

EXECUTIVE SUMMARY

Audit Scotland published its national report, *A review of telehealth in Scotland*, on 13 October 2011. This is now available at www.audit-scotland.gov.uk. As part of our review, we commissioned James Robertson to undertake economic modelling to compare telehealth intervention with conventional care for patients with chronic obstructive pulmonary disease (COPD). The aim of this work was to assess whether telehealth has the potential to achieve savings or free up capacity to help NHS boards manage increasing demand for their services. This workbook accompanies the separate modelling report, *Modelling telehealth: chronic obstructive pulmonary disease*, which is also available on our website.

The modelling work was conducted with the assistance of a panel of people with relevant experience who helped develop the methodology and provided invaluable knowledge and experience.

It was possible to cost two COPD telehealth pilots relative to conventional management (Inverclyde CHP - workbook 1 and NHS Lanarkshire - workbook 2). While there are a number of significant uncertainties, it is estimated that telehealth management of patients with COPD at home might help NHS boards avoid costs of around £1,000 per patient per year (see workbook 3). Even after changing to more negative assumptions in the sensitivity analysis, the findings still support the conclusion that using telehealth for home-monitoring of COPD has the potential to help NHS boards reduce activity for those patients and reduce costs. An important factor driving this is the reduction in the rate of hospital admissions under telehealth management for patients with COPD, compared to conventional management.

Workbook 1 - Analysis using Inverclyde CHP COPD telehealth pilot

Key background information from Inverclyde CHP

Length of telehealth COPD telehealth pilot	1 year
Number of patients involved in telehealth audit	15
Total number of hospital admissions per year pre-pilot (ie under conventional management)	33
Total number of hospital admissions during pilot year (ie using telehealth management)	7

The Inverclyde CHP pilot installed monitoring equipment in patients' homes allowing them to input symptoms and signs of their COPD at regular intervals. This information was transmitted via broadband to a respiratory nurses specialist, to review and decide if any intervention was necessary.

CONVENTIONAL MANAGEMENT (CM) CALCULATIONS

Standard cost per admission per patient

Lowest range cost per patient	£1,971
Central cost per patient	£2,800
Highest range cost per patient	£8,465

Non admissions costs per patient per year £525

Conventional management admission rates

Estimated central admissions per patient per year	2.2
Better CM result (lower admissions pp pa, central - 10%)	1.98
Worse CM result (higher admissions pp pa, central +20%)	2.64

CM admission only costs per patient per year	Worse CM results (higher admissions pp pa)	Central CM results (admissions pp pa)	Better CM results (fewer admissions pp pa)
Low end of admissions cost range	(i) £5,203	(ii) £4,336	(iii) £3,903
Central admissions cost range	(i) £7,392	(ii) £6,160	(iii) £5,544
High end of admissions cost range	(i) £22,348	(ii) £18,623	(iii) £16,761

Total cost of CM (includes both admission and non-admission costs)	Worse CM results (higher admissions pp pa)	Central CM results (admissions pp pa)	Better CM results (fewer admissions pp pa)
Low end of admissions cost range	(i) £5,728	(ii) £4,861	(iii) £4,428
Central admissions cost range	(i) £7,917	(ii) £6,685	(iii) £6,069
High end of admissions cost range	(i) £22,873	(ii) £19,148	(iii) £17,286

TELEHEALTH (TH) CALCULATIONS

Standard cost per admission per patient

Lowest range cost per patient	£1,971
Central cost per patient	£2,800
Highest range cost per patient	£8,465

Non admissions cost per patient per year £3,745

Telehealth (TH) admissions rates

Estimated central admissions per patient per year	0.47
Better TH result (lower admissions pp pa, central - 10%)	0.42
Worse TH result (higher admissions pp pa, central +20%)	0.56

Telehealth admission only costs per patient per year	Worse TH results (higher admissions pp pa)	Central TH results (admissions pp pa)	Better TH results (fewer admissions pp pa)
Low end of admissions cost range	(i) £1,104	(ii) £926	(iii) £828
Central admissions cost range	(i) £1,568	(ii) £1,316	(iii) £1,176
High end of admissions cost range	(i) £4,740	(ii) £3,979	(iii) £3,555

Total cost of telehealth (includes both admission and non-admission costs)	Worse TH results (higher admissions pp pa)	Central TH results (admissions pp pa)	Better TH results (fewer admissions pp pa)
Low end of admissions cost range	(i) £4,849	(ii) £4,671	(iii) £4,573
Central admissions cost range	(i) £5,313	(ii) £5,061	(iii) £4,921
High end of admissions cost range	(i) £8,485	(ii) £7,724	(iii) £7,300

Inverclyde total cost differences per patient per year: Total conventional COPD management cost per patient per year minus telehealth COPD management costs per patient per year	Worse results	Central results	Better results
Low admissions cost range	(i) £879	(ii) £190	(iii) £-145
Central admissions cost range	(i) £2,604	(ii) £1,624	(iii) £1,148
High end of admissions cost range	(i) £14,388	(ii) £11,424	(iii) £9,986

Notes

The figures shaded in yellow are used as part of the conventional management of COPD totals in Workbook 3.
The figures shaded in orange are used as part of the telehealth management of COPD totals in Workbook 3

How did we calculate the figures?

Lowest range taken from 2010/11 ISD Scotland - Scottish National Tariffs for COPD/Bronchitis - (involves some form of intubation and includes complications and co-morbidities)

This is a weighted average based on the 2010/11 ISD Scotland - Scottish National Tariffs for COPD/Bronchitis

Highest range taken from 2010/11 ISD Scotland - Scottish National Tariffs for COPD/Bronchitis - (involves some form of intubation with major complications and co-morbidities)

The conventional management non-admission costs are the sum of costs attributable to patients who self medicate after checking to do this with the GP surgery by phone or in person, (£66 per patient per year), plus the costs of home visits from the GP surgery at £426 per patient per year plus the costs per patient of an annual GP (and if applicable also an NHS consultant) review of the patient (£33 per patient per year).

2.20 calculated by dividing the rate of admission under conventional management with the total number of patients = 33/15 = 2.20

1.98 calculated by 2.20 -10% for better conventional management result (2.20 - 0.22 = 1.98)

2.64 calculated by 2.20 +20% for worse conventional management result (2.20 + 0.44 = 2.64)

i (£1971 x 2.64 =£5203 ii (£1971 x 2.2= £4336) iii (£1971 x 1.98= £3903)
i (£2800 x 2.64 =£7392) ii (£2800 x 2.2= £6160) iii (£2800 x 1.98= £5544)
i (£8465 x 2.64 =£22348) ii (£8465 x 2.2= £18623) iii (£8465 x 1.98= £16761)

i (£5203 + £525 = £5728) ii (£4336 + £525 = £4861) iii (£3903 + £525 = £4428)
i (£7392 + £525 = £7917) ii (£6160 + £525 = £6685) iii (£5544 + £525= £6069)
i (£22348 + £525 = £22873) ii (£18623 + £525 = £19148) iii (£16761 + £525= £17286)

Lowest range taken from 2010/11 ISD Scotland - Scottish National Tariffs for COPD/Bronchitis - (involves some form of intubation and includes complications and co-morbidities)

This is a weighted average based on the 2010/11 ISD Scotland - Scottish National Tariffs for COPD/Bronchitis

Highest range taken from to 2010/11 ISD Scotland - Scottish National Tariffs for COPD/Bronchitis - (involves some form of intubation with major complications and co-morbidities)

This is the average cost per patient per year for telehealth equipment (£771) and staff time for monitoring such as respiratory nurses, telecare attendants, management costs, staff training etc (£2,974). The cost was derived using data from Inverclyde CHP.

0.47 calculated by dividing the rate of admission during pilot period by total number of patients = 7/15 = 0.47

0.42 calculated by 0.47 -10% for better telehealth result (0.47-0.047 = 0.42)

0.56 calculated by 0.47 + 20% for worse telehealth result (0.47 + 0.0094 = 0.56)

i (£1971 x 0.56 = £1104) ii (£1971 x 0.47= £926) iii (£1971 x 0.42= £828)
i (£2800 x 0.56 = £1568) ii (£2800 x 0.47= £1316) iii (£2800 x 0.42= £1176)
i (£8465 x 0.56 = £4740) ii (£8465 x 0.47= £3979) iii (£8465 x 0.42= £3555)

i (£1104 + £3745 = £4849) ii (£926 + £3745 = £4671) iii (£828 + £3745= £4573)
i (£1568 + £3745 = £5313) ii (£1316 + £3745 = £5061) iii (£1176 + £3745= £4921)
i (£4740 + £3745 = £8485) ii (£3979 + £3745 = £7724) iii (£3555 + £3745= £7300)

i (£5728 - £4849 = £879) ii (£4861 - £4671 = £190) iii (£4428 - £4573 = -£145)
i (£7917 - £5313 = £2604) ii (£6685 - £5061 = £1624) iii (£6069 - £4921 = £1148)
i (£22873 - £8485 = £14,388) ii (£19148 - £7724 = £11424) iii (£17286 - £7300 = £9986)

Workbook 2 - Analysis using NHS Lanarkshire COPD telehealth pilot

Key background information from NHS Lanarkshire

Length of COPD telehealth pilot	2 years
Number of patients involved in telehealth audit	38
Total number of hospital admissions per year pre-pilot (ie under conventional management)	17
Total number of hospital admissions during pilot year (ie using telehealth management)	11

The NHS Lanarkshire pilot used a system which provides an electronic COPD patient record that is accessible to all healthcare professionals involved in the care of the patient. An automated voice response facility allows patients to interact with the system via a freephone telephone call. By not using home-monitoring equipment, the telehealth equipment costs were significantly reduced, thus the telehealth non-admissions costs for NHS Lanarkshire are much lower than the Inverclyde pilot.

CONVENTIONAL MANAGEMENT (CM) CALCULATIONS

Standard cost per admission per patient

Lowest range cost per patient	£1,971
Central cost per patient	£2,800
Highest range cost per patient	£8,465

Non admissions cost per patient per year £525

Conventional management admission rates

Estimated central admissions per patient per year	0.45
Better CM result (lower admissions pp pa, central - 10%)	0.4
Worse CM result (higher admissions pp pa, central +20%)	0.54

CM admission only costs per patient per year	Worse CM results (higher admissions pp pa)	Central CM results (admissions pp pa)	Better CM results (fewer admissions pp pa)
Low end of admissions cost range	(i) 1,064	(ii) £887	(iii) £788
Central admissions cost range	(i) £1,512	(ii) £1,260	(iii) £1,120
High end of admissions cost range	(i) £4,571	(ii) £3,809	(iii) £3,386

Total cost of CM (includes both admission and non-admission costs)	Worse CM results (higher admissions pp pa)	Central CM results (admissions pp pa)	Better CM results (fewer admissions pp pa)
Low end of admissions cost range	(i) £1,589	(ii) £1,412	(iii) £1,313
Central admissions cost range	(i) £2,037	(ii) £1,785	(iii) £1,645
High end of admissions cost range	(i) £5,096	(ii) £4,334	(iii) £3,911

TELEHEALTH (TH) CALCULATIONS

Standard cost per admission per patient

Lowest range cost per patient	£1,971
Central cost per patient	£2,800
Highest range cost per patient	£8,465

Non admissions cost per patient per year £689

Telehealth (TH) admissions rates

Estimated central admissions per patient per year	0.29
Better TH result (lower admissions pp pa, central - 10%)	0.26
Worse TH result (higher admissions pp pa, central +20%)	0.35

Telehealth admission only costs per patient per year	Worse TH results (higher admissions pp pa)	Central TH results (admissions pp pa)	Better TH results (fewer admissions pp pa)
Low end of admissions cost range	(i) £690	(ii) £572	(iii) £512
Central admissions cost range	(i) £980	(ii) £812	(iii) £728
High end of admissions cost range	(i) £2,963	(ii) £2,455	(iii) £2,201

Total cost of telehealth (includes both admission and non-admission costs)	Worse TH results (higher admissions pp pa)	Central TH results (admissions pp pa)	Better TH results (fewer admissions pp pa)
Low end of admissions cost range	(i) £1,379	(ii) £1,261	(iii) £1,201
Central admissions cost range	(i) £1,669	(ii) £1,501	(iii) £1,417
High end of admissions cost range	(i) £3,652	(ii) £3,144	(iii) £2,890

Lanarkshire total cost differences per patient per year: Total conventional COPD management cost per patient per year minus Telehealth COPD management costs per patient per year	Worse results	Central results	Better results
Low admissions cost range	(i) £210	(ii) £151	(iii) £112
Central admissions cost range	(i) £368	(ii) £284	(iii) £228
High end of admissions cost range	(i) £1,444	(ii) £1,190	(iii) £1,021

Notes

The figures shaded in yellow are used as part of the conventional management of COPD totals in Workbook 3.
The figures shaded in orange are used as part of the telehealth management of COPD totals in Workbook 3

How did we calculate the figures?

Lowest range taken from 2010/11 ISD Scotland - Scottish National Tariffs for COPD/Bronchitis - (involves some form of intubation and includes complications and co-morbidities)

This is a weighted average based on the 2010/11 ISD Scotland - Scottish National Tariffs for COPD/Bronchitis

Highest range taken from 2010/11 ISD Scotland - Scottish National Tariffs for COPD/Bronchitis - (involves some form of intubation with major complications and co-morbidities)

The conventional management non-admission costs are the sum of costs attributable to patients who self medicate after checking to do this with the GP surgery by phone or in person, (£66 per patient per year), plus the costs of home visits from the GP surgery at £426 per patient per year plus the costs per patient of an annual GP (and if applicable also an NHS consultant) review of the patient (£33 per patient per year).

0.45 calculated by dividing the rate of admission under conventional management with the total number of patients = 17/38 = 0.45

0.40 calculated by 0.45 - 10% for better conventional management result (0.45 - 0.04 = 0.40)

0.54 calculated by 0.45 + 20% for worse conventional management result (0.45 + 0.09 = 0.54)

i (£1971 x 0.54 = £1064) ii (£1971 x 0.45 = £887) iii (£1971 x 0.40 = £788)
i (£2800 x 0.54 = £1512) ii (£2800 x 0.45 = £1260) iii (£2800 x 0.40 = £1120)
i (£8465 x 0.54 = £4571) ii (£8465 x 0.45 = £3809) iii (£8465 x 0.40 = £3386)

i (£1064 + £525 = £1589) ii (£887 + £525 = £1412) iii (£788 + £525 = £1313)
i (£1512 + £525 = £2037) ii (£1260 + £525 = £1785) iii (£1120 + £525 = £1645)
i (£4571 + £525 = £5096) ii (£3809 + £525 = £4334) iii (£3386 + £525 = £3911)

Lowest range taken from 2010/11 ISD Scotland - Scottish National Tariffs for COPD/Bronchitis - (involves some form of intubation and includes complications and co-morbidities)

This is a weighted average based on the 2010/11 ISD Scotland - Scottish National Tariffs for COPD/Bronchitis

Highest range taken from 2010/11 ISD Scotland - Scottish National Tariffs for COPD/Bronchitis - (involves some form of intubation with major complications and co-morbidities)

This is the average cost per patient per year for telehealth equipment (£29) and staff time for monitoring such as respiratory nurses, telecare attendants management costs, staff training etc (£660). This cost was derived using data provided by NHS Lanarkshire.

0.29 calculated by dividing the rate of admission during pilot period by total number of patients = 11/38 = 0.29

0.26 calculated by 0.29 - 10% for better telehealth result (0.29 - 0.029 = 0.26)

0.35 calculated by 0.29 + 20% for worse telehealth result (0.29 + 0.058 = 0.35)

i (£1971 x 0.35 = £690) ii (£1971 x 0.29 = £572) iii (£1971 x 0.26 = £512)
i (£2800 x 0.35 = £980) ii (£2800 x 0.29 = £812) iii (£2800 x 0.26 = £728)
i (£8465 x 0.35 = £2963) ii (£8465 x 0.29 = £2455) iii (£8465 x 0.26 = £2201)

i (£690 + £689 = £1379) ii (£572 + £689 = £1261) iii (£512 + £689 = £1201)
i (£980 + £689 = £1669) ii (£812 + £689 = £1501) iii (£728 + £689 = £1417)
i (£2963 + £689 = £3652) ii (£2455 + £689 = £3144) iii (£2201 + £689 = £2890)

i (£1589 - £1379 = £210) ii (£1412 - £1261 = £151) iii (£1313 - £1201 = £112)
i (£2037 - £1669 = £368) ii (£1785 - £1501 = £284) iii (£1645 - £1417 = £228)
i (£5096 - £3652 = £1444) ii (£4334 - £3144 = £1190) iii (£3911 - £2890 = £1021)

Workbook 3 - Totals

Figures also used in Exhibit 7 of Audit Scotland report - *A Review of Telehealth in Scotland*

Average estimated cost per patient per year *

Conventional COPD Management

Estimated non-admissions cost of conventional GP based care	£500
Estimated cost of hospital admissions	£3,700
Estimated total cost of conventional COPD management	£4,200
Range of total costs after applying sensitivity analysis for number of hospital admissions and cost per admission	£2,900 - £14,000

Notes and links to Workbooks 1 and 2

The non-admissions costs are the sum of costs attributable to patients who self-medicate after checking to do this with the GP surgery by phone or in person, (£66 per patient per year), plus the costs of home visits from the GP surgery at £426 per patient per year plus the costs per patient of an annual GP (and if applicable also an NHS consultant) review of the patient (£33 per patient per year). The total cost is £525 rounded to £500.

Central estimated cost of hospital admission. For Inverclyde CHP the cost is £6,160, and for NHS Lanarkshire it is £1,260. Rounded average of the two is £3,700.

Favourable admission rate and lower hospital spell costs (-10% pp pa)	£2,900	(For Inverclyde CHP this is £4,428. For NHS Lanarkshire this is £1,313. Average between the two pilots is £2,900.)
Central admission rate and hospital spell costs	£4,200	(For Inverclyde CHP this is £6,685. For NHS Lanarkshire this is £1,785. Average between the two pilots is £4,200.)
Adverse admission rate and higher hospital spell costs (+20% pp pa)	£14,000	(For Inverclyde CHP this is £22,873. For NHS Lanarkshire this is £5,096. Average between the two pilots is £14,000.)

Telehealth Management of COPD

Estimated cost of telehealth equipment	£400
Estimated cost of NHS staff costs for monitoring plus GP based medical intervention when necessary	£1,800
Estimated cost of hospital admission	£1,100
Estimated total cost of COPD telehealth management	£3,300
Range of total costs after applying sensitivity analysis for number of hospital admissions and cost per admission.	£2,900 - £6,100

Average estimated equipment costs per patient per year. For Inverclyde CHP the cost is £771 and for NHS Lanarkshire the cost is £29. Rounded average of the two is £400. Note the figure for NHS Lanarkshire is much lower because they used a remote phone link system rather than monitoring equipment, thus reducing costs.

Average of total non-admission telehealth costs per patient per year (excluding telehealth equipment costs). The approximate cost for Inverclyde CHP is £2,974 and for NHS Lanarkshire it is £660. Rounded average of the two is £1,800.

Central estimated cost of hospital admission. For Inverclyde CHP the cost is £1,316 and for NHS Lanarkshire it is £812. Rounded average of the two is £1,100.

Favourable admission rate and lower hospital spell costs (-10% pp pa)	£2,900	(For Inverclyde CHP this is £4,573. For NHS Lanarkshire this is £1,201. Average between the two pilots is £2,900.)
Central admission rate and hospital spell costs	£3,300	(For Inverclyde CHP this is £5,061. For NHS Lanarkshire this is £1,501. Average between the two pilots is £3,300.)
Adverse admission rate and higher hospital spell costs (+20% pp pa)	£6,100	(For Inverclyde CHP this is £8,485. For NHS Lanarkshire this is £3,652. Average between the two pilots is £6,100.)

Estimated savings (by using telehealth compared to conventional management)**

£1,000

Notes:

* Figures have been rounded to the nearest £100.

** Difference shown is based on unrounded total costs for telehealth and conventional COPD management.