Good Boost: Artificial Intelligence Powered Aqua Rehabilitation Delivered in Partnership with Public-Pools

Health Economic Evaluation

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1. BACKGROUND

Musculoskeletal (MSK) conditions cover a broad range of conditions affecting the bones, joints, muscles and spine. It is estimated to affect over 17.8 million people in the UK(1). They can affect the ability of a person to undertake normal daily activities, as symptoms such as pain and stiffness can affect mobility. There are three sub-groups of musculoskeletal conditions: inflammatory diseases, conditions of musculoskeletal pain, and osteoporosis and fragility fractures. An inflammatory disease can be diagnosed as rheumatoid arthritis, of which, in the UK over 400,000 adults suffer with the disease. The condition affects any age and progresses rapidly. Other forms of inflammatory disease are Juvenile idiopathic arthritis, Ankylosing spondylitis, Psoriatic arthritis and Gout. Conditions of musculoskeletal pain is the most common type of condition and affects over 8.75 million people. The main treatment is physical activity undertaken in primary care. Osteoporosis and fragility fractures are most common in older people and can affect over 300,000 people a year. Usual treatment is medication to strengthen bones and prevent falls and fractures.

In 2013-14, MSK accounted for £4.7 billion of NHS programme spending. In terms of the economic burden to the NHS, it is estimated arthritis-osteoarthritis and rheumatoid arthritis cost the economy £10.2 billion in direct costs(2). In 2014/15, 9.5m working days were lost due to work related MSK conditions. The clinical effectiveness of various exercise interventions is proven to be beneficial for patients with MSK conditions. An understanding of the impact upon health outcomes, but also upon the economy is necessary. In 2017, Public Health England, published evidence for cost-effective interventions for preventing and improving MSK conditions. The various interventions, such as self-referral to physiotherapy, group yoga for back pain, and exercise for lower back pain were all cost-effective interventions. Additionally, a randomized controlled trial to evaluate the effectiveness of manual physiotherapy, exercise therapy or a combination for hip and knee osteoarthritis (OA) compared with usual care not only found clinical improvements, but found that exercise and manual therapy were more cost-effective than usual care(3).

The economic impact of interventions delivered to support MSK conditions are essential, to evaluate the health outcomes and costs analogously. This report will seek to undertake an early health economic analysis to understand the potential financial impact of the Good Boost technology.

2. PROPOSED TECHNOLOGY AND POPULATION

Good Boost deliver aquatic exercise and rehabilitation programmes in public swimming pools for people with musculoskeletal conditions. The community health programme has been designed and developed over the past few years to support group therapeutic activity programmes and encourage individually tailored exercises using the Good Boost app. The waterproof tablet computers provide support to up to 20 people within a group aquatic class with a variety of musculoskeletal conditions and varying abilities. The tailored programme allows for individual exercises amongst a group setting.

Alongside the app, Good Boost use artificial intelligence (AI) to assess the participant and ensure the best clinical practice and existing research forms the basis of the rehabilitation therapeutic aquatic exercise (TAE). The instructor will make an initial assessment and the AI technology will display the

exercises most suitable to maximise physiological progress for prevention and treatment of musculoskeletal conditions.

The proposed technology in the SBRI 15 Phase 1 is to combine the Good Boost app with the AI system which will allow the exercises suggested and feedback from the app to be shown alongside the progression or alterations required to maximise physiological progress for musculoskeletal conditions.

The primary end customer for the technology are participants who are living with musculoskeletal conditions, such as older adults who have previously fallen or at risk of falling (sarcopenia and falls fractures), osteoarthritis patients, and knee, hip and replacement patients requiring rehabilitation, recovery and rehabilitation support. Good Boost envisage the programme will support participants who are currently in standard care rehabilitation, and provide an alternative as well as an adjunct to current care. The main indication focus for this report will be hip and knee replacement patients and osteoarthritis patients.

3. MARKET ACCESS AND COMMERCIALISATION

Currently Good Boost have a unique payment model, by which participants pay £5 per Good at their local leisure centre. The attendance of these classes is over 80%, with good adherence. Going forward, Good Boost are hoping to package the App and AI system together as an annual license fee and upfront costs of the hardware to leisure centres. The annual fee is estimated to be £2,400 + VAT, and upfront costs of the hardware £150 + VAT per tablet. It is estimated the average pool will purchase 15 tablets.

Another potential funding pathway for Good Boost will involve a mixed model. Pool operators will be required to cover part of the costs of running and delivering the service, which will be subsidised by NHS CCGs/Local Commissioners. It is likely potential commercialisation agreements with CCGs are possible if Good Boost can demonstrate the gain in MSK health outcomes because of the programmes.

4. POTENTIAL FINANCIAL IMPACT

There are few economic evaluations to estimate the cost-effectiveness of aquatic and rehabilitation programmes. To date, Good Boost is an effective app integrated into referral services at leisure centres to aqua-rehab treatment. The areas for which quantifiable benefits could be accrued will be estimated. The perspective of an NHS investing into the programme alongside leisure centres will be outlined.

4.1. Quantifiable Benefits of Good Boost

For assessment of Good Boost, the health economic assessment will focus upon calculating the budget impact in relation to the cost reduction generated through the following:

a) Good Boost preventing advancement osteoarthritis to TKA, Hip and Knee Surgery
b) Reduce need for outpatient physiotherapy appointments
c) Reduce number of GP or outpatient appointments for symptoms

The cost reduction generated from the above will be based upon assumptions that Good Boost is an effective intervention, in addition to the following:

- At each pool, the average number of unique participants per operational year is 144
- Participants will engage in 3 group sessions per week, 10 participants per session
- Good boost operates in 11 pools, with growth to 32 pools by May 2019.

- Participants will continue with current care by the NHS i.e. intervention acts as an adjunct, however, outpatient appointments may be affected by the intervention

a) Good Boost preventing advancement of TKA, Hip and Knee Surgery

On average, of the 144 participants who participate, through Good Boost's data and associated research publication, 1 participant per month who are eligible OA/Arthroplasty participants will avoid the need for a hip or knee replacement. Up to 5 participants per month will be eligible for hip/knee replacement, however only 20% of participants are projected will adhere to be able to achieve the outcome of a reduction in need for hip or knee replacement. Therefore, in year 1, an average of 12 participants will be able to avoid a hip or knee joint replacement surgery. Table 1 presents the potential saving to the NHS, with a full breakdown of the % who achieve avoidance and the % of unique participants per pool.

Table 1: Potential saving per year

	Hip and Knee Replacements	**Assumptions**
Average cost	£6,277	Hamilton et al. 2009 (4)
Total number of participants per year	144	Number of unique participants
Number per year avoid	60	Total number that could be achieved
% achieve avoidance	20%	
Number per year achieve avoidance	12	
% unique participants per pool avoid replacement	8%	
Possible Saving per Year	£75,318	

b) Reduce need for outpatient physiotherapy appointment

In terms of the number of patients who join with an MSK condition that would have otherwise been referred to NHS outpatients, Good Boost's data indicates that an average of 10 patients per month could benefit. Of the 10 patients, it is projected that on average, only 25% of patients will adhere for at least 6 weeks to achieve equivalent benefit to physiotherapy treatment. The equivalent physiotherapy treatment requires patients to attend on average of 8 weeks of appointments at £53 per hour(5). In Table 2 the potential savings, depending on the ability for Good Boost to lead to avoidance of between 2-8 physiotherapy outpatient appointments are presented.

Table 2: Potential savings due to avoided NHS outpatients

	Avoid all 8 physiotherapy appointments	**Avoid 4 physiotherapy appointments**	**Avoid 2 physiotherapy appointments**	**Assumptions**
Average cost	£424	£212	£106	£53 per hour per physiotherapy appointment(5)
Total number of participants per year	144	144	144	Number of unique participants

Number per year avoid	120	120	120	Total number that could be achieved
% achieve avoidance	25%	25%	25%	% of patients who achieve adherence to ensure equivalent benefit
Number per year achieve avoidance	30	30	30	
% unique participants per pool avoid physiotherapy	21%	21%	21%	
Possible Saving per Year	£12,720	£6,360	£3,180	

c) Reduce the number of GP appointments

Good Boost envisage being able to act as a social prescriber as part of an MSK self-referral set up by GP's to divert unnecessary appointments. MSK patients currently require a GP appointment and referral for physiotherapy and social prescribing treatments. There is an increasing shift of MSK self-referral to physiotherapy and community services. Good Boost's data demonstrates that an average of 5 patients will self-refer to participate to the pool sessions per month and avoid the need for a GP appointment. Table 3 presents the breakdown of the cost savings, where Good Boost assume 100% who may have set up GP appointments for a referral will be diverted to Good Boost.

Table 3: Potential savings because of reduction in GP appointments

	(N/£/%)	**Assumptions**
Average cost	£37	£37 per 9.22 GP appointment(5)
Total number of participants per year	144	Number of unique participants
Number per year avoid	60	Total number that could be achieved
% achieve avoidance	100%	% of patients who achieve adherence to ensure equivalent benefit
Number per year achieve avoidance	60	
% unique participants per pool avoid physiotherapy	42%	
Possible Saving per Year	£2,220	

4.2. Potential Budget Impact Analysis from an NHS perspective

4.2.1. Return on Investment

The total potential savings per year to each pool were calculated based on the quantifiable benefits estimated in section 4.1. It was estimated the potential savings to the NHS could total around £90,000 per pool. However, the savings do not include the cost to the NHS of investment. Assuming the cost of running Good Boost is around £4,800 per year, which the NHS funds, and the cost per individual is £2 per session (average 3 sessions per week), it is estimated the NHS may save around £85,000 per year.

Table 4: Total Potential Savings

Savings	£
Hip and Knee Replacement	£75,318
Physiotherapy Outpatient Appointment	£12,720
GP Self-Referral	£2,220
Total	£90,258
Cost of Good Boost to NHS	£4,800
Savings to NHS	£85,458
ROI	£17.80

4.2.2. Potential Budget Impact Analysis

The potential savings presented estimated a cost benefit to the NHS of up to £85,000 per pool. Good Boost are forecasting sales of 32 pools in the first year, extending to 600 pools by 2023. Consequently, the total possible savings to the NHS overall in the first year, 2019, were estimated at £2.73, and increasing to £51 million, if rolled out to 600 pools.

Year	2019	2020	2021	2022	2023
Pools	32	125	300	400	600
Possible Saving per Year	£2,734,656	£10,682,250	£25,637,400	£34,183,200	£51,274,800

4.3. Scenario Analyses

Given the analyses presented in section 4.1 and 4.2 are based upon assumptions and estimates to be fully tested in the initial pilot study, scenarios analyses to understand how the potential savings may vary were undertaken. Three scenarios were assumed:

Scenario 1: Only 5% of OA/Arthroplasty patients adhere **and** benefit from Good Boost to prevent advancement of hip and knee replacement, 8 physiotherapy outpatients no longer required by 20% adherence and 50% of patients self-refer to Good Boost, avoiding GP referral appointments

Scenario 2: 20% of OA/Arthroplasty patients adhere **and** benefit from Good Boost to prevent advancement of hip and knee replacement, **2** physiotherapy outpatients no longer required by 20% adherence to Good Boost and 100% of patients self-refer to Good Boost, avoiding GP referral appointments

Scenario 3: Only 5% of OA/Arthroplasty patients adhere **and** benefit from Good Boost to prevent advancement of hip and knee replacement, **2** physiotherapy outpatients no longer required by 20% adherence and 50% of patients self-refer to Good Boost, avoiding GP referral appointments

Scenario 4: Assumptions surrounding the impact of Good Boost remain the same as at baseline, however, the cost of the programme is borne entirely by the NHS. i.e. £4,800 per year, plus the £2 cost of 3 sessions per week, per year.

In Scenario 1 and 3, it was estimated there was a potential the intervention may increase costs to the NHS per pool, whilst in Scenario 2, savings of around £35,000 were estimated. Table 5 presents the results of the three scenarios. Appendix 1 presents the breakdown of the results for each of the scenarios individually.

Table 5: Scenario Analyses Results per Pool

Scenario Analyses	Savings per Pool	ROI per Pool
1	£27,860	£5.80
2	£75,918	£15.82
3	£18,320	£3.82
4	£45,330	£1.01

5. LIMITATIONS AND CONCLUSIONS

The savings presented in this assessment are based upon the preliminary data that can be extrapolated to every pool delivering Good Boost in order to achieve national reductions and impact upon NHS resource utilisation. Good Boost continue to collect data to analyse the effectiveness of the programmes and how delivery can lead to clinically improved outcomes for patients with musculoskeletal disease. The results of the data analysis will be imperative to the potential savings presented in this analysis. It was estimated the total potential savings to the NHS was £85,000 per pool based upon the assumptions of Good Boost preventing knee and hip surgeries, physiotherapy appointments and GP referral appointments. In conservative scenarios, where the assumptions of Good Boost impacting NHS resource utilisation were reduced, continued to present savings of around £18,000 - £75,000. It appeared that the impact of adherence affecting hip and knee replacement has greatest bearing upon the overall savings per pool.

The preliminary assessments show positive results that may benefit the NHS, if the NHS were to enter a mixed model of payment with leisure centres. Whilst Good Boost currently deliver the sessions in partnership with Swim England and local pools, the potential financial impact presented in this analysis provide initial evidence for a mixed model of funding. Through operating a mixed model of funding, it is possible pool operators will be able to gain a revenue stream, and the NHS improvements in cost efficiency and benefits to MSK health outcomes. However, the scenarios analyses presented show the need to report the validated clinical impact upon health outcomes and resource utilisation to fully understand the extent of the savings to the NHS. Of even greater benefit to the NHS would be if local pools and participants continue to subsidise and pay for the service, which would allow the NHS to reap the savings, without the cost output.

There is opportunity for Good Boost to relieve the pressure upon NHS resources, through the group and individualised sessions they provide. To what extent Good Boost can directly influence and lead to avoidance in NHS surgeries and appointments should be fully validated by clinical data collected and is dependent on the payment model going forward.

6. REFERENCES

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7. APPENDIX 1

Scenario 1	£
5% adherence Hip and Knee Replacement	£18,830
8 Physiotherapy Outpatient Appointments	£12,720
50% GP Self-Referral	£1,110
Total	£32,660
Cost of Good Boost Per Pool	£4,800
Total Savings	£27,860

Scenario 2	£
20% adherence Hip and Knee Replacement	£75,318
2 Physiotherapy Outpatient Appointments	£3,180
100% GP Self-Referral	£2,220
Total	£80,718
Cost of Good Boost Per Pool	£4,800
Total	£75,918

Scenario 3	£
5% adherence Hip and Knee Replacement	£18,830
2 Physiotherapy Outpatient Appointments	£3,180
50% GP Self-Referral	£1,110
Total	£23,120
Cost of Good Boost Per Pool	£4,800
Total	£18,320

Scenario 4	£
Hip and Knee Replacement (as baseline assumptions)	£75,318
Physiotherapy Outpatient Appointment (as baseline assumptions)	£12,720
GP Self-Referral (as baseline assumptions)	£2,220
Total	£90,258
Cost of Good Boost to NHS per pool	£44,928
Total	£45,330

Health Enterprise East

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