests in Relation to Inappropriate Requesting Patterns According to RCPath Guidance.*

| | Total samples | Number of patients with previous NT-proBNP results | Total previous NT-proBNP results of all patients | Number of patients with further NT-proBNP results | Total further NT-proBNP results of all patients | Total number of patients with inappropriate NT-proBNP requests |
|---|---|---|---|---|---|---|
| Colchester A+E patients with NT-proBNP result <300 ng/L | 72 | 22 | 42 | 15 | 21 | 22 |
| Colchester A+E patients with NT-proBNP result >300 ng/L | 72 | 24 | 66 | 28 | 42 | 24 |
| Ipswich GP patients with NT-proBNP result <400 ng/L | 80 | 27 | 51 | 11 | 11 | 27 |
| Ipswich GP patients with NT-proBNP result 400-2000 ng/L | 80 | 38 | 136 | 14 | 19 | 35 |
| Ipswich GP patients with NT-proBNP result >2000 ng/L | 80 | 50 | 146 | 28 | 40 | 39 |
| Ipswich A+E patients with NT-proBNP result <300 ng/L | 8 | 6 | 12 | 4 | 4 | 6 |
| Ipswich A+E patients with NT-proBNP result >300 ng/L | 8 | 4 | 7 | 1 | 1 | 4 |
| Total | 400 | 171 | 460 | 101 | 138 | 157 |

Table 1 shows that 157 (39.3%) of the 400 randomly selected NT-proBNP patient requests were inappropriate. Of the 171 patients with previous requests, 21 received a new diagnosis of HF. A further 7 patients had a previous diagnosis of HF (despite no recorded NT-proBNP), hence 157 samples had been tested inappropriately according to RCPath MRI.

**Table 2** - *Total Costs of ESNEFT NT-proBNP Requests and the Total Costs of all Previous and Further NT-proBNP Requests.*

| | Total cost of NT-proBNP requests (£) | Total cost of previous NT-proBNP requests (£) | Total cost of further NT-proBNP requests (£) | Total cost of inappropriate NT-proBNP requests based on previous requests (£) |
|---|---|---|---|---|
| Colchester A+E patients with NT-proBNP result <300 ng/L | 2109.6 | 1230.6 | 615.3 | 644.6 |
| Colchester A+E patients with NT-proBNP result >300 ng/L | 2109.6 | 1933.8 | 1230.6 | 703.2 |
| Ipswich GP patients with NT-proBNP result <400 ng/L | 2344 | 1494.3 | 322.3 | 791.1 |
| Ipswich GP patients with NT-proBNP result 400-2000 ng/L | 2344 | 3984.8 | 556.7 | 1025.5 |
| Ipswich GP patients with NT-proBNP result >2000 ng/L | 2344 | 4277.8 | 1172 | 1142.7 |
| Ipswich A+E patients with NT-proBNP result <300 ng/L | 234.4 | 351.6 | 117.2 | 175.8 |
| Ipswich A+E patients with NT-proBNP result >300 ng/L | 234.4 | 205.1 | 29.3 | 117.2 |
| Total | 11720 | 13478 | 4043.4 | 4600.1 |



Table 2 shows that the cost of the 400 NT-proBNP requests equates to £11,720. From the 400-patient sample size, £13,478 was spent on previous NT-proBNP requests and £4043.40 was spent on subsequent NT-proBNP requests, totalling £17,521.40 spent on potentially inappropriate requests.

**Table 3 -** *Total Samples Rejected and Cost Savings when Utilising Minimum Retesting Intervals (MRI).*

| | Total inappropriate NT-proBNP requests | Total rejected with 3-month MRI | Total rejected with 6-month MRI | Total rejected with 12-month MRI | Total savings for 3-month MRI (£) | Total savings for 6-month MRI (£) | Total savings for 12-month MRI (£) |
|---|---|---|---|---|---|---|---|
| Col A+E <300 ng/L | 22 | 5 | 8 | 14 | 146.5 | 234.4 | 410.2 |
| Col A+E >300 ng/L | 24 | 8 | 11 | 13 | 234.4 | 322.3 | 380.9 |
| IPS GP <400 ng/L | 27 | 4 | 5 | 15 | 117.2 | 146.5 | 439.5 |
| IPS GP 400-2000 ng/L | 35 | 5 | 13 | 20 | 146.5 | 380.9 | 586 |
| IPS >2000 ng/L | 39 | 10 | 20 | 24 | 293 | 586 | 703.2 |
| IPS A+E <300 ng/L | 6 | 1 | 3 | 4 | 29.3 | 87.9 | 117.2 |
| IPS A+E >300 ng/L | 4 | 0 | 1 | 2 | 0 | 29.3 | 58.6 |
| Total | 157 | 33 | 61 | 92 | 966.9 | 1787.3 | 2695.6 |

Table 3 shows potential savings range from £966.90 with a 3-month rejection rule across both A+E and GP patients, to £2695.60 saved with a 12-month rejection rule across both A+E and GP patients. If A+E samples were excluded from the rejection rules, the potential savings would reduce to £556.70 for a 3-month rejection rule, and to £1728.70 for a 12-month rejection rule.

## Discussion

A sample was deemed inappropriate if there was a previous NT-proBNP request, or a previous diagnosis of HF and the selected sample did not lead to a new diagnosis. Within the 400 patients, 52.3% of requests were inappropriate due to the presence of previous or subsequent NT-proBNP results, with a small percentage of patients (1.8%) deemed to have inappropriate requesting due to prior diagnosis of HF without a documented NT-proBNP result. The total cost of inappropriate testing for our selected patients was £4600.10 (39.3%). If extrapolated to our annual NT-proBNP requests, the potential savings could be as high as £434,583 in ESNEFT alone.

From our findings, 21 patients would have had a new diagnosis missed if their repeat request had been blocked in line with RCPath guidance. The data were recalculated for 3, 6 and 12 months rejection strategies to see whether an MRI rejection strategy for NT-proBNP would have missed a new diagnosis. One patient of the 400 (0.25%) would be missed with a 3-month MRI rejection strategy, three patients (0.75%) missed with a 6-month MRI rejection strategy and 8 patients (2%) missed with a 12-month MRI rejection strategy. MRI rejection strategies for NT-proBNP were applied to the remaining 157 inappropriate requests to determine potential savings. The results indicated that 33 samples (8.3%) would have been rejected with a 3-month MRI, 61 samples (15.3%) with a 6-month MRI and 92 (23%) samples with a 12-month MRI.

If these data were extrapolated to our total annual testing population, potential savings could be £203,747 for a 12-month MRI, at a clinical consequence of 605 missed diagnoses; £135,536 saved for a 6-month MRI, at a clinical consequence of 227 missed diagnoses; and £73,526 saved for a 3-month MRI, at a clinical consequence of 76 missed diagnoses.

The 6-month MRI would reject and save almost double the amount compared to the 3-month MRI, whereas the 12-month MRI provides triple the savings but eight times the rejections compared to the 3-month MRI. Thus the 12-month MRI is disproportionate in terms of savings in comparison to the 6-month MRI in terms of clinical consequence.

## Conclusions

To conclude, NT-proBNP can be an expensive assay to run, despite its useful ability to aid in the RI/RO of HF. A significant number of patient requests are deemed inappropriate (~39%), and the introduction of rejection strategies can aid in reducing the amount of work handled by the NHS in terms of patients bled, samples run and interpretations of inappropriately requested tests. A 6-month MRI rejection strategy for NT-proBNP requests minimises the number of new diagnoses missed, while reducing the number of samples run in biochemistry laboratories and saving the NHS hundreds of thousands of pounds per year.

## References

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4. Don-Wauchope, A. C., McKelvie, R. S. (2015), *Evidence based application of BNP/NT-proBNP testing in heart failure*, Clinical Biochemistry, volume 48, issues 4-5, pp 236-246.
5. Fonseca, C. (2006), *Diagnosis of heart failure in primary care*, Heart Failure Review, volume 11, pp 95-107.