Imperial Heart Failure Pathway Transformation

Health Economic Model - Interim Report

June 2021

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Context:

Consuming 2% of the entire NHS budget, 1m people in the UK have HF - with a forecasted increase of 50% by 2040[1]. Although 40% of patients will have seen their GP with symptoms of HF prior to diagnosis, the high demand, and importance and difficulty of accuracy, results in diagnosis and treatment as per NICE timelines in only 4% of patients.

Consequently, 80% of HF is diagnosed only at life-threatening hospital admission, with 83% found to have the common form with reduced ejection fraction (HFrEF)[2].

In North West London (NWL) the data confirm very low rates of HF diagnoses in the community compared to national figures. This is reflected in high rates of hospital admissions and readmissions with HF.

Furthermore, specialist nursing clinics (for education and initiation / optimisation and monitoring of prognostic medication) are at capacity, meaning delays to access and optimisation to therapy.

AZ is working in partnership with the DiscoverNow Hub, Imperial College Healthcare Trust and primary care leaders to improve the Heart Failure pathway, initially in NWL.

In July 2020 a co-design team was formed with representation from Imperial College Healthcare Trust, North West London CCGs and Astra Zeneca. The team mobilised a project with objectives to:

- Create a more integrated pathway across primary and secondary care for HF in NWL
- Reduce unplanned HF admissions to secondary care
- Improve efficiency of the HF services so time of specialists can be used more effectively
- Improve patient experience and outcomes

Over 13 different pathway changes have been made, with most of them being implemented in Jan-July 2021. To demonstrate the potential value of pathway changes and the introduction of new technologies a health economic model of the pathway has been developed.

Introduction to the Health Economic Model

Economic evaluation is a tool used by decision makers to maximise health outcomes for the population they act on behalf of, given a fixed budget and scarce resources. The outcomes of economic evaluation are usually presented from the perspective of the payer or decision maker. This has been applied in this analysis to inform AstraZeneca and the NHS of the potential impact of improvements in the Heart Failure pathway in North West London.

In this context the analysis in this report informs how pathway changes and the use of technologies would affect healthcare costs and resource use, and where possible, patient outcomes. Pathway costs and patient activity data used in the model have been provided by the Whole Systems Integrated Care (WSIC) data set for the North West London (NWL)-based Healthcare Trusts

[1] Cowie, M. The heart failure epidemic: a UK perspective

[2] Bottle A, Kim D, Aylin P*, et al* Routes to diagnosis of heart failure: observational study using linked data in England *Heart* 2018;**104:**600-605.

This report uses an early state model to demonstrate the effectiveness of two technologies, EkoDUO(R) and Luscii(R) Remote Patient Monitoring, alongside other pathway improvements.

This is an interim model and analysis to reflect the work from January 2021 until June 2021. It is anticipated that further data and analysis will be available in December 2021, once changes recently made to the pathway have been monitored for several months.

Data analysis

Pathway analysis

The national picture for how heart failure is diagnosed illustrates mixed outcomes for patients. In the British Heart Foundation (BHF) document, Heart Failure: a Blueprint for change[3], it describes how earlier opportunities for diagnosis are being missed in Primary Care. One of the reasons for this is the lack of access to N-terminal (NT)-pro hormone BNP (NTP-pro BNP) blood test used in the diagnosis pathway for heart failure. The missed opportunities for earlier diagnosis are leading to 80% of patients being diagnosed in hospital, which is more costly and leads to poorer patient outcomes compared to those who receive their diagnosis in a community setting[4].

The National Institute of Health and Care Excellence (NICE) Guideline (NG106[5]) describes the process General Practitioners (GP) should take when a patient presents with suspected heart failure. This is shown in Figure 1.

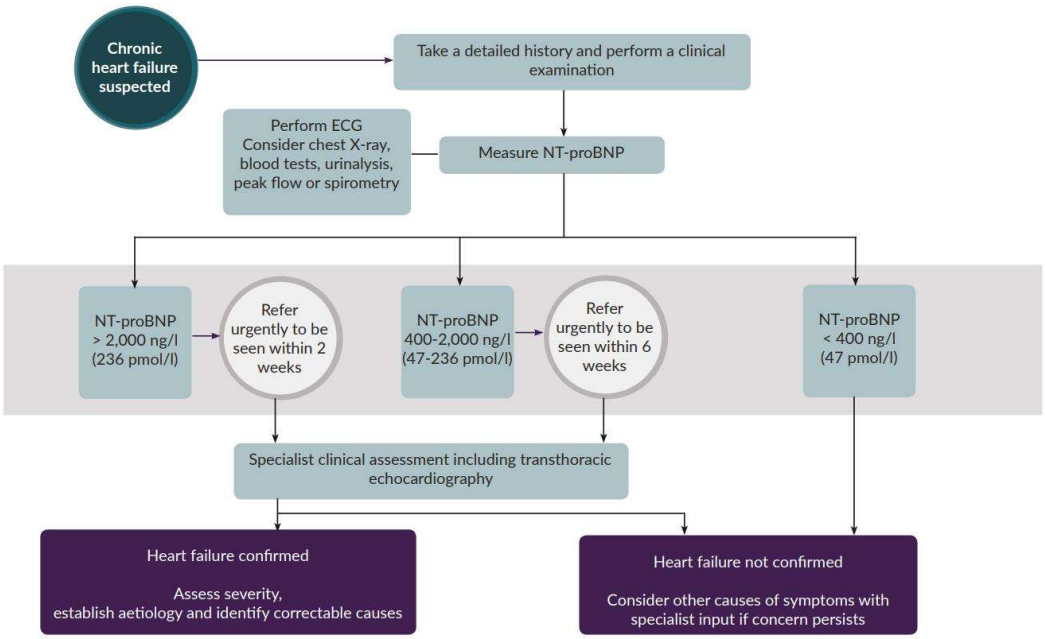

Figure 1. Visual summary for diagnosing chronic heart failure (NICE, 2018)

[3] Heart Failure: A Blueprint for change (2021) Building a better future for heart failure together. British Heart Foundation.

[4] Bottle A, Kim D, Aylin P, *et al* Routes to diagnosis of heart failure: observational study using linked data in England *Heart* 2018;**104:**600-605.

[5] NICE 2018. Overview | Chronic heart failure in adults: diagnosis and management | Guidance | NICE

However, patients' route to diagnosis can vary to that described in NG106, and patients are diagnosed either through a referral from their GP or following an unplanned emergency admission to hospital.

When a patient is diagnosed following a referral from their GP, this is termed the Community diagnosis pathway in this analysis. Where a patient is diagnosed as a result of an emergency admission, this is termed the Inpatient pathway in this analysis. To ensure the validity of the data defining both routes to diagnosis, cardiologists validated the diagnostic coding for each pathway.

Community - any diagnosis of heart failure following a referral for heart failure testing from a GP

Inpatient - a diagnosis of heart failure (either a primary or secondary condition) as a result of an emergency admission to hospital for which there was a subsequent inpatient stay

Figure 2 illustrates the clinically validated method of allocating patients into each diagnosis pathway

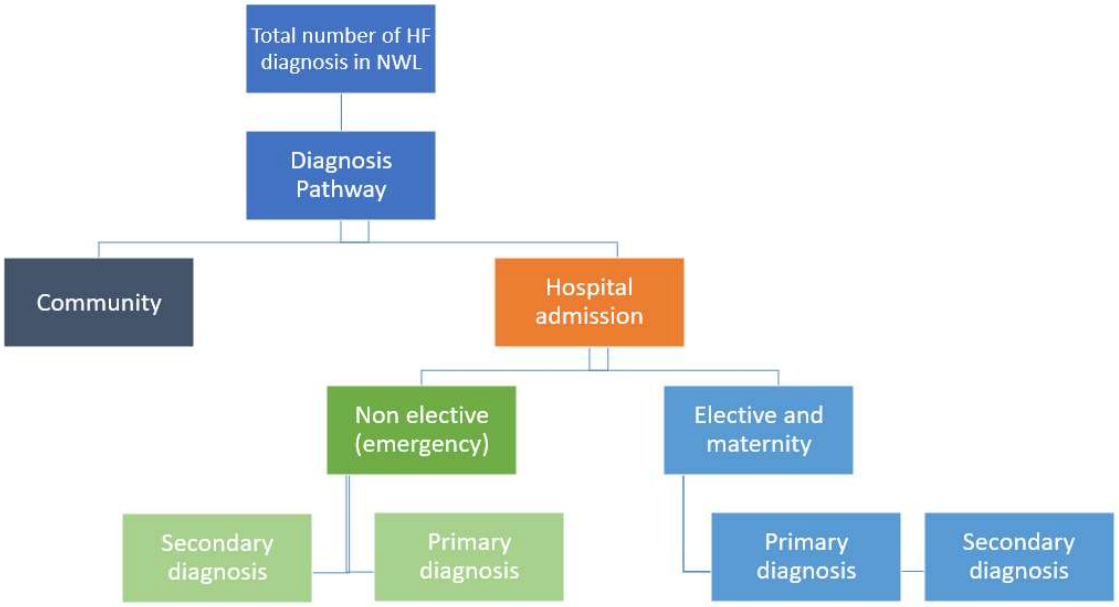

Figure 2. Methodology of allocating patients diagnosed with heart failure into each diagnosis pathway

The dataset used to identify patients to be included in the analysis was taken from the WSIC database. The data is formed from 95% of north west London patient records, approximately 2.3 million[6]. Since 2015, each patient record has a link between their primary and secondary care activity, allowing for a detailed longitudinal analysis of patient activity.

[6] Bottle, A., Cohen, C., Lucas, A. *et al.* How an electronic health record became a real-world research resource: comparison between London's Whole Systems Integrated Care database and the Clinical Practice Research Datalink. *BMC Med Inform Decis Mak* 20, 71 (2020). https://doi.org/10.1186/s12911-020-1082-7

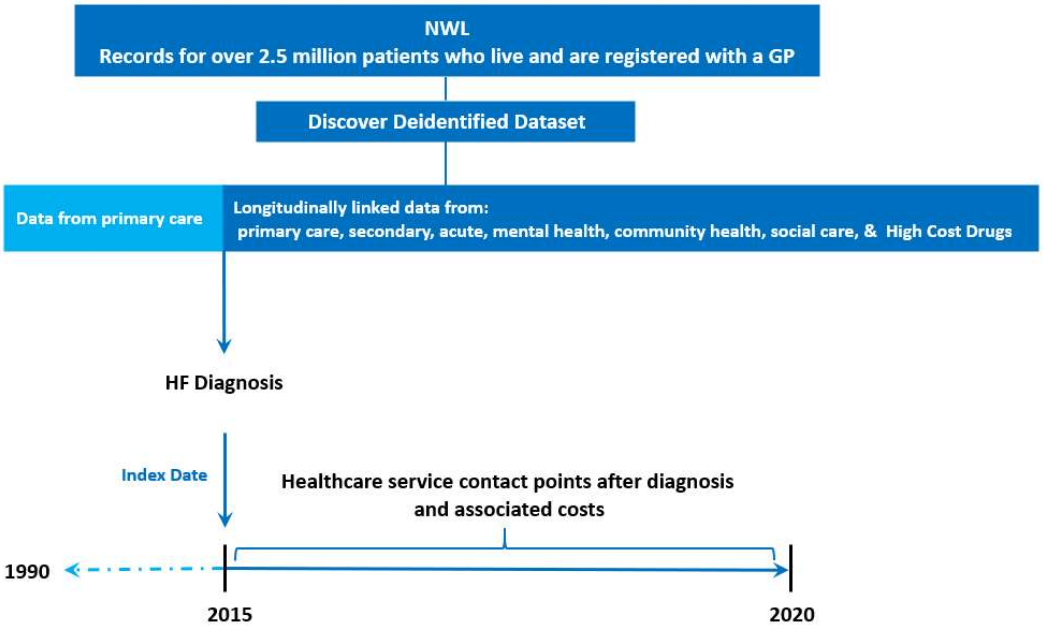

Figure 3. Study logic for inclusion in the aggregated data set used in the analysis of heart failure patient in north west London

The WSIC data showed that, on average, over the 5-year period (2015-2019, excluding 2020 due to impact of Covid-19), there were 5908 patients per year diagnosed with heart failure. Approximately 32% of these patients were diagnosed in a community setting and 68% of patients diagnosed in hospital as part of inpatient stay following an emergency admission. These figures are presented in Table 1 and are the figures used in the economic model.

Average number of patients diagnosed per year in the study period	5908
% of patients diagnosed in the community pathway (n)	32% (1891)
% of patients diagnosed in the inpatient pathway	68% (4017)

Table 1. Average number people diagnosed with heart failure in north west London each year, and the proportion diagnosed in each pathway

Patient characteristics

Table 2 illustrates the patient characteristics of the two diagnosis pathways prior to diagnosis:

	Community diagnosis	**Inpatient diagnosis**
Number of patients between 2015 - 2020	10,873	23,145
Age (years)		
Median (SD)	75 (13.3)	77 (13.3)
Sex (%)		
Male	54	51
Female	46	49
Ethnicity (%)		
White	51	52
Asian / British Asian	28	25
Black / British Black	9	8
All other ethnic groups	12	15
Comorbidities		
Median (per person)	2	2
Symptoms prior to diagnosis		
% of patients with no recorded symptoms	75	79
% of patients recorded as breathless prior to diagnosis	18	17
Median number of breathless events per patient recorded in Primary Care prior to diagnosis	3.2	3.5
Median number of ankle swelling events per patient recorded in Primary Care prior to diagnosis	0.2	0.1
Median number of fatigue events per patient recorded in Primary Care prior to diagnosis	0.1	0.1

Survival post-diagnosis (Months)		
Median	22	12

Table 2. Patient characteristics prior to diagnosis in the community and inpatient pathways

Table 2 illustrates that the characteristics of both populations are similar. Median age at time of diagnosis may be clinically significant and could be associated with shorter life expectancy following diagnosis. However, the analysis of survival is not discussed in this report.

The similarity of patient characteristics demonstrates that these variables could not be used to predict which patients are likely to enter the community or inpatient pathway. Therefore a diagnostic device that generates different data may aid primary care clinicians in making decisions about whether to refer a patient for an NT-pro BNP test or an echocardiogram for suspected heart failure.

Coding of symptoms appears to be an unreliable measure of presence of symptoms. It was found that 75% of patients who were referred for an echocardiogram in hospital were found not to have any recorded symptoms of fatigue, breathlessness or ankle swelling (the three most typical heart failure symptoms) at any time prior to their diagnosis. This is unlikely to be the case as patients would have likely presented with at least one of the symptoms in order for the referral to happen. This suggests coding is an unreliable measure of presence of symptoms.

Mortality

Median survival post-diagnosis is shown in Table 1. The difference between the two pathway groups is 10 months with a *p-value* of 0.00001, analysed using Analysis of Variance, ANOVA, statistical analysis. Detailed patient survival analysis has not been performed to adjust for any variables associated with mortality. Whilst this does not invalidate the association between pathway and mortality, it is unable to explain the cause of the differences in mortality.

Cost analysis

The costs for each pathway have been drawn from the patient population in the WSIC data set. All costs are for resources associated with heart failure. These costs have been clinically validated by a team of cardiologists.

Table 3 shows the costs associated with each pathway. Median costs have been reported to reduce the effect of outliers and skewed data.

	Community	Inpatient
A and E (prior to diagnosis)	£297	£409
Diagnosis spell in hospital		£4,207
A and E (post diagnosis)	£457	£568
Non elective (prior)	£3,328	£4,632

Non elective (post diagnosis)	£6,699	£8,749
Day Case prior (elective)	£1,165	£1,268
Daycase post (elective)	£1,335	£1,280
Elective prior	£3,189	£2,832
Elective post	£3,365	£3,354
Outpatient first visit (prior)	£418	£447
Outpatient first visit (post)	£496	£495
Outpatient follow up (prior)	£335	£436
Outpatient follow up (post)	£396	£384
Outpatient procedure (prior)	£367	£398
Outpatient procedure (post)	£390	£363
Primary Care (prior)	£4,471	£4,869
Primary care (post)	£3,156	£1,927
Total	£29,864	£36,927
Difference		+£7,063

Table 3. Pathway cost analysis

The difference in total per-patient pathway costs is £7,063. Table 4 demonstrates the costs of each pathway pre and post diagnosis as well as the cost of the emergency admission during which the diagnosis is made

Pathway	Pre-diagnosis	Diagnosis	Post diagnosis	Total	Difference
Community	£13,570		£16,294	£29,864	
In-patient	£15,291	£4,207	£17,429	£36,927	+£7,063
Costs included in this analysis are aggregated prior to- and post-diagnosis: Emergency Department costs; Non-elective admissions; Elective admissions; Outpatient admissions: Primary Care activity					

Table 4. Disaggregated costs across the pathway for each route of diagnosis

To provide some adjustment for shorter life expectancy post-diagnosis, per month costs for all post-diagnosis activity have been summed and divided by median life expectancy. This is presented in Table 5. This demonstrates that per month costs are approximately double in the inpatient pathway compared to the community pathway.

Pathway	Total costs	Costs per month of life
Community (GP referral)	£16,294	£740
In-patient	£17,429	£1452

Table 5. Post-diagnosis monthly costs per patient

Economic model

The model of the current pathway is built from three individual models which are linked to show both their individual and cumulative effect. The WSIC data is used to populate all of the models. There is a model for EkoDUO, Luscii RPM and other pathway changes. And all models are linked together.

EkoDuo

EkoDUO is a digital stethoscope with enhanced audio capability, compared to standard analogue stethoscope, with an artificial intelligence powered diagnostic ability. The use of EkoDUO in Primary Care is to be used alongside NT Pro BNP and not a replacement for the blood test.

The sensitivity and specificity of EkoDUO have been reported as 80% and 67% respectively, from interim research study results. Sensitivity is the probability of a diagnostic device showing positive in a person who has the condition, and specificity is the probability of a device showing negative in a person who does not have the condition. Using this information alongside the underlying rate of heart failure and the population to be screened can be used to calculate the Positive Predictive Value (PPV) and Negative Predictive Value (NPV) of a diagnostic device, in this case EkoDUO.

The PPV is the probability that a person has the condition given a positive result, and the NPV is the probability the person does not have the condition given a negative result.

The effect of a false positive is that a person who does not have the condition goes on to receive an unnecessary NT-pro BNP test. Cost of an NT-pro BNP test used in this model is £19[7]. A false negative means that a patient who does not have the condition is not followed up for treatment.

[7] NICE. 2021. *Reducing inappropriate use of NT pro BNP: A Quality Improvement project*. [online] Available at: <https://www.nice.org.uk/sharedlearning/reducing-inappropriate-use-of-nt-pro-bnp-a-quality-improvement-project> [Accessed 28 June 2021].

The effect of finding a true positive result in Primary Care could lead to a patient being diagnosed in the community pathway rather than the inpatient pathway. This would save the NHS £7,063, as shown in Table 4.

Three use cases have been used to demonstrate the effect of EkoDUO in screening different populations: *All patients; breathless patients; and patients aged 40-85yrs*. The cost of screening, the effect of diverting patients into the community pathway and the cost of false positives have all been considered in these use cases.

The total cost of using EkoDUO in north west London is estimated to be £510,000 per annum. Each unit of EkoDUO has an annual cost of £425. This includes the device cost plus licence cost / subscription fee. This is the price cited on EkoHealth website and it is assumed the NHS would be able to procure the device and licence at lower costs.

The patient population of north west London is approximately 2.4 million. There are approximately 1200 GPs[8] in north west London. Assuming 1 unit of EkoDUO per GP, this is a total cost of £510,000. In reality devices might be shared in a GP surgery, or even if they have one device each, they may only need one subscription account. The costs we have provided are therefore 'worst case scenario' costs, although these have not been validated with the supplier.

All Use Case - this use case assumes all primary care consultations are screened for heart failure

Population to be screened	**5,249,268** (whole primary care population)
Cost per year (Eko DUO)	**£510,000**
Gross savings (assuming £7063 per patient)	All patients identified earlier: 3887(Inpatient average per year) patients = **£27,453,881**
Number of false positive and negatives	1.8M False positives 778 False negatives **Cost - £34,200,000 (1.8M x £19 NTProBNP)**
Net savings (Gross savings - screening costs)	All patients identified earlier: £27,453,881 - £510,000 - £34,200,000= **£-7,056,119**

Table 6a. All Use Case

Breathless Use Case - this use case uses coding for patient presenting as breathless per annum across all north west London Primary Care consultations in a single year (19,921) and all patients who were coded as breathless and who went on to receive a diagnosis of heart failure in that year (674).

[8] Lginform.local.gov.uk. 2021. *Ratio of GPs per 10,000 population in City of London | LG Inform*. [online] Available at: <https://lginform.local.gov.uk/reports/lgastandard?mod-metric=3713&mod-area=E09000001&mod-group=AllBoroughInRegion_London&mod-type=namedComparisonGroup> [Accessed 28 June 2021].

Population to be screened	**19,921** (breathless population)
Cost per year (Eko DUO)	**£510,000**
Gross savings (assuming £7063 per patient)	Only patients with breathlessness identified earlier. 674 patients (coded with breathlessness and diagnosed with HF in inpatient) = **£4,760,462**
Number of false positive and negatives	6,352 False positives 135 False negatives **Cost - £120,688 (6,352 x £19 NTProBNP)**
Net savings (Gross savings - screening costs)	Breathless only identified earlier; £4,760,462 - £510,000 - £120,688 = **£4,129,774**

Table 6b. Breathless Use Case

Age Use Case - in this use case, all patients aged between 40 to 85 years old are screened. The optimal screening programme would identify all patients who have heart failure as early as possible. Where no screening programme is already in place, the number of patients identified will exceed the number of patients diagnosed, because more effective resources are being allocated to finding patients. The model predicts the incidence of heart failure cases to double in a screening programme compared to those diagnosed in north west London each year (11,400 through screening compared to annual mean of 5908). It may be logical to suggest that if the number of cases found through screening is twice the number diagnosed each year, all patients will be identified earlier, in the community pathway. However, it may be too optimistic to suggest that, in practice, all cases of heart failure will be identified in primary care. Conservatively, In this use case, it has been assumed the maximum number of patients diverted to the Community pathway is 90%, not 100%

Population to be screened	**1,145,126** (Patients aged 40-85 in NWL)
Cost per year (Eko DUO)	**£510,000**
Gross savings (assuming £7063 per patient)	All patients identified earlier: 4017*(Inpatient average per year) patients = **£28,379,134** *This approach will find 9161 patients, given an underlying rate of HF of 1% in the population
Number of false positive and negatives	374,072 False positives 2290 False negatives **Cost - £7,107,368 (374072 x £19 NTProBNP)**

Net savings (Gross savings - screening costs)	All patients identified earlier: £28,372,071 - £510,000 - £7,107,368= **£20,754,703.** **(**If 10% of all patients still diagnosed in inpatient, this reduces to **£16,755,053)**

Table 6c. Age Use Case

Pathway enhancements

Additional pathway improvements have been implemented; however, it is too early to be able to model the benefits that are solely attributed to the pathway enhancements independent of other interventions considered in this report. Figure 4 illustrates these pathway improvements.

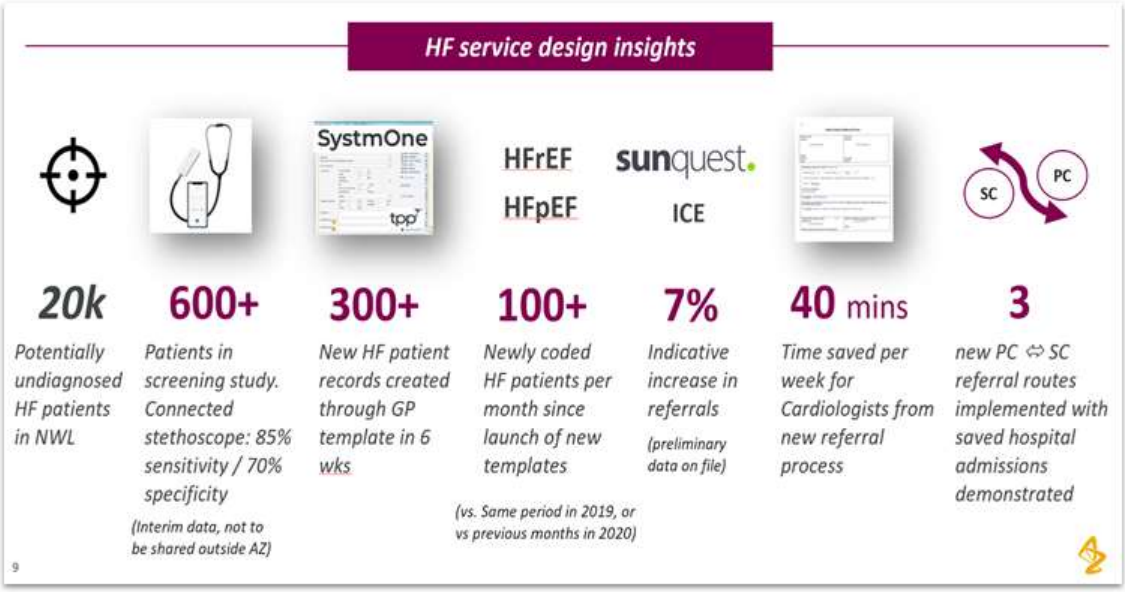

Figure 4. Pathway improvements

The 7% increase in patient referrals, shown in figure 4, may have diverted patients from the inpatient to the community pathway. To conservatively assess the benefits, it is assumed that only 75% of these referrals were diverting patients. This would result in a 5% diversion from inpatient to community (n=296). If 296 patients were diagnosed earlier and in the community pathway, this would result in £2.1M of savings through pathway optimisation. With approximately 200,000 new cases per year in the UK[9], the potential national savings could be £70M.

Luscii Remote Patient Monitoring

Luscii Remote Patient Monitoring (Luscii RPM) is a form of telemedicine that can monitor patient health through collecting data such as heart rate, blood pressure and weight. Patients record this data regularly and Luscii RPMthen transmits the data to a clinician who can monitor the patient, the data can also be set to trigger alerts for the clinician. The use of remote patient monitoring is seen as a way of increasing productivity through reducing time taken per patient; improving patient

[9] BHF. 2021. *number of people diagnosed heart failure each year uk - Bing*. [online] Available at: <https://www.bing.com/search?q=number+of+people+diagnosed+heart+failure+each+year+uk&form=ANNH01&refig=8f0acc57bc81411eb023d1ccc28b0c36> [Accessed 28 June 2021].

outcomes through monitoring their data and preventing admissions through alerting clinicians earlier than would otherwise happen.

A number of additional benefits have yet to be included in the model because the associated data has not yet been collected. They are:

- Analysis of nurse list size to understand whether nurses can manage greater list size through not having to visit each patient.
- Speed to medicines optimisation. Does the use of Luscii RPM reduce the speed to patient stabilisation compared to the current standard of care.? Does the use of Luscii improve specific heart failure outcomes measured through the Minnesota Living With Heart Failure Questionnaire?
- Analysis of data to understand whether patients achieve higher levels of activation, measured using the Patient Activation Measure (PAM). Patients who have higher levels of PAM appear to use less healthcare resources and have a lower risk or hospital admission[10]

A Cochrane Review[11] has shown that remote monitoring of patients with heart failure, following discharge, can reduce their risk of readmission by up to 25%. To understand the benefits of this on the patient data set, the effect of the reduction was modelled.

Table 7 demonstrates the increased cost and risk of readmission in the inpatient diagnosis group compared to the community diagnosis group. Using this data, the costs of Luscii RPM and the reduced readmissions are shown in Table 8.

Luscii has a unit cost of £175 (this is an estimated figure based on pilot costs, this requires validation with Luscii in any follow-up analysis) and is assumed to be provided to all patients following their diagnosis.

Pathway	**Average cost of readmissions per patient**	**Risk of readmission**
Community pathway	£6,699	53%
Inpatient pathway	£8,749	61%

Table 7. Cost of readmissions in each pathway, and risk of readmission

As Is	**Number of patients readmitted**	**Costs (total)**
Community	1002	£6,712,398

[10] Deeny, S; Thorlby, R; and Steventon, A. 2018. Briefing: Reducing emergency admissions: unlocking the potential of people to better manage their long-term conditions

[11] Inglis SC, Clark RA, Dierckx R, Prieto-Merino D, Cleland JGF. Structured telephone support or non-invasive telemonitoring for patients with heart failure. Cochrane Database of Systematic Reviews 2015, Issue 10. Art. No.: CD007228. DOI: 10.1002/14651858.CD007228.pub3. Accessed 23 June 2021.

Inpatient	2450	£21,435,050
TOTAL	3452	£28,147,448
To Be (+Luscii RPM)	**Number of patients readmitted**	**Costs(total)**
Community	752	£5,030,949
Inpatient	1838	£16,071,913
TOTAL	2589	£21,102,862
Difference	863	£7,044,586
Cost of Luscii		£604,100
Savings		£6,440,486

Table 8. Results of cost savings from patients using Luscii RPM

Pathway model

A model has been built which extrapolates the effect of using EkoDUO, Luscii RPM and additional pathway improvements to divert patients away from the inpatient diagnosis to the community diagnosis route. This is an interim analysis based on the WSIC data.

Model assumptions

EkoDuo

The sensitivity and specificity of EkoDUO is 80% and 67% respectively. The cost of EkoDUO is £425 per annum and it is estimated that 1200 units are required in north west London.

In the Age Use case, the number of people positively identified as having heart failure is 11,440. This is nearly twice the annual number of people diagnosed with heart failure in north west London. This is due to the effect of screening a wider population. The Age use case, in identifying a greater number of patients, could be assumed to find all patients in the community diagnosis group. However, to be conservative in the estimate, the maximum number of patients that can be diverted away from the inpatient diagnosis has been capped at 90%. If, following further evidence this figure is not plausible, it can be changed within the model.

It should be noted that the effect of EkoDUO finding up to 90% of patients in the community setting, the additional pathway improvements of diverting patients from the inpatient to the community pathway may be reduced due to the impact of EkoDUO. So, these two improvements are not modelled together. Until EkoDUO is used, the pathway benefits will be assumed to be providing savings. After the introduction of EkoDUO, the impact of these benefits could be reduced in the model.

Luscii Remote Patient Monitoring

Deeney et al, 2018, suggest that remote patient monitoring is associated with increases in PAM scores, and increases in PAM scores are associated with reduced rates of readmission. However, without empirical evidence to support this, it was decided to leave this variable out of the model until such time it's validity has been established. The model only assumes a 25% reduction in readmission, as per the Cochrane Report

Results

Cost savings

Table 9 demonstrates the individual cost savings of each technology/pathway change in isolation i.e. one at a time. When used together, Luscii savings will reduce because of efficiency earlier in the pathway.

Technology / pathway change	**Savings (per year)**
EkoDUO (Age Use Case)	£22,873,029
Luscii RPM	£6,440,486
Other pathway changes	£2,086,410

Table 9. Individual effect of each technology / pathway change

Luscii savings will reduce when either EkoDUO or other pathway changes are also used. This is because earlier efficiency will reduce the number of patients in the inpatient group, and this reduces numbers of readmissions. This reduction in readmissions will limit the savings opportunities by Luscii.

Table 10 demonstrates the effect of EkoDUO used in combination with Luscii RPM and Pathway changes in combination with Luscii RPM

Pathway	**Savings (Total)**
EkoDUO used in combination with Luscii RPM	£27,177,084
Pathway changes in combination with Luscii RPM	£8,313,429

Table 10. Overall savings of different pathway options

Life years gained

The difference in life expectancy post diagnosis between the two pathway groups is 10 months. Using EkoDUO to identify patients earlier and in the community diagnosis pathway, it is estimated that 246 life years will be saved if 90% of patients are diverted into the Community pathway. These patients could feasibly enjoy a high quality of life if their condition is diagnosed earlier.

Quality of life is measured using the EQ-5D in the UK, on a scale of 0-1. 0 is anchored at death and 1 is maximum quality of life. Heart failure patients following diagnosis could enjoy a score of 0.63[12]. When using EkoDUO as a screening tool, with the patients diverted to community pathways capped at 90%, the total number of life years gained will be 2854, or 1799 QALYs.

Discussion

On average, 5908 patients are diagnosed with heart failure in north west London each year. Approximately 32% of these patients are diagnosed in the community and 68% are diagnosed in the inpatient setting.

Costs of resources both before and after diagnosis are higher in the group of patients diagnosed via the inpatient diagnosis pathway. This presents an opportunity for cost savings if patients can be diagnosed in the community setting.

EkoDUO has potential to find patients earlier as part of a routine screening methodology. The use cases demonstrate how the populations to be screened, and the underlying prevalence of heart failure within those populations, affect the cost effectiveness of the technology. However, our analysis demonstrates that use of EkoDUO appropriately for a targeted cohort of patients would maximise its value in the pathway. The most clinically and economically plausible population is all patients aged between 40 and 85 years old.

The use of EkoDUO will consume many other pathway benefits as more patients will be found earlier. However, until EkoDUO is introduced, there are demonstrable benefits of the pathway changes and efficiency.

Luscii RPM has the potential to reduce readmissions by up to 25%. The potential savings will offset the cost of Luscii. Additional benefits such as increase in PAM scores, reduced speed to optimisation, greater list sizes per nurse could further add to the value of Luscii.

The changes in the pathway could save £27.4M in North West London alone, and lead to an additional 155 QALYs. In cost-effectiveness terms this dominates the current standard of care as it is both more effective and cheaper.

[12] Calvert, M., Freemantle, N. and Cleland, J., 2005. The impact of chronic heart failure on health-related quality of life data acquired in the baseline phase of the CARE-HF study. *European Journal of Heart Failure*, 7(2), pp.243-251.

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[2] Bottle A, Kim D, Aylin P*, et al*Routes to diagnosis of heart failure: observational study using linked data in England*Heart* 2018;**104:**600-605.

[3]NICE 2018. Overview | Chronic heart failure in adults: diagnosis and management | Guidance | NICE

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