

PRinVR

Pulmonary Rehabilitation in Virtual Reality

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Background



Transforming health and care for
Staffordshire & Stoke-on-Trent



PR has evidence to be the **BEST** treatment intervention & more cost effective than medications for patients with COPD



NHS Long-Term Plan has clear recommendation to expand **PR** Provision (Digital/Virtual/Conventional)



PR- improves exercise tolerance, health status
-prevent disease progression
reduces RISK of exacerbations, hospitalisations and most importantly **reduces MORTALITY**.

COPD is a leading cause of death worldwide

~384 million have COPD globally¹

-1.2 million UK

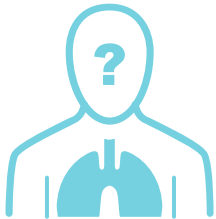
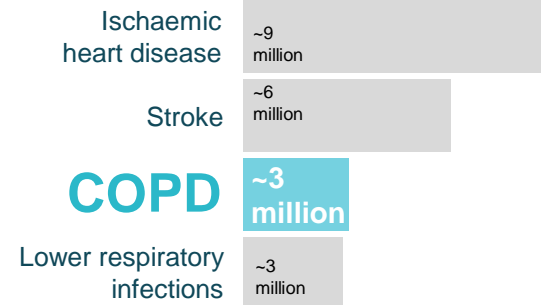
-30K in Staffordshire



COPD direct costs are estimated to be
€38.6 billion in the EU¹



COPD is the
**third leading
cause of death
worldwide**¹³



Up to **70%** of COPD may be
undiagnosed²



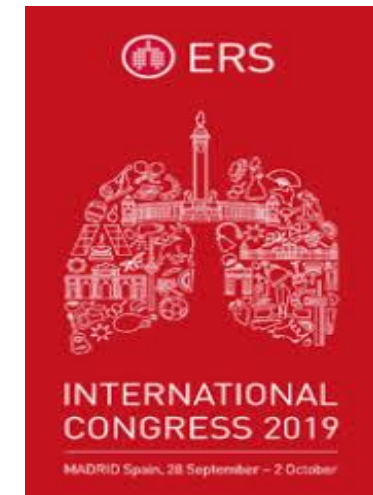
The majority of COPD costs are attributed to
exacerbations⁶⁻¹²

1. GOLD. Global strategy for the diagnosis, management, and prevention of COPD: 2020 report <https://goldcopd.org>; 2. Diab N et al. *Am J Respir Crit Care Med*. 2018;198:1130–1139; 3. Ford ES et al. *Chest*. 2015;147:31-45; 4. Chen X et al. *Int J COPD*. 2016;11:2625-2632; 5. Nishimura S et al. *Respirology*. 2004;9:466-473; 5.; 6. Qureshi H et al. *Ther Adv Chronic Dis*. 2014;5:212-227; 7. Press VG et al. *Curr Opin Pulm Med*. 2018;24:138-146; 8. Celli BR et al. *Eur Respir J*. 2004;23:932-946; 9. Toy EL et al. *COPD*. 2010;7:214-228; 10. Anzueto A. *Eur Respir Rev*. 2010;19:113-118; 11. Geitona M et al. *Respir Med*. 2011;105:402-409; 12. Perera PN et al. *COPD*. 2012;9:131-141; 13. WHO. The top 10 causes of death. <https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death>.

Retrospective study data from a primary care cohort in Staffordshire

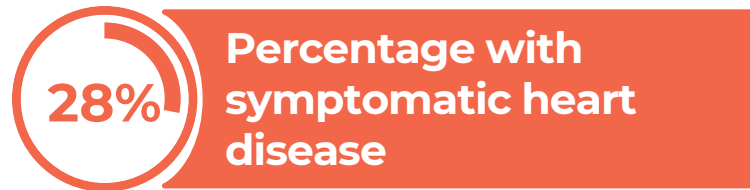


Correlation of COPD exacerbation with comorbidities, lung function and mortality within a single-practice primary-care cohort in UK



Retrospective study data from a primary care cohort in Staffordshire

- **Substantial variation** in COPD disease burden and usage of healthcare resources was observed across a single primary-care cohort¹
- **Comorbidities:**²



IHD, Ischaemic heart disease.

1. Singh M. Presented at: European Respiratory Society; 28 September–2 October 2019; Madrid, Spain. *Eur Respir J.* 2019;14:PA5010.
2. Singh M. Presented at: American Thoracic Society, 19 – 24 September 2017, Washington, US. *Am J Respir Crit Care Med.* 2017;195:A3629.

Retrospective study data from a primary care cohort in Staffordshire

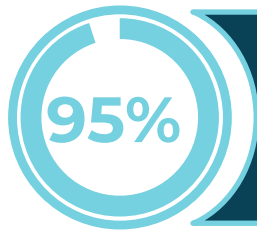
- **Exacerbation:** Reductions in FEV₁ were seen in exacerbators compared to non-exacerbators:

Moderate exacerbators:

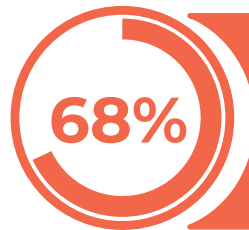
10%

Severe exacerbators:

27.5%



Percentage of exacerbators with ≥1 comorbidity



Percentage of exacerbators requiring readmission within 12 months

- High mortality was noted in the readmission group: 1 in 3 patients died during hospital stay

A combination of treatment approaches are required for optimal care of COPD

Smoking cessation¹

Pulmonary rehabilitation^{2,3}

Inhaled maintenance therapy^{2,4}

Physical activity⁵

Self-management intervention⁶

Flu and pneumococcal vaccination^{2,7}

Prophylactic use of antibiotics^{2,8}

Oxygen therapy⁹

22%

Reduction in exacerbation risk with ex-smokers compared with current smokers¹

~42%

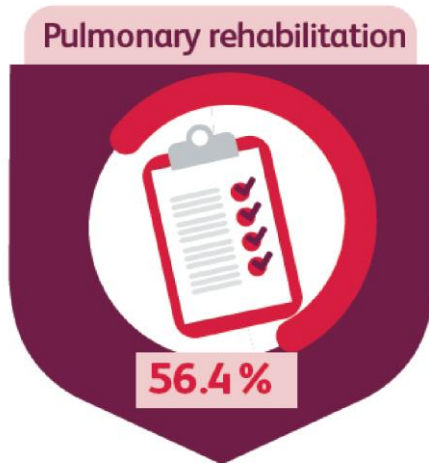
Reduction in mortality with early initiation of pulmonary rehabilitation³

30%

Reduction in moderate or severe exacerbation risk for triple therapy vs LAMA/LABA (relative risk 0.70, 95% CI 0.53–0.94) in a meta-analysis of several trials^{4,a}

1. Au D et al. *J Gen Intern Med.* 2009;24:457-463; 2. GOLD. Global strategy for the diagnosis, management, and prevention of COPD: 2020. <https://goldcopd.org>;
3. Rysø CK et al. *BMC Pulm Med.* 2018;18:154; 4. Cazzola M et al. *Eur Respir J.* 2018;52:1801586; 5. Donaire-Gonzalez D et al. *Eur Respir J.* 2015;46:1281-1289;
6. Zwerink M et al. *Cochrane Database Syst Rev.* 2014;19:CD002990; 7. Garrastazu R et al. *Arch Bronconeumol.* 2016;52:88-95;
8. Wilson R et al. *J Infect.* 2013;67:497-515; 9. Ringbaek TJ et al. *Eur Respir J.* 2002;20:38-42.

Providing high-value care



Referral to pulmonary rehabilitation (PR)

17,064 adults with COPD had an MRC score 3–5 in the past 3 years. **56.4%** of these people were referred for PR.



QI Priority 4

Refer **70%** or more of people with an Medical Research Council (MRC) score 3–5 to **pulmonary rehabilitation (PR)** and evidence this with the appropriate SNOMED code in their notes by November 2021.



Pulmonary Rehabilitation during COVID19

Supervised pulmonary tele-rehabilitation (PTR) versus pulmonary rehabilitation in severe COPD: a randomised multicentre trial

Hansen H, et al. *Thorax* 2020;**75**:413–421. doi:10.1136/thoraxjnl-2019-214246

in this single-blinded, multicentre, superiority randomised controlled trial, patients were assigned 1:1 to 10 weeks of groups-based PTR (60 min, three times weekly) or conventional PR (90 min, two times weekly). Assessments were performed by blinded assessors at baseline, end of intervention and at 22 weeks' follow-up from baseline. The primary analysis was based on the intention-to-treat principle.

- ❑ Supervised Tele PR was non inferior to Conventional PR on 6MWD
- ❑ No differences noticed in improvement in symptoms and functional capacity between groups
- ❑ More patients completed Tele-PR than Conventional PR ($p < 0.01$)

Drivers for the new model of PR in Staffordshire

- -High COPD related ED and hospital attendances
- High level of elderly population & burden of multimorbidities
- Demographic difficulties: High level of variability of services between practices & localities
- -High readmission rate 68% with 12 months, High mortality rate of 1 in 3 in readmission group of COPD patients

Benefits of PRinVR

- Home based, personalised programme delivered remotely by using standalone VR Headset
- Healthcare Staff **supervise** patients remotely
- Predicts Cardio-Respiratory, Mental Decline before patient is symptomatic
- Records Personalised Wellness Score generated by AI
- Suitable for all patients except where VR is contraindicated
- One Healthcare Professional can deliver upto 1440 Therapies per year
- ****Suitable for Patient with COPD who is unable to attend conventional face to face PR**

Background of the project in Staffordshire

- We were successful in gaining funds from the NHSE's Estates & Technology Transformation Fund (ETTF) for a pulmonary rehabilitation (PR) via virtual reality (VR) pilot
- PRinVR uses artificial intelligence to support real time supervision of a COPD patient
- Core components of programme are:
 - Education and patient activation
 - Personalised exercise programme
 - Psychological therapy for reduction of anxiety
 - Predictive analysis and alert mechanism.

The patient does not have to be digitally literate, nor have WiFi -as a part of the 'VR device kit' patient is given EE Wifi if they do not have internet in their home.

TOGETHER
WE'RE **BETTER** 

Transforming health and care for
Staffordshire & Stoke-on-Trent

Patient Experience: Blessing in disguise during COVID 19

- By delivering PRinVR in the patients own home you are offering
 - Flexibility
 - a programme suitable for the housebound patient
 - no requirement to organise travel
 - in light of Covid is perfect for those patients advised to shield
 - Remote monitoring
- This has lead to
 - better compliance
 - improved outcome
 - no cost to the NHS from organising transport to a missed appointment.

- **Feedback from patients include**

“improved sleep, increased exercise tolerance and increased energy.”

“enjoying being on the beach, but enjoy being able to do these exercise at home!”

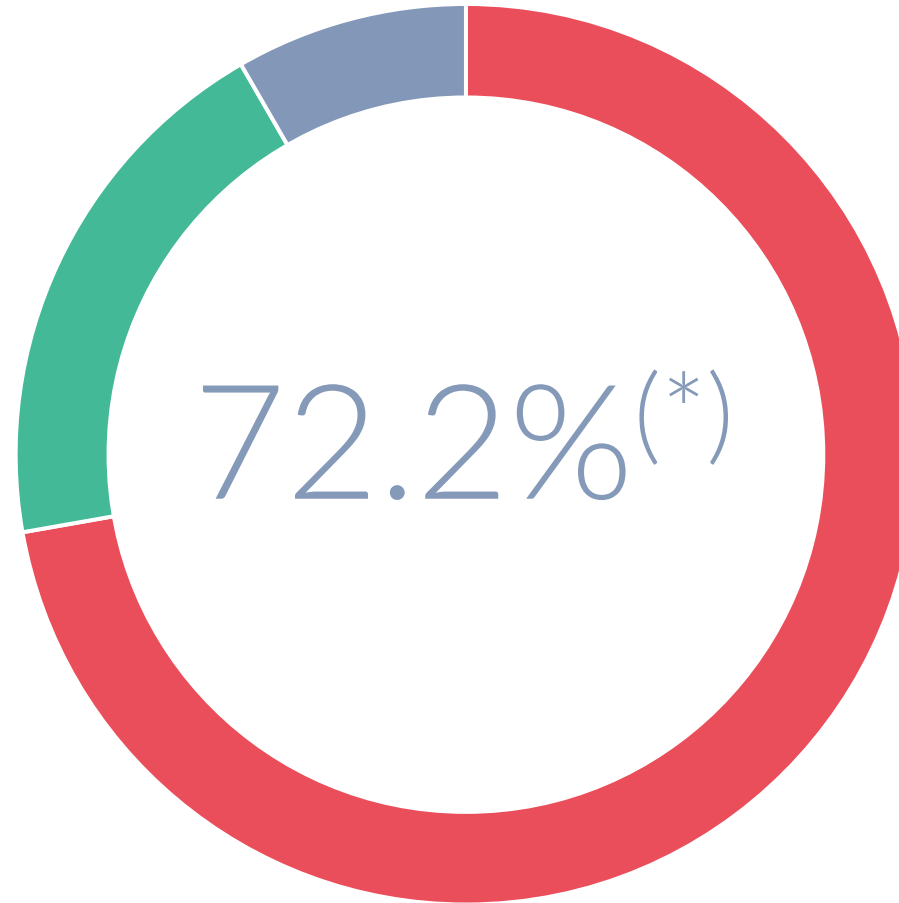
We have also had patients ask to extend the programme and in other areas patients have completed a 2nd programme.

Evaluation data: Referral Overview

Direct GP Referrals		
Total Referrals	307	
Rejected		28
Declined		69
Deferred		10
Total Available	200	
Total Onboarded	175 + 15*	
Waiting List	none	
DNC		65
Completed	85	
Active Current	25	

MPFT Referral		
Total Referrals	31	
Rejected		2
Declined		4
Deferred		3
Total Available	22	
Total Onboarded	18	
Waiting List	4	
DNC		7
Completed	2	
Active	9	

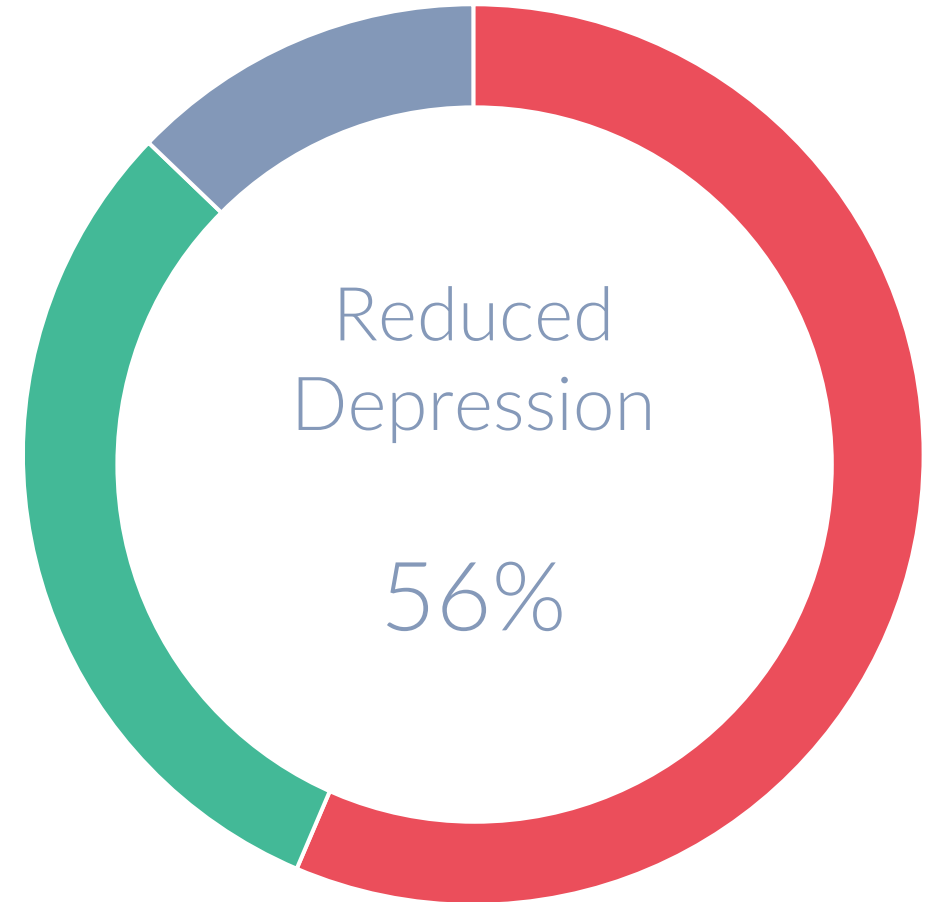
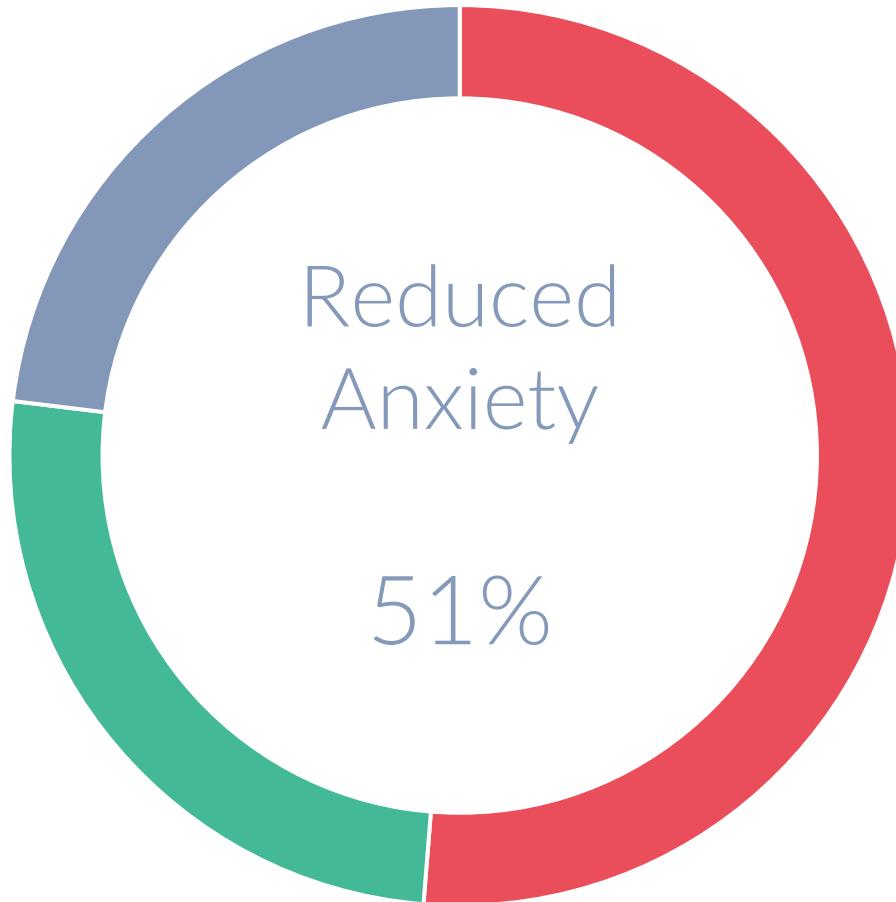
Functional Exercise Improvement .



■ Improved ■ worsened ■ No Change

(*)Conventional PR
59.8%

Mental Health Improvement





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Estimated Return On Investment (max)

Hospital
Admissions
Saved

~366

Hospital
Bed Days
Saved

~1466

Secondary
NHS
Savings

- MI 1
- Stroke 2

Estimated ROI (max). **£805K**
£1 = £2.1

What is Next?





Smart Community Services

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Concept Health 
beyond boundaries

Thank you.

