

Evaluating The Economic Effects Of Flexible Radionuclide Delivery Timing And Same-Day Work-Up And Radioembolization In Patients With Unresectable Liver Tumors Undergoing Selective Internal Radiation Therapy

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Introduction

Background

The nature of radioactive decay means that the administration of medical interventions that utilize radionuclides is time sensitive and requires careful planning. For techniques such as selective internal radiation therapy (SIRT), pre-treatment work-up procedures are also required to assess the vascular anatomy of the liver, potentially occlude certain hepatic blood vessels, and establish the hepatopulmonary shunt fraction. The work-up, which normally takes 60–120 minutes, consists of an angiogram, a scintigraphy (also known as lung-shunting scan or macroaggregated albumin (MAA) lung perfusion scan) and possibly a CT-hepatic angiogram.

With SIR-Spheres Y-90 resin microspheres, the Order-Map-Treat program enables the work-up (“Map”) and procedure (“Treat”) to be performed on the same day, while the complementary FLEXdose Delivery Program allows the prescribed activity to be administered with more or fewer microspheres depending on the target coverage. FLEXdose has the flexibility of three SIR-Spheres Y-90 resin microspheres delivery options, five days a week, facilitating individualized treatment of patients in a flexible manner at multiple timepoints every week.

The ability to perform same-day work-up and procedure with the Order-Map-Treat is beneficial as it has the potential to require only one outpatient admission for SIRT work-up and procedure, thereby ameliorating the risk of disease progression in the time between work-up and procedure. In the SARAH randomized controlled trial of SIR-Spheres Y-90 resin microspheres versus sorafenib, for example, the median delay between randomization and treatment initiation was 29 days (interquartile range [IQR] 23–36) in the SIRT group versus 7 days (IQR 3–9) in the sorafenib group, with the difference at least in part attributable to the need for patients to undergo work-up ahead of the SIRT procedure itself.¹

The FLEXdose Delivery Program allows the same individualized dose of radiation to be delivered using different numbers of microspheres, thereby also allowing liver coverage to be individualized based on factors such as tumor burden and presence of multifocal disease.

Objective

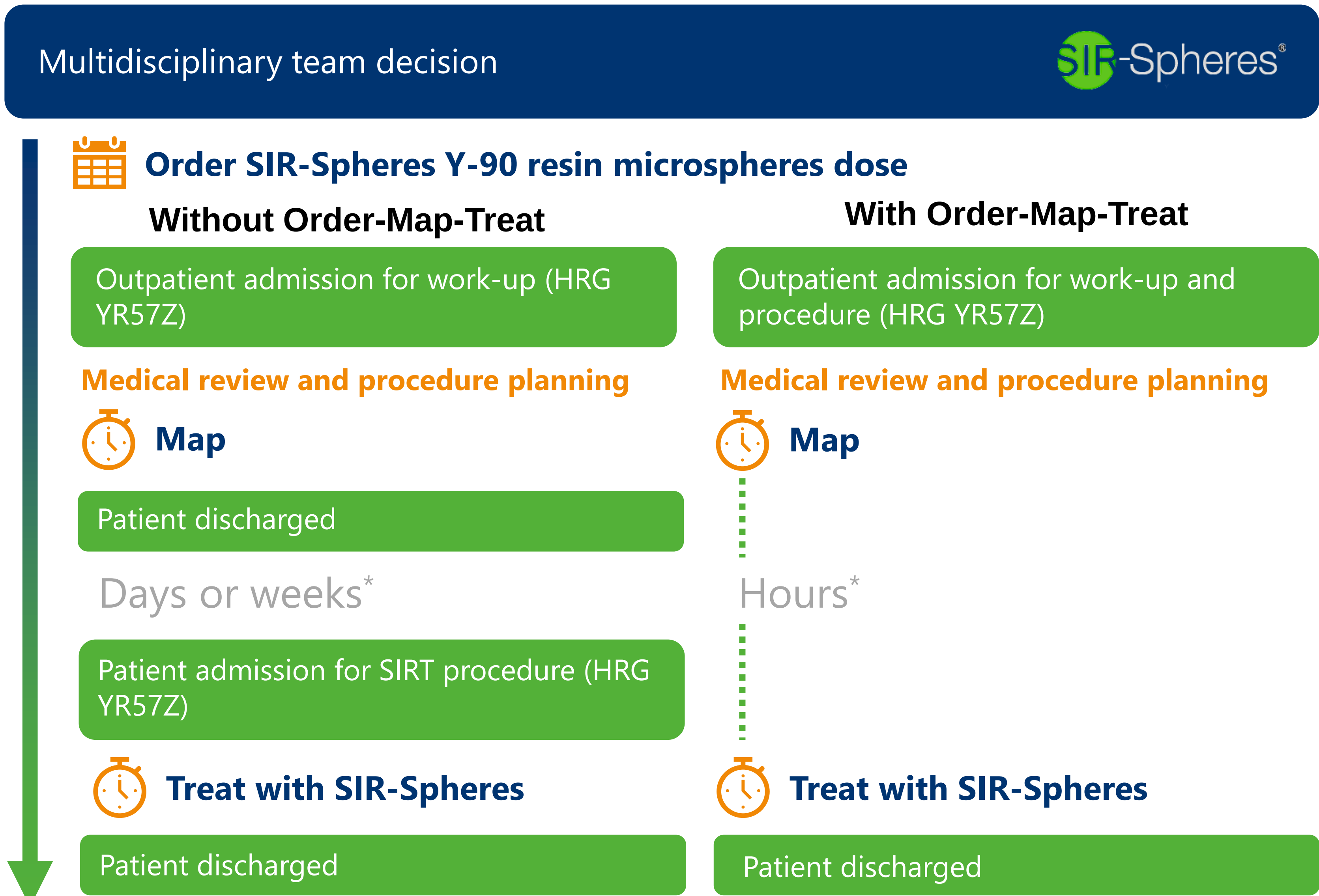
The aim of the present study was to evaluate the effect of the SIR-Spheres Y-90 resin microspheres Order-Map-Treat program on the cost of performing SIRT in the UK from the perspective of the national healthcare payer, specifically the Department of Health (DoH). We also sought to calculate SIR-Spheres activity relative to the calibration date to illustrate the flexible number of microspheres that could be administered to achieve a particular target dose.

Methods

Economic Analysis of the Order-Map-Treat Program

The effects of the Order-Map-Treat program on costs were evaluated from the perspective of the UK DoH. Costs of work-up and treatment were calculated based on 2018-19 NHS Reference Costs, and the cost reduction was assumed to arise from the avoidance of one day case admission per patient treated with SIRT (Figure 1). The healthcare resource group (HRG) YR57Z was used (“Percutaneous, Chemoembolisation or Radioembolisation, of Lesion of Liver”), corresponding to a 2018-19 reference cost of GBP 2,619.² As the analysis was conducted at the national level and focused primarily on establishing a relative cost with the Order-Map-Treatment program versus without, no market forces factor was applied to the underlying reference cost. The costs of a dose of SIR-Spheres Y-90 resin microspheres was taken from the recent multiple technology appraisal (MTA) of SIRT technologies in the treatment of unresectable hepatocellular carcinoma (HCC) conducted by the (NICE).³

Figure 1: Selective internal radiation therapy work-up and procedure with and without the Order-Map-Treat Program



* Typical time scale between work-up and selective internal radiation therapy (SIRT) procedure. HRG, healthcare resource group.

SIR-Spheres Activity Relative to Calibration Date

The activity of SIR-Spheres relative to the calibration date was calculated based on the 64.2 hour half life of Yttrium-90, and the number of spheres required to provide one GBq of activity was calculated, assuming an average vial of SIR-Spheres Y-90 resin microspheres containing 44 million microspheres with activity of 3 GBq at the time of calibration.

Results

Economic Analysis of the Order-Map-Treat Program

Assuming that the Order-Map-Treat program enables work-up and treatment to be performed in a single day case admission, the cost savings relative to administering SIR-Spheres Y-90 resin microspheres without the program would be GBP 2,619 per patient, corresponding to a cost reduction of 19.8% from GBP 13,237 to GBP 10,619 per patient (Figure 2).

SIR-Spheres Activity Relative to Calibration Date

The total SIR-Spheres Y-90 activity across 44 million microspheres was 7.3 GBq 82 hours before calibration, decreasing to 2.3 GBq 24 hours after calibration (Figure 3). The number of microspheres required to deliver one GBq of radiation (i.e. the basis of the FLEXdose Delivery Program) was found to increase from 6.1 million 82 hours before calibration to 19.2 million spheres 24 hours after calibration (Figure 3). For an example target dose of 1.2 GBq, the dose could be administered over a minimum of 7 million microspheres (3 days pre-calibration) versus 18 million microspheres on the day of calibration.

Figure 2: Healthcare Resource Group-based cost estimates of SIR-Spheres, work-up and procedure with and without the Order-Map-Treat program

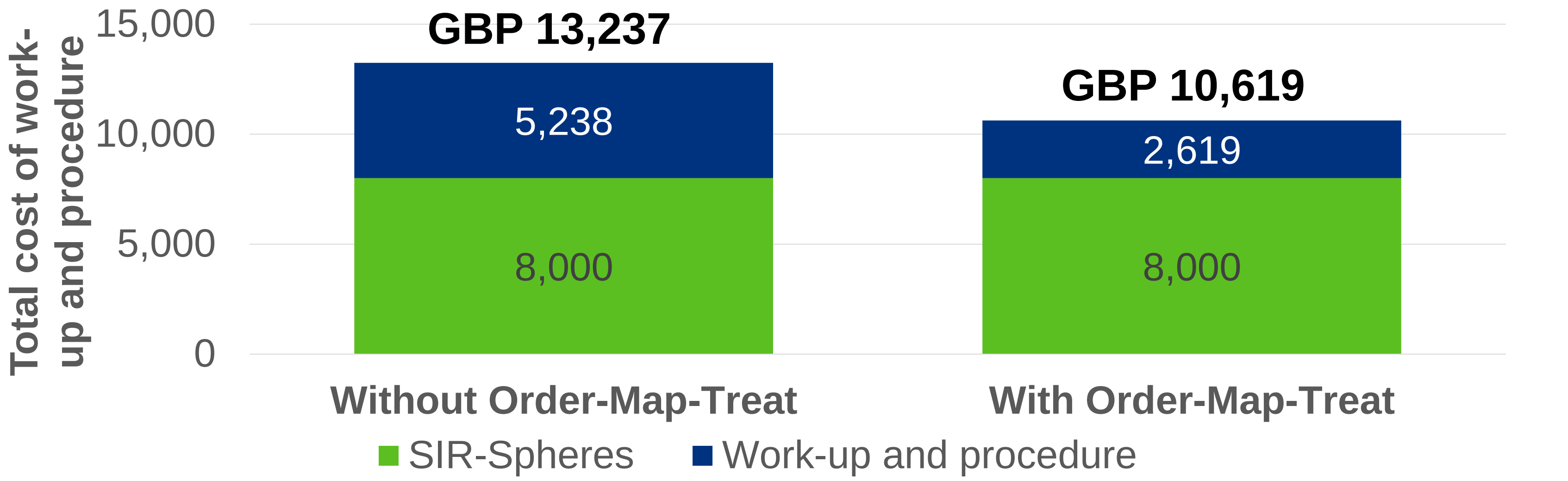
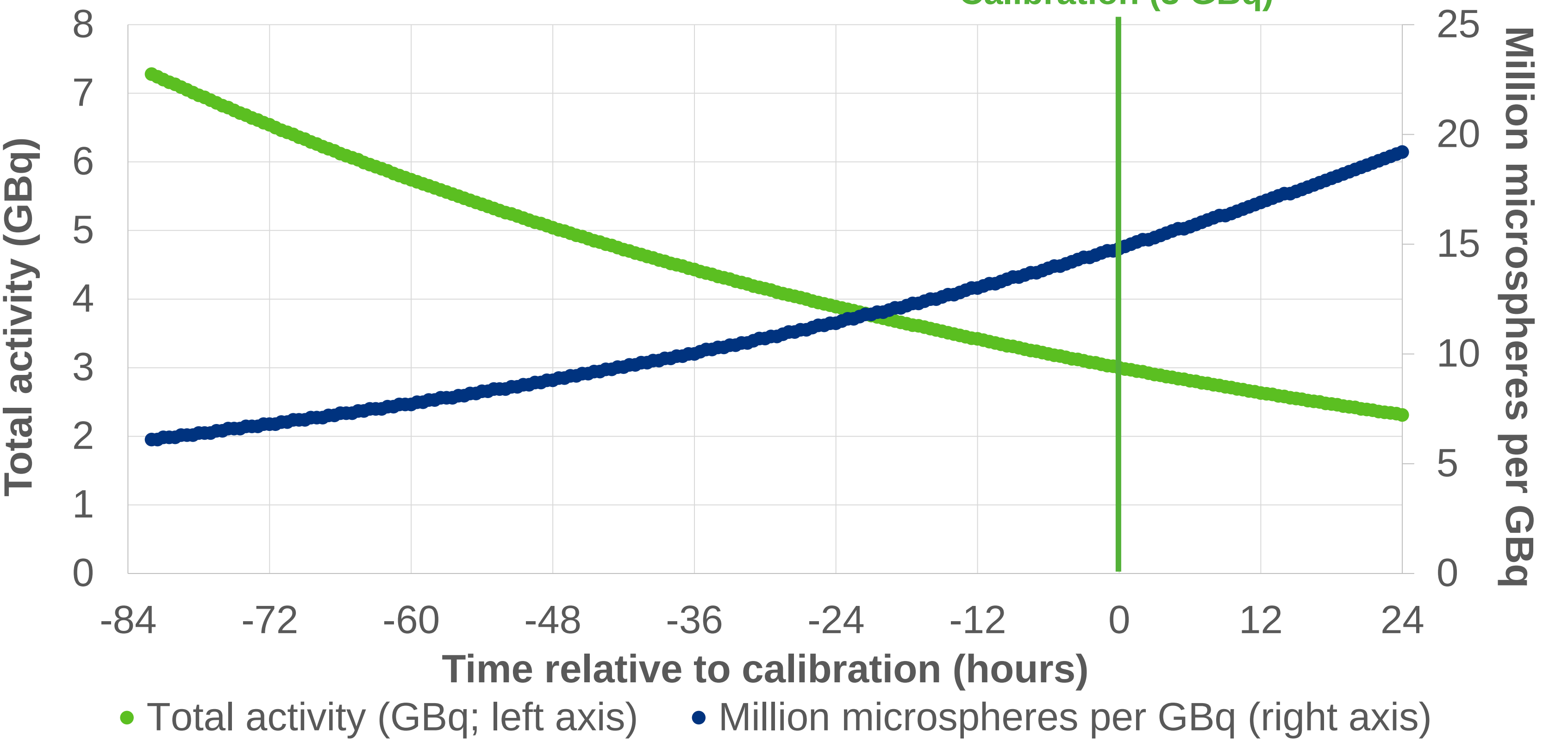


Figure 3: SIR-Spheres® Y-90 resin microspheres activity chart showing total activity and number of microspheres required to deliver one GBq at time points between 82 hours prior to and 24 hours after calibration



Conclusions

The present analysis showed that the Order-Map-Treat program would result in cost savings from the UK DoH perspective versus performing SIRT without the program. The additional flexibility afforded by the FLEXdose and Order-Map-Treat programs increase SIRT flexibility for interventional radiologists and nuclear medicine technicians, allow any dose to be administered on any day, and allow personalized dose adjustments up to the time of treatment.

References

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