Executive Summary

This report evaluates the clinical effectiveness, safety, costs, and cost-utility associated with percutaneous vertebroplasty (PVP) and percutaneous balloon kyphoplasty (PBK) in patients with painful osteoporotic vertebral compression fractures (OVCF). In addition, legal, social, ethical and organisational issues associated with PVP and PBK are explored.

Clinical Evaluation

Percutaneous Vertebroplasty

The safety and clinical effectiveness of PVP was informed by 12 randomised controlled trials (RCTs), 2 non-RCTs, 2 database analyses and 15 single-arm trials. The included RCTs were of high to moderate quality, and the non-RCTs and single-arm trials were of moderate to low quality.

Compared to CT, PVP led to significant reductions in pain (mean difference [MD] -1.52; 95% confidence interval [CI] -2.86, -0.17; p = 0.03), Oswestry disability index (ODI) (MD -16.27; 95% CI -23.53, -9.01; p < 0.0001) and Roland-Morris Disability Questionnaire (RDQ) (MD -2.03; 95% CI -3.06, -1.01; p = 0.0002) at 1 month. These results remained statistically different at 12 months, but were heterogenous and did not surpass the lower bounds of minimum clinically important differences (MCIDs) (noting, the applicability of the MCIDs are uncertain). Sub-group analysis was performed on fracture age to investigate heterogeneity. Fractures younger than 8 weeks (acute) reported statistical and clinically important reductions in pain at 1 month. By 12 months, only the statistical effect persisted. Similarly, for fractures older than 8 weeks, there were statistical differences in pain at 1 and 12 months; however, they did not surpass identified MCIDs.

Compared to sham, PVP statistically reduced pain at 1 month (MD -0.76; 95% CI -1.21, -0.31; p = 0.0009) and 12 months (MD -0.88; 95% CI -1.47, -0.29; p = 0.003). The effects were heterogenous, and unlikely to translate to clinically relevant differences. Results for the remaining outcomes were inconsistent. Fractures younger than 8 weeks reported statistical differences in pain (up to 12 months) and EQ-5D (up to 6 months) favouring PVP, but the clinical importance of these differences was uncertain. Fractures older than 8 weeks reported statistical differences in pain but not EQ-5D at 1 month and 12 months. The effects for pain did not surpass identified MCIDs and did not persist at later timepoints.

The sham and CT arms were pooled for the analysis of safety. Overall, there was no statistical difference in mortality, adverse events or new fractures across the RCTs and non-RCTs. Analyses of the US Medicare database reported the relative incidences of mortality and most adverse events (bedsores, cardiac complications, infection and pneumonia) were significantly lower at 30 days, 5 years and 10 years following PVP compared to CT (noting the absolute event rate was not reported).

Percutaneous Balloon Kyphoplasty

The safety and clinical effectiveness of PBK was informed by 4 RCTs, 4 non-RCTs, 2 databases and 6 single-arm trials. The included RCTs were of high to moderate quality, and the non-RCTs and single-arm trials were of moderate to low quality.

Compared to CT, PBK demonstrated a statistical and clinically meaningful reduction in pain at 1 week (MD -3.63; 95% CI -5.59, -1.68; $p < 0.001$). By 12 months the effect did not surpass MCID thresholds (MD -1.27; 95% CI -2.04, -0.51; $p < 0.01$). There were insufficient trials to perform sub-group analysis based on fracture age.

Mortality and adverse events were similar between PBK and CT in the RCTs and non-RCTs. Analyses of the US Medicare database reported the relative incidences of mortality, hospital readmission and adverse events were significantly lower at 30 days and 10 years following PBK compared to CT.

No studies evaluated PBK compared to sham.

Costs and Cost-Effectiveness

A decision analytic model was created to evaluate the cost-effectiveness of PVP and PBK vs CT, with probabilistic and univariate sensitivity analyses used to evaluate uncertainty and the impact of key assumptions. When considering trials that enrolled both acute (younger than 8 weeks) and sub-acute (older than 8 weeks) fractures there were no QoL improvements following PVP. The intervention was not cost-effective in this broad population given the comparator is lower cost than the intervention.

Trials evaluating acute fractures reported significant improvements in EQ-5D at some time points following PVP, and consequently an economic analysis was undertaken for this sub-population. The model determined the incremental cost-effectiveness ratio (ICER) for PVP (vs CT) to be CHF19,669 per quality-adjusted life year (QALY) using the baseline adjusted results of the VERTOS II trial at 12 months. PBK was cost-effective compared to CT with an ICER of CHF18,405 per QALY at 1 year, noting, however, that the model was informed by 1 trial in patients who had fractures for 3 months or less.

The probabilistic sensitivity analyses determined an 85% probability that PVP is superior (i.e. cost-effective) compared to CT at a willingness-to-pay threshold of CHF100,000/QALY at 12 months using results of the adjusted baseline analysis from VERTOS II. PBK was found to have an 87% probability of being superior to CT at a willingness-to-pay threshold of CHF100,000/QALY using results of the FREE trial. Univariate sensitivity analyses indicated that the cost-effectiveness of PVP and PBK was most influenced by assumed costs for CT.

A budget impact analysis using three substitution scenarios (100%, 75% and 50% of patients substituting from PVP and PBK to CT) was undertaken to determine the financial impact of delisting PVP and PBK. If 100% of patients substituted from PVP to CT, there is a net saving of CHF6.5 million

in 2020. Likewise, if 100% of patients substituted from PBK to CT, there is a net saving of CHF3.8 million in 2020. If both procedures would be delisted, there would be a collective net saving of CHF10.3 million in 2020, increasing to CHF13.5 million by 2024.

Legal, Social, Ethical and Organisational Issues

Disinvesting from PVP and PBK may impact the utilisation of healthcare resources, as the procedures had a shorter length of stay, and patients were more likely to be discharged home, compared to CT. The lack of consistent differences between the sham and intervention arms makes it unclear whether PVP exhibited true clinical effectiveness or whether the effects were attributable to a placebo- or confounding-effect.

Conclusion

PVP and PBK appeared to have a beneficial effect on pain in the short-term compared to CT and sham, and acute fractures (less than 8 weeks old) appeared to be more responsive to these procedures; however, the differences generally do not persist over time. PVP and PBK reported comparable safety compared to CT and sham from RCTs and non-RCTs; however, results from larger database analyses indicated PVP and PBK reduced mortality and adverse event rates at 30 days and 10 years post-intervention.

PVP was not cost-effective when using estimates derived from studies that included both acute and sub-acute fractures, as there were no QoL improvements. If results of the VERTOS II trial were considered, which included patients with acute fractures only, PVP was cost-effective compared to CT at 12 months. Similarly, PBK was cost-effective compared to CT, noting the EQ-5D estimates were informed by only 1 trial. Delisting PVP and PBK would result in a net cost saving for the payer.