

## Preoperative tests

### Routine preoperative tests for elective surgery

*Clinical guideline <...>*

*Appendix C: Clinical review protocols*

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**Disclaimer**

Healthcare professionals are expected to take NICE clinical guidelines fully into account when exercising their clinical judgement. However, the guidance does not override the responsibility of healthcare professionals to make decisions appropriate to the circumstances of each patient, in consultation with the patient and, where appropriate, their guardian or carer.

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## Appendix C: Clinical review protocols

### C.1 Resting electrocardiogram

**Table 1: Intervention review protocol: Resting electrocardiogram**

Component	Description
Review question	What is the clinical and cost-effectiveness of using resting electrocardiogram (ECG) as a preoperative test in improving patient outcomes in adults and young people undergoing non-cardiac elective surgery?
Objectives	The aim of this review is to determine if use of resting ECG as a preoperative test improves post-surgery outcomes in people undergoing non cardiac surgery.
Population	<p>All adults and young people (ASA grade 1 or above) undergoing non cardiac surgery</p> <p>Exclusion criteria:</p> <ul style="list-style-type: none"> <li>• People undergoing cardiac surgery (such as valve replacement and coronary artery graft)</li> <li>• People undergoing transplantation</li> <li>• People undergoing emergency surgery</li> </ul> <p>Stratified analysis if data available for</p> <ul style="list-style-type: none"> <li>• Surgery type or surgery grade (if specified).</li> <li>• ASA grade.</li> <li>• Selected comorbidities; cardiovascular, respiratory and renal diseases, obesity, diabetes.</li> </ul> <p>Any studies including initial risk stratification of patients will be included.</p>
Subgroups	<p>The following factors will be considered for subgroup analysis if heterogeneity is present:</p> <ul style="list-style-type: none"> <li>• Cardiovascular, respiratory and renal diseases, obesity, diabetes, high cholesterol, cerebrovascular, peripheral vascular</li> </ul>
Intervention	Preoperative resting ECG
Comparator	No preoperative test
Outcomes	<p><b>Critical</b></p> <ul style="list-style-type: none"> <li>• All-cause mortality.</li> <li>• Health related quality of life.</li> </ul> <p><b>Important</b></p> <ul style="list-style-type: none"> <li>• Complications related to surgery or anaesthesia (for example arrhythmias, myocardial infarction, heart failure, respiratory failure, acute kidney failure, infection)</li> <li>• Length of hospital stay after an operation.</li> <li>• Hospital readmission.</li> <li>• Adverse events caused by testing.</li> <li>• Intensive care unit (ICU) admission.</li> <li>• Composite outcomes such as the major adverse cardiovascular events (MACE) that incorporate cardiac deaths and non-fatal cardiac events.</li> <li>• Optimisation of medical therapy</li> </ul>
Study design	<ul style="list-style-type: none"> <li>• Systematic reviews of RCTs</li> </ul>

	<ul style="list-style-type: none"> <li>• RCTs</li> <li>• Non-randomized comparative studies</li> </ul> <p>Exclusions:</p> <ul style="list-style-type: none"> <li>• Observational studies</li> <li>• Case series</li> <li>• Case reports</li> <li>• Narrative summaries (including literature reviews)</li> <li>• Animal studies</li> </ul>
Population size and directness	No restrictions.
Setting	<ul style="list-style-type: none"> <li>• NHS-commissioned secondary and tertiary care.</li> </ul>
Search Strategy	See Appendix G Update from 2003 guideline
Review Strategy	<p><b>Appraisal of methodological quality</b></p> <ul style="list-style-type: none"> <li>• The methodological quality of each study will be assessed using NICE checklists and the quality of the evidence will be assessed by GRADE for each outcome.</li> </ul> <p><b>Synthesis of data</b></p> <ul style="list-style-type: none"> <li>• Meta-analysis will be conducted where appropriate.</li> <li>• Results will be analysed separately for each type of surgery and then the GDG will revise if results can be extrapolated or amalgamated across different surgeries</li> </ul>

**Table 2: Prognostic review protocol: Resting electrocardiogram**

Component	Description
<b>Review question</b>	Does resting electrocardiogram (ECG) predict prognosis (patient outcomes after surgery) in adults and young people undergoing non-cardiac elective surgery?
<b>Objectives</b>	Determine the predictive ability of resting electrocardiogram (ECG) as a pre-operative test for patient outcomes post-surgery.
<b>Population</b>	<p>All adults and young people (ASA grade 1 or above) undergoing non cardiac surgery.</p> <p>Exclusion criteria:</p> <ul style="list-style-type: none"> <li>• Patients undergoing cardiac surgery (such as valve replacement and coronary artery graft)</li> <li>• Patients undergoing transplantation</li> <li>• Patients undergoing emergency surgery</li> </ul> <p>Stratified analysis if data available for</p> <ul style="list-style-type: none"> <li>• Surgery type or surgery grade (if specified).</li> <li>• ASA grade.</li> <li>• Selected comorbidities; cardiovascular, respiratory and renal diseases, obesity, diabetes.</li> </ul> <p>Any studies including initial risk stratification of patients will be included.</p>
<b>Prognostic test</b>	Resting electrocardiogram
<b>Outcomes</b> (30 days post-surgery)	<p><b>Critical:</b></p> <ul style="list-style-type: none"> <li>• All-cause mortality</li> </ul> <p><b>Important:</b></p>

Component	Description
	<ul style="list-style-type: none"> <li>• Complications relating to surgery or anaesthesia</li> <li>• Length of hospital stay</li> <li>• Hospital re-admission</li> <li>• Adverse events caused by testing</li> <li>• Health-related quality of life</li> <li>• ICU admission</li> </ul>
<b>Study design</b>	Ideally prospective cohorts
<b>Exclusions</b>	Studies with univariate analyses will be excluded
<b>Key confounders</b>	<ul style="list-style-type: none"> <li>• Age</li> <li>• Comorbidities</li> </ul>
<b>The review strategy</b>	<p><b>Appraisal of methodological quality</b></p> <ul style="list-style-type: none"> <li>• The methodological quality of each study will be assessed using NICE checklists and the quality of the evidence will be assessed for each outcome.</li> </ul> <p><b>Synthesis of data</b></p> <ul style="list-style-type: none"> <li>• Meta-analysis will be conducted where appropriate.</li> </ul> <p>Results will be analysed separately for each type of surgery and then the GDG will revise if results can be extrapolated or amalgamated across different surgeries</p>

## C.2 Resting Echocardiogram

**Table 3: Review protocol: Resting echocardiogram**

Component	Description
Review question 6b	What is the usefulness of resting echocardiogram as a preoperative test in altering perioperative management for adults and young people with mild to severe comorbidities undergoing grade 3 or 4 (major/complex) elective surgery?
Objectives	Determine the predictive ability of preoperative resting echocardiography testing as a pre-operative test for improving patient outcomes post-surgery.
Population	<p>Adult patients ASA 2 or above at risk of cardiovascular disease undergoing grade 3 or 4 surgery non-cardiac related surgery</p> <p>Exclusion criteria:</p> <ul style="list-style-type: none"> <li>• People undergoing cardiac surgery (such as valve replacement and coronary artery graft)</li> <li>• People undergoing transplantation</li> <li>• People undergoing emergency surgery</li> </ul> <p>Stratified analysis if data available for</p> <ul style="list-style-type: none"> <li>• Surgery type or surgery grade (if specified).</li> <li>• ASA grade.</li> <li>• Selected comorbidities; cardiovascular, respiratory and renal diseases, obesity, diabetes.</li> </ul> <p>Any studies including initial risk stratification of patients will be included.</p>
Subgroups	The following factors will be considered for subgroup analysis if heterogeneity is present:

	Comorbidities: cardiovascular diseases, diabetes, obesity, respiratory, renal
Interventions	Resting echo
Comparator	No resting echo
Outcomes	<p><b>Critical:</b></p> <ul style="list-style-type: none"> <li>• Change in health care management (for example cancellation of surgery or correct ischaemia, valvular disease or HF on the basis of the results of the tests).</li> </ul> <p><b>Important:</b></p> <ul style="list-style-type: none"> <li>• All-cause mortality.</li> <li>• Complications related to surgery or anaesthesia.</li> <li>• Length of hospital stay after an operation.</li> <li>• Hospital readmission.</li> <li>• Adverse events caused by testing (time of testing).</li> <li>• Health related quality of life.</li> <li>• Intensive care unit (ICU) admission.</li> <li>• Composite outcomes such as the major adverse cardiovascular events (MACE) that incorporate cardiac deaths and non-fatal cardiac events.</li> <li>• Optimisation of medical therapy</li> </ul>
Study design	<ul style="list-style-type: none"> <li>• Systematic reviews of RCTs</li> <li>• RCTs</li> <li>• Non-randomized comparative studies</li> </ul> <p>Exclusions:</p> <ul style="list-style-type: none"> <li>• Cohort</li> <li>• Case series</li> <li>• Case reports</li> <li>• Narrative summaries (including literature reviews)</li> <li>• Animal studies</li> </ul>
Population size and directness	No restrictions
Setting	NHS-commissioned Secondary and Tertiary Care
Search Strategy	2000 cut-off for papers
Review Strategy	<p><b>Appraisal of methodological quality</b></p> <p>The methodological quality of each study will be assessed using NICE checklists and the quality of the evidence will be assessed by GRADE for each outcome.</p> <p><b>Synthesis of data</b></p> <p>Meta-analysis will be conducted where appropriate.</p>

### C.3 Cardiopulmonary exercise testing (CPET)

**Table 4: Intervention review protocol: Cardiopulmonary exercise test (CPET)**

Component	Description
Review question	What is the clinical and cost-effectiveness of using cardiopulmonary exercise test (CPET)

	as a preoperative test in improving patient outcomes in adults and young people with mild to severe comorbidities undergoing grade 3 or 4 (major/complex) non-cardiac elective surgery?
Objectives	The aim of this review is to determine if use of CPET as a preoperative test improves patient outcomes.
Population	<p>Adult patients classified as ASA grade 2 or above undergoing:</p> <ul style="list-style-type: none"> <li>• Grade 3 and 4 non-cardiac surgery</li> </ul> <p>Exclusion criteria:</p> <ul style="list-style-type: none"> <li>• People with severe COPD (equivalent to NYHA IIIb)</li> <li>• People undergoing cardiac surgery (such as valve replacement and coronary artery graft)</li> <li>• People undergoing transplantation</li> <li>• People undergoing emergency surgery</li> </ul> <p>Stratified analysis if data available for</p> <ul style="list-style-type: none"> <li>• Surgery type or surgery grade (if specified).</li> <li>• ASA grade.</li> <li>• Selected comorbidities; cardiovascular, respiratory and renal diseases, obesity, diabetes.</li> </ul> <p>Any studies including initial risk stratification of patients will be included.</p>
Subgroups	<p>The following factors will be considered for subgroup analysis if heterogeneity is present:</p> <ul style="list-style-type: none"> <li>• Type of ischaemic heart disease (such as chronic stable angina, unstable angina, NSTEMI and STEMI)</li> <li>• Heart failure</li> <li>• Vascular diseases</li> <li>• Surgical procedure</li> <li>• Presence of COPD (mild or moderate)</li> <li>• Older people (as many of them would experience comorbidities)</li> </ul>
Intervention	<ul style="list-style-type: none"> <li>• Cardiopulmonary exercise test (CPET)</li> </ul>
Comparator	<ul style="list-style-type: none"> <li>• No CPET test/clinical assessment only</li> </ul>
Outcomes	<p><b>Critical</b></p> <ul style="list-style-type: none"> <li>• All-cause mortality.</li> <li>• Health related quality of life.</li> </ul> <p><b>Important</b></p> <ul style="list-style-type: none"> <li>• Complications related to surgery or anaesthesia (for example arrhythmias, myocardial infarction, heart failure, respiratory failure, acute kidney failure, infection)</li> <li>• Length of hospital stay after an operation.</li> <li>• Hospital readmission.</li> <li>• Adverse events caused by testing.</li> <li>• Intensive care unit (ICU) admission.</li> </ul>
Study design	<ul style="list-style-type: none"> <li>• Systematic reviews of RCTs</li> <li>• RCTs</li> <li>• Non-randomized comparative studies</li> </ul> <p>Exclusions:</p>

	<ul style="list-style-type: none"> <li>• Observational studies</li> <li>• Case series</li> <li>• Case reports</li> <li>• Narrative summaries (including literature reviews)</li> <li>• Animal studies</li> </ul>
Population size and directness	No restrictions
Setting	<ul style="list-style-type: none"> <li>• NHS-commissioned secondary and tertiary care.</li> </ul>
Search Strategy	See Appendix G
Review Strategy	<p><b>Appraisal of methodological quality</b></p> <ul style="list-style-type: none"> <li>• The methodological quality of each study will be assessed using NICE checklists and the quality of the evidence will be assessed by GRADE for each outcome.</li> </ul> <p><b>Synthesis of data</b></p> <ul style="list-style-type: none"> <li>• Meta-analysis will be conducted where appropriate.</li> <li>• Results will be analysed separately for each type of surgery and then the GDG will revise if results can be extrapolated or amalgamated across different surgeries</li> </ul>

**Table 5: Prognostic review protocol: CPET**

Component	Description
<b>Review question</b>	Does cardiopulmonary exercise testing (CPET) predict prognosis (patient outcomes after surgery) in adults and young people with mild to severe comorbidities undergoing grade 3 or 4 non-cardiac elective surgery?
<b>Objectives</b>	Determine the predictive ability of CPET as a pre-operative test for patient outcomes post-surgery.
<b>Population</b>	<p>People with mild to severe comorbidities (classified as ASA grade 2 or above) undergoing grade 3 and 4 non-cardiac elective surgery.</p> <p>Stratified analysis if data available for</p> <ul style="list-style-type: none"> <li>• Surgery type or surgery grade (if specified).</li> <li>• ASA grade.</li> <li>• Selected comorbidities; cardiovascular, respiratory and renal diseases, obesity, diabetes.</li> </ul> <p>Exclusions:</p> <ul style="list-style-type: none"> <li>• People with severe COPD (unless &lt;10% of study population)</li> <li>• Patients undergoing cardiac surgery (such as valve replacement and coronary artery graft)</li> <li>• People undergoing transplantation surgery</li> <li>• People undergoing emergency surgery</li> </ul> <p>Any studies including initial risk stratification of patients will be included.</p>
<b>Prognostic test</b>	<p><b>Cardiopulmonary exercise test measures, including:</b></p> <ul style="list-style-type: none"> <li>• VO<sub>2</sub> (oxygen uptake)</li> <li>• Peak VO<sub>2</sub> (highest value during test)</li> <li>• VO<sub>2</sub> max (maximal oxygen uptake)</li> <li>• VCO<sub>2</sub> (carbon dioxide exhaled)</li> </ul>

Component	Description
	<ul style="list-style-type: none"> <li>• AT – Anaerobic threshold (exercise capacity)</li> <li>• VE/VO<sub>2</sub> and VE/VCO<sub>2</sub> – ventilatory equivalents</li> </ul>
<b>Outcomes</b> (30 days post-surgery)	<b>Critical</b> <ul style="list-style-type: none"> <li>• All-cause mortality</li> </ul> <b>Important</b> <ul style="list-style-type: none"> <li>• Complications relating to surgery or anaesthesia</li> <li>• Length of hospital stay</li> <li>• Hospital re-admission</li> <li>• Adverse events caused by testing</li> <li>• Health-related quality of life</li> <li>• ICU admission</li> </ul>
<b>Study design</b>	Ideally prospective cohorts
<b>Exclusions</b>	We will exclude studies with univariate analyses
<b>Key confounders</b>	<ul style="list-style-type: none"> <li>• Age</li> <li>• Comorbidities</li> </ul>
<b>The review strategy</b>	Stratified analysis if data available for <ul style="list-style-type: none"> <li>• Surgery type or surgery grade (if specified).</li> <li>• ASA grade.</li> <li>• Selected comorbidities; cardiovascular, respiratory and renal diseases, obesity, diabetes.</li> </ul>

## C.4 Polysomnography

**Table 6: Intervention review protocol: Polysomnography**

Component	Description
Review question	What is the clinical and cost-effectiveness of using polysomnography as a preoperative test (to detect obstructive sleep apnoea) in improving patient outcomes in adults and young people with obesity undergoing grade 3 or 4 (major/complex) elective non-cardiac surgery?
Objectives	The aim of this review is to determine if use of polysomnography as a preoperative test improves outcomes in people with obesity.
Population	All adult and young people with obesity (ASA grade 2 or above) with obesity undergoing grade 3 or 4 (major) elective non-cardiac surgery.  Exclusion criteria: <ul style="list-style-type: none"> <li>• Patients with a pre-existing diagnosis of obstructive sleep apnoea</li> <li>• People undergoing cardiac surgery (such as valve replacement and coronary artery graft)</li> <li>• People undergoing transplantation</li> <li>• People undergoing emergency surgery</li> </ul> Stratified analysis if data available for <ul style="list-style-type: none"> <li>• Surgery type or surgery grade (if specified).</li> <li>• ASA grade.</li> </ul>

	Any studies including initial risk stratification of patients will be included.
Subgroups	<p>The following factors will be considered for subgroup analysis if heterogeneity is present:</p> <ul style="list-style-type: none"> <li>• Comorbidities</li> <li>• BMI</li> <li>• Older age</li> <li>• Male</li> <li>• Hypertension</li> </ul> <p>Stratified by surgery procedure</p>
Intervention	Polysomnography
Comparative strategies	No polysomnography
Outcomes	<p>Critical outcomes</p> <ul style="list-style-type: none"> <li>• All-cause mortality.</li> </ul> <p>Important outcomes</p> <ul style="list-style-type: none"> <li>• Complications related to surgery or anaesthesia.</li> <li>• Length of hospital stay after an operation.</li> <li>• Hospital readmission.</li> <li>• Adverse events caused by testing.</li> <li>• Health-related quality of life.</li> <li>• Intensive care unit (ICU) admission.</li> <li>• Optimisation of therapy.</li> <li>• Change in management.</li> </ul>
Study design	<ul style="list-style-type: none"> <li>• Systematic reviews of RCTs or observational studies</li> <li>• RCTs</li> <li>• Non-randomized comparative studies</li> </ul> <p>Exclusions:</p> <ul style="list-style-type: none"> <li>• Observational studies (including case control studies)</li> <li>• Case series</li> <li>• Case reports</li> <li>• Narrative summaries (including literature reviews)</li> <li>• Animal studies</li> </ul>
Population size and directness	No restrictions.
Setting	<ul style="list-style-type: none"> <li>• NHS-commissioned Primary care.</li> <li>• Community settings in which NHS care is received.</li> </ul>
Search Strategy	See Appendix G
Review Strategy	<p><b>Appraisal of methodological quality</b></p> <ul style="list-style-type: none"> <li>• The methodological quality of each study will be assessed using NICE checklists and the quality of the evidence will be assessed by GRADE for each outcome.</li> </ul> <p><b>Synthesis of data</b></p> <ul style="list-style-type: none"> <li>• Meta-analysis will be conducted where appropriate.</li> </ul>

**Table 7: Prognostic review protocol: Polysomnography**

Component	Description
<b>Review question</b>	Does polysomnography predict prognosis (patient outcomes after surgery) in adults and young people with obesity undergoing grade 3 or 4 (major/complex) elective non-cardiac surgery?
<b>Objectives</b>	The aim of this review is to determine the predictive ability of polysomnography for patient outcomes post-surgery.
<b>Population</b>	<p>All adult and young people with obesity (ASA grade 2 or above) undergoing grade 3 or 4 (major) elective non-cardiac surgery.</p> <p>Exclusion criteria:</p> <ul style="list-style-type: none"> <li>• Patients with a pre-existing diagnosis of obstructive sleep apnoea</li> <li>• People undergoing cardiac surgery (such as valve replacement and coronary artery graft)</li> <li>• People undergoing transplantation</li> <li>• People undergoing emergency surgery</li> </ul> <p>Stratified analysis if data available for</p> <ul style="list-style-type: none"> <li>• Surgery type or surgery grade (if specified).</li> <li>• ASA grade.</li> <li>• Selected comorbidities; cardiovascular, respiratory and renal diseases, obesity.</li> </ul> <p>Any studies including initial risk stratification of patients will be included.</p>
<b>Prognostic test</b>	Polysomnography
<b>Outcomes</b> (30 days post-surgery)	<p><b>Critical</b></p> <ul style="list-style-type: none"> <li>• All-cause mortality</li> </ul> <p><b>Important</b></p> <ul style="list-style-type: none"> <li>• Complications relating to surgery or anaesthesia</li> <li>• Length of hospital stay (post-operation)</li> <li>• Hospital re-admission</li> <li>• Adverse events after surgery (wound infection)</li> <li>• Health-related quality of life</li> <li>• ICU admission</li> </ul>
<b>Study design</b>	<p>Ideally prospective cohorts but retrospective cohorts will be accepted</p> <p>Only papers with a multivariate analysis will be included</p>
<b>Exclusions</b>	<p>Exclusion criteria:</p> <ul style="list-style-type: none"> <li>• Patients with a pre-existing diagnosis of obstructive sleep apnoea</li> <li>• Patients undergoing cardiac surgery (such as valve replacement and coronary artery graft)</li> <li>• Patients undergoing transplantation</li> </ul>
<b>How the information will be searched</b>	See Appendix G

Component	Description
<b>Key confounders</b>	<p><i>Minimum set of confounders that should be adjusted for (will vary per outcome)</i></p> <ul style="list-style-type: none"> <li>• Comorbidities</li> <li>• BMI</li> <li>• Older age</li> <li>• Male</li> <li>• Hypertension</li> </ul>
<b>The review strategy</b>	<p>Stratified by:</p> <ul style="list-style-type: none"> <li>• Type of surgery</li> </ul>

## C.5 Health technology assessment update

**Table 8: Intervention review protocol: HTA update**

Component	Description
Review question 1	<p>What is the usefulness of the following tests in predicting outcome or altering perioperative management for adults and young people undergoing any type of elective surgery:</p> <ul style="list-style-type: none"> <li>• Full blood count (haemoglobin, white blood cell count and platelet count)</li> <li>• Kidney function tests (urea, estimated glomerular filtration rate and electrolyte tests)</li> <li>• Pulmonary function tests (also including blood gas analysis)</li> </ul>
Objectives	<p>The aim of this review is to determine if the use of full blood count, kidney function and pulmonary function as preoperative tests improve post-surgical outcomes</p>
Population	<p>Adult and young people classified as patients ASA grade 1 or 2 undergoing:</p> <ul style="list-style-type: none"> <li>• Minor (grade 1) or intermediate (grade 2) surgery</li> <li>• Major/complex surgery (3 and 4)</li> </ul> <p>Selected comorbidities; cardiovascular, respiratory and renal diseases, obesity, diabetes.</p> <p>Stratified analysis if data available for</p> <ul style="list-style-type: none"> <li>• Surgery type or surgery grade (if specified).</li> <li>• ASA grade.</li> <li>• Selected comorbidities; cardiovascular, respiratory and renal diseases, obesity, diabetes.</li> </ul> <p>Exclusions:</p> <ul style="list-style-type: none"> <li>• People undergoing lung resection surgery who have pulmonary function tests will be excluded.</li> <li>• People undergoing cardiac surgery (such as valve replacement and coronary artery graft)</li> <li>• People undergoing transplantation</li> <li>• People undergoing emergency surgery</li> </ul>
Subgroups	<p>The following factors will be considered for subgroup analysis if heterogeneity is present:</p> <ul style="list-style-type: none"> <li>• Apparently healthy individuals with no clinical indication for testing FBC, U&amp;Es and PFTs</li> <li>• Patients receiving treatment likely to alter results (for example diuretics)</li> </ul>

	<ul style="list-style-type: none"> <li>• Elderly</li> </ul>
Intervention	<p>Routine preoperative testing of:</p> <ul style="list-style-type: none"> <li>• Full blood count (haemoglobin, white blood cell count and platelet count)</li> <li>• Kidney function tests (urea, estimated glomerular filtration rate and electrolyte tests)</li> <li>• Pulmonary function tests (also including blood gas analysis)</li> </ul> <p>A combination of the above tests will be included only if the efficacy of each test is analysed individually, but not if the results are given as a composite outcome of</p>
Comparator	No routine preoperative testing
Outcomes (30-day post-surgery)	<ul style="list-style-type: none"> <li>• All-cause mortality.</li> <li>• Change in health care management (for example cancellation of surgery).</li> <li>• Complications related to surgery or anaesthesia.</li> <li>• Length of hospital stay after an operation.</li> <li>• Hospital readmission.</li> <li>• Adverse events caused by testing (time of testing).</li> <li>• Health-related quality of life.</li> <li>• Intensive care unit (ICU) admission.</li> </ul>
Importance of outcomes	<p><b>Critical outcomes:</b></p> <ul style="list-style-type: none"> <li>• All-cause mortality</li> <li>• Complications related to surgery or anaesthesia</li> </ul>
Study design	<ul style="list-style-type: none"> <li>• Systematic reviews of RCTs or observational studies</li> <li>• RCTs</li> <li>• Non-randomized comparative studies</li> <li>• Observational studies (including case control studies)</li> </ul> <p>Exclusions:</p> <ul style="list-style-type: none"> <li>• Case series</li> <li>• Case reports</li> <li>• Narrative summaries (including literature reviews)</li> <li>• Animal studies</li> </ul>
Population size and directness	No restrictions
Setting	<ul style="list-style-type: none"> <li>• NHS-commissioned primary care.</li> <li>• Secondary care</li> </ul>
Search Strategy	<p>See Appendix G</p> <p><b>Search after May 2009</b> for adult patients ASA grade 1 or 2 (with cardiovascular, renal and respiratory diseases) undergoing:</p> <ul style="list-style-type: none"> <li>• minor (grade 1) or intermediate (grade 2) surgery (HTA update)</li> </ul> <p><b>Full searches</b> for adult patients ASA grade 1 or 2 (with obesity, diabetes) undergoing:</p> <ul style="list-style-type: none"> <li>• minor (grade 1) or intermediate (grade 2) surgery</li> <li>• grade surgery 3 or 4</li> </ul>
Review Strategy	<p><b>Appraisal of methodological quality</b></p> <ul style="list-style-type: none"> <li>• The methodological quality of each study will be assessed using NICE checklists and the quality of the evidence will be assessed by GRADE for each outcome.</li> </ul> <p><b>Synthesis of data</b></p> <ul style="list-style-type: none"> <li>• Meta-analysis will be conducted where appropriate.</li> </ul>

**Table 9: Prognostic review protocol: HTA update**

Component	Description
<b>Review question</b>	Do full blood count (haemoglobin, white blood cell count and platelet count), kidney function tests (urea, estimated glomerular filtration rate and electrolyte tests) (U&Es) and pulmonary function tests (also including blood gas analysis) predict prognosis (patient outcomes after surgery) in adults and young people ASA 1-4 undergoing grade 1-4 elective non-cardiac surgery?
<b>Objectives</b>	The aim of this review is to determine the predictive ability of Full blood count, Kidney function tests and Pulmonary function tests (also including blood gas analysis) patient outcomes post-surgery.
<b>Population</b>	<p>Adult and young people classified as patients ASA grade 1 to 4 undergoing:</p> <ul style="list-style-type: none"> <li>• minor (grade 1) or intermediate (grade 2) or major (grade 3 and 4) surgery</li> </ul> <p>Selected comorbidities; cardiovascular, respiratory and renal diseases, obesity, diabetes.</p> <p>Stratified analysis if data available for</p> <ul style="list-style-type: none"> <li>• Surgery type or surgery grade (if specified).</li> <li>• ASA grade.</li> <li>• Selected comorbidities; cardiovascular, respiratory and renal diseases, obesity, diabetes.</li> </ul> <p>Exclusions:</p> <ul style="list-style-type: none"> <li>• Patients undergoing lung resection surgery who have pulmonary function tests will be excluded.</li> <li>• Patients undergoing cardiac surgery.</li> <li>• Patients undergoing emergency surgery.</li> </ul>
<b>Presence / absence of risk factor</b>	<ul style="list-style-type: none"> <li>• Full blood count (haemoglobin, white blood cell count and platelet count) (FBC)</li> <li>• Kidney function tests (urea, estimated glomerular filtration rate and electrolyte tests) (U&amp;Es)</li> <li>• Pulmonary function tests (also including blood gas analysis) (PFTs)</li> </ul>
<b>Outcomes (30-day post-surgery)</b>	<p><b>Critical:</b></p> <ul style="list-style-type: none"> <li>• All-cause mortality.</li> <li>• Change in health care management (for example cancellation of surgery).</li> <li>• Complications related to surgery or anaesthesia.</li> <li>• Length of hospital stay after an operation.</li> <li>• Hospital readmission.</li> <li>• Adverse events caused by testing (time of testing).</li> <li>• Health-related quality of life.</li> <li>• Intensive care unit (ICU) admission.</li> </ul>
<b>Study design</b>	Ideally prospective cohorts
<b>Exclusions</b>	We have excluded studies with patients with severe COPD, those undergoing cardiac surgery (such as valve replacement and coronary artery graft), any type of organ transplantation or emergency surgery. Diagnostic studies assessing the CPET's diagnostic accuracy were not included.
<b>Key confounders</b>	<ul style="list-style-type: none"> <li>• Age</li> <li>• Comorbidities</li> </ul>

Component	Description
The review strategy	Stratified analysis if data available for <ul style="list-style-type: none"> <li>• Surgery type or surgery grade (if specified).</li> <li>• ASA grade.</li> <li>• Selected comorbidities; cardiovascular, respiratory and renal diseases, obesity, diabetes.</li> </ul>

## C.6 Glycated haemoglobin test

### C.6.1 HbA1c in diagnosed diabetes

**Table 10: Intervention review protocol: HbA1c in diagnosed diabetes**

Component	Description
Review question	What is the clinical and cost-effectiveness of using HbA1c (glycated haemoglobin) as a preoperative test in improving patient outcomes in adults and young people with diabetes and mild to severe comorbidities undergoing non-cardiac elective surgery?
Objectives	The aim of this review is to determine if use of HbA1c (glycated haemoglobin) as a preoperative test improves outcomes in people with diagnosed diabetes. Determining if their diabetes is controlled or not.
Population	Adult patients with diabetes (all types) undergoing non-cardiac related surgery  Exclusion criteria: <ul style="list-style-type: none"> <li>• People undergoing cardiac surgery (such as valve replacement and coronary artery graft)</li> <li>• People undergoing transplantation</li> <li>• People undergoing emergency surgery</li> </ul> Stratified analysis if data available for <ul style="list-style-type: none"> <li>• Surgery type or surgery grade (if specified).</li> <li>• ASA grade.</li> <li>• Selected comorbidities; cardiovascular, respiratory and renal diseases, obesity.</li> </ul> Any studies including initial risk stratification of patients will be included.
Subgroups	The following factors will be considered for subgroup analysis if heterogeneity is present: <ul style="list-style-type: none"> <li>• Type of ischaemic heart disease (such as chronic stable angina, unstable angina, NSTEMI and STEMI)</li> <li>• Heart failure</li> <li>• Vascular diseases</li> <li>• Older people (as many of them may experience comorbidities)</li> </ul>
Intervention	HbA <sub>1c</sub> (glycated haemoglobin)
Comparator	<ul style="list-style-type: none"> <li>• No HbA<sub>1c</sub> (glycated haemoglobin) /clinical assessment only</li> <li>• Random blood glucose</li> </ul>
Outcomes	<b>Critical:</b> <ul style="list-style-type: none"> <li>• All-cause mortality.</li> <li>• Health-related quality of life.</li> </ul>

	<p><b>Important:</b></p> <ul style="list-style-type: none"> <li>• Complications related to surgery or anaesthesia (for example arrhythmias, myocardial infarction, heart failure, respiratory failure, acute kidney failure, infection)</li> <li>• Length of hospital stay</li> <li>• Hospital readmission.</li> <li>• Intensive care unit (ICU) admission.</li> </ul>
Study design	<ul style="list-style-type: none"> <li>• Systematic reviews of RCTs</li> <li>• RCTs</li> <li>• Non-randomized comparative studies</li> </ul> <p>Exclusions:</p> <ul style="list-style-type: none"> <li>• Observational studies</li> <li>• Case series</li> <li>• Case reports</li> <li>• Narrative summaries (including literature reviews)</li> <li>• Animal studies</li> </ul>
Population size and directness	No restrictions.
Setting	<ul style="list-style-type: none"> <li>• NHS-commissioned secondary and tertiary care.</li> </ul>
Search Strategy	See Appendix G
Review Strategy	<p><b>Appraisal of methodological quality</b></p> <ul style="list-style-type: none"> <li>• The methodological quality of each study will be assessed using NICE checklists and the quality of the evidence will be assessed by GRADE for each outcome.</li> </ul> <p><b>Synthesis of data</b></p> <ul style="list-style-type: none"> <li>• Meta-analysis will be conducted where appropriate.</li> <li>• Results will be analysed separately for each type of surgery and then the GDG will revise if results can be extrapolated or amalgamated across different surgeries</li> </ul>

**Table 11: Review protocol 2 (prognostic): HbA1c in diagnosed diabetes**

Component	Description
<b>Review question</b>	Does HbA1c (glycated haemoglobin) predict prognosis (predicting patient outcomes after surgery) of people with diabetes (all types) and mild to severe comorbidities undergoing grade 3 or 4 (major/complex) non-cardiac elective surgery?
<b>Objectives</b>	The aim of this review is to determine the predictive ability of tests that detect hyperglycaemia in patients with diabetes on outcomes post-surgery.
<b>Population</b>	<p>Adult patients with diabetes (all types) undergoing non-cardiac related surgery</p> <p>Exclusion criteria:</p> <ul style="list-style-type: none"> <li>• People undergoing cardiac surgery (such as valve replacement and coronary artery graft)</li> <li>• People undergoing transplantation</li> <li>• People undergoing emergency surgery</li> </ul> <p>Stratified analysis if data available for</p> <ul style="list-style-type: none"> <li>• Surgery type or surgery grade (if specified).</li> </ul>

Component	Description
	<ul style="list-style-type: none"> <li>• ASA grade.</li> <li>• Selected comorbidities; cardiovascular, respiratory and renal diseases, obesity.</li> </ul> <p>Any studies including initial risk stratification of patients will be included.</p>
<b>Prognostic test</b>	Level of glycated haemoglobin (HbA1c)
<b>Outcomes</b> (30 days post-surgery)	<p><b>Critical:</b></p> <ul style="list-style-type: none"> <li>• All-cause mortality</li> </ul> <p><b>Important:</b></p> <ul style="list-style-type: none"> <li>• Complications relating to surgery or anaesthesia</li> <li>• Length of hospital stay (post-operation)</li> <li>• Hospital re-admission</li> <li>• Adverse events after surgery (wound infection)</li> <li>• Health-related quality of life</li> <li>• ICU admission</li> </ul>
<b>Study design</b>	<b>Ideally prospective cohorts</b>
<b>Exclusions</b>	<p>Exclude studies with univariate analyses if there are studies with multivariable analysis</p> <p>Exclusions:</p> <ul style="list-style-type: none"> <li>• Cardiac surgery (for example valve replacement, coronary artery graft)</li> <li>• Transplantation surgery</li> </ul>
<b>Key confounders</b>	<p><i>Minimum set of confounders that should be adjusted for (will vary per outcome)</i></p> <ul style="list-style-type: none"> <li>• Age</li> <li>• BMI</li> <li>• Comorbidities (cardiovascular, respiratory and renal diseases, obesity)</li> <li>• Patients taking drugs that cause a rapid rise in glucose (such as corticosteroids or antipsychotic drugs (<math>\leq 2</math> months). HbA<sub>1c</sub> can be used in patients taking these drugs longer term (<math>&gt; 2</math> months) who are not clinically unwell.</li> <li>• Ethnic groups</li> <li>• Patients with acute pancreatic damage or who have undergone pancreatic surgery</li> <li>• Patients with renal failure</li> <li>• Patients with HIV infection</li> </ul>
<b>The review strategy</b>	<p>Stratified by:</p> <ul style="list-style-type: none"> <li>• Type of surgery</li> </ul>
<b>Notes</b>	We will consider studies that have compared random glucose test or HbA1c (first arm) versus urine analysis (second arm) by reporting results only for the first arm.

## C.6.2 HbA1c in undiagnosed diabetes

**Table 12: Intervention review protocol: HbA1c in undiagnosed diabetes**

Component	Description
Review question	What is the clinical and cost effectiveness of using HbA <sub>1c</sub> (glycated haemoglobin) as a preoperative test in improving patient outcomes in adults and young people with mild to severe comorbidities undergoing non cardiac elective surgery?
Objectives	The aim of this review is to determine if use of HbA <sub>1c</sub> (glycated haemoglobin) as a

	preoperative test improves outcomes in people without diagnosed diabetes
Population	<p>Adult patients without diagnosed diabetes (all types) undergoing non-cardiac related surgery</p> <p>Exclusion criteria:</p> <ul style="list-style-type: none"> <li>• People with diagnosed diabetes</li> <li>• People undergoing cardiac surgery (such as valve replacement and coronary artery graft)</li> <li>• People undergoing transplantation</li> <li>• People undergoing emergency surgery</li> </ul> <p>Stratified analysis if data available for</p> <ul style="list-style-type: none"> <li>• Surgery type or surgery grade (if specified)</li> <li>• ASA grade.</li> <li>• Selected comorbidities; cardiovascular, respiratory and renal diseases, obesity.</li> </ul> <p>Any studies including initial risk stratification of patients will be included.</p>
Subgroups	<p>The following factors will be considered for subgroup analysis if heterogeneity is present:</p> <ul style="list-style-type: none"> <li>• Type of ischaemic heart disease (such as chronic stable angina, unstable angina, NSTEMI and STEMI)</li> <li>• Heart failure</li> <li>• Vascular diseases</li> <li>• Older people (as many of them would experience comorbidities)</li> </ul>
Intervention	HbA <sub>1c</sub> (glycated haemoglobin)
Comparator	No HbA <sub>1c</sub> (glycated haemoglobin) /clinical assessment only
Outcomes	<p><b>Critical:</b></p> <ul style="list-style-type: none"> <li>• All-cause mortality.</li> <li>• Health-related quality of life.</li> </ul> <p><b>Important:</b></p> <ul style="list-style-type: none"> <li>• Complications related to surgery or anaesthesia (for example arrhythmias, myocardial infarction, heart failure, respiratory failure, acute kidney failure, infection)</li> <li>• Length of hospital stay after an operation.</li> <li>• Hospital readmission.</li> <li>• Intensive care unit (ICU) admission.</li> </ul>
Study design	<ul style="list-style-type: none"> <li>• Systematic reviews of RCTs</li> <li>• RCTs</li> <li>• Non-randomized comparative studies</li> </ul> <p>Exclusions:</p> <ul style="list-style-type: none"> <li>• Observational studies</li> <li>• Case series</li> <li>• Case reports</li> <li>• Narrative summaries (including literature reviews)</li> <li>• Animal studies</li> </ul>
Population size and directness	No restrictions

Setting	<ul style="list-style-type: none"> <li>NHS-commissioned secondary and tertiary care.</li> </ul>
Search Strategy	See Appendix G
Review Strategy	<p><b>Appraisal of methodological quality</b></p> <ul style="list-style-type: none"> <li>The methodological quality of each study will be assessed using NICE checklists and the quality of the evidence will be assessed by GRADE for each outcome.</li> </ul> <p><b>Synthesis of data</b></p> <ul style="list-style-type: none"> <li>Meta-analysis will be conducted where appropriate.</li> <li>Results will be analysed separately for each type of surgery and then the GDG will revise if results can be extrapolated or amalgamated across different surgeries</li> </ul>
Notes	<ul style="list-style-type: none"> <li>Results may potentially inform cost effectiveness considerations.</li> </ul>

**Table 13: Review protocol 2 (prognostic): HbA1c in undiagnosed diabetes**

Component	Description
<b>Review question</b>	Does HbA1c (glycated haemoglobin) predict prognosis (predicting patient outcomes after surgery) of people with mild to severe comorbidities undergoing grade 3 or 4 non-cardiac elective surgery?
<b>Objectives</b>	The aim of this review is to determine the predictive ability of tests that detect hyperglycaemia for patient outcomes post-surgery.
<b>Population</b>	<p>Adult patients with diabetes (all types) undergoing non-cardiac related surgery</p> <p>Exclusion criteria:</p> <ul style="list-style-type: none"> <li>People with diagnosed diabetes</li> <li>People undergoing cardiac surgery (such as valve replacement and coronary artery graft)</li> <li>People undergoing transplantation</li> <li>People undergoing emergency surgery</li> </ul> <p>Stratified analysis if data available for</p> <ul style="list-style-type: none"> <li>Surgery type or surgery grade (if specified).</li> <li>ASA grade.</li> <li>Selected comorbidities; cardiovascular, respiratory and renal diseases, obesity.</li> </ul> <p>Any studies including initial risk stratification of patients will be included.</p>
<b>Prognostic test</b>	Level of glycated haemoglobin (HbA1c)
<b>Outcomes</b> (30 days post-surgery)	<p><b>Critical:</b></p> <ul style="list-style-type: none"> <li>All-cause mortality</li> </ul> <p><b>Important:</b></p> <ul style="list-style-type: none"> <li>Complications relating to surgery or anaesthesia</li> <li>Length of hospital stay (post-operation)</li> <li>Hospital re-admission</li> <li>Adverse events after surgery (wound infection)</li> <li>Health-related quality of life</li> </ul>

Component	Description
	<ul style="list-style-type: none"> <li>• ICU admission</li> </ul>
<b>Study design</b>	Ideally prospective cohorts but retrospective cohorts will be accepted
<b>Exclusions</b>	<p>Exclusion criteria:</p> <ul style="list-style-type: none"> <li>• Patients undergoing cardiac surgery (such as valve replacement and coronary artery graft)</li> <li>• Patients undergoing transplantation</li> <li>• Patients with diabetes</li> </ul>
<b>Key confounders</b>	<p><i>Minimum set of confounders that should be adjusted for (will vary per outcome)</i></p> <ul style="list-style-type: none"> <li>• Age</li> <li>• Comorbidities (cardiovascular, respiratory and renal diseases, obesity)</li> <li>• Patients taking drugs that cause a rapid rise in glucose (such as corticosteroids or antipsychotic drugs (<math>\leq 2</math> months). HbA<sub>1c</sub> can be used in patients taking these drugs longer term (<math>&gt; 2</math> months) who are not clinically unwell.</li> <li>• Ethnic groups (Asian)</li> <li>• Patients with acute pancreatic damage or who have undergone pancreatic surgery</li> <li>• Patients with renal failure</li> <li>• Patients with HIV infection</li> </ul>
<b>The review strategy</b>	<p>Stratified by:</p> <ul style="list-style-type: none"> <li>• Type of surgery</li> </ul>
<b>Notes</b>	We will consider studies that have compared random glucose test or HbA <sub>1c</sub> (first arm) versus urine analysis (second arm) by reporting results only for the first arm.

