Worcestershire NHS
Acute Hospitals NHS Trust

Guideline For Members Of The Diabetes Team And Dietetic Department For Advising On Insulin Dose Adjustment And Teaching The Skills Of Insulin Dose Adjustment To Adults With Type 1 Or Type 2 Diabetes Mellitus

This guidance does not override the individual responsibility of health professionals to make appropriate decision according to the circumstances of the individual patient in consultation with the patient and /or carer. Health care professionals must be prepared to justify any deviation from this guidance.

Introduction

Patients with diabetes who are treated with insulin are encouraged to self-manage their diabetes by making systematic changes to their insulin doses. Registered Dietitians (RD) and Diabetes Specialist Nurses (DSN) have a key role in educating patients how to make these adjustments safely.

These professionals also have a role in advising on appropriate dose adjustments in a clinic setting. This guideline is aimed at giving consistent advice to adults with type 1 or 2 diabetes mellitus in Worcestershire and to support RDs and DSNs when advising adult patients on insulin dose adjustment.

This guideline is for use by the following staff groups :

Senior Registered Dietitians (band 6 and above) with experience working with diabetes and Diabetes Specialist Nurses working within the diabetes team who do not hold independent and supplementary prescribing qualifications.

Lead Clinician(S)

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Emma Innes	Community Diabetes Specialist Team
Approved by Diabetes Directorate on:	18th March 2014
Approved by Medicines Safety Group on:	2nd November 2016
This is the most current document and is to be used until a revised version is available:	2nd November 2018

Key amendments to this guideline

Date	Amendment	By:
March 2014	New document	
August 2016	Updated with new insulins	Rosanne Dunkley

GUIDELINE FOR MEMBERS OF THE DIABETES TEAM AND DIETETIC DEPARTMENT FOR ADVISING ON INSULIN DOSE ADJUSTMENT AND TEACHING THE SKILLS OF INSULIN DOSE ADJUSTMENT TO ADULTS WITH TYPE 1 OR TYPE 2 DIABETES MELLITUS

Introduction

Patients with diabetes who are treated with insulin are encouraged to self-manage their diabetes by making systematic changes to their insulin doses. Registered Dietitians (RD) and Diabetes Specialist Nurses (DSN) have a key role in educating patients how to make these adjustments safely.

These professionals also have a role in advising on appropriate dose adjustments in a clinic setting. This guideline is aimed at giving consistent advice to adults with diabetes in Worcestershire and to support RDs and DSNs when advising adult patients on insulin dose adjustment. The guideline includes advising on insulin dose adjustment and teaching the patient self-management skills of insulin dose adjustment in an inpatient, outpatient or group education setting. The guideline covers patients with type 1 and type 2 diabetes mellitus. Dietitians would not be advising on specific dose adjustments for inpatients. Diabetes nurses may make recommendations to the prescriber but would not alter the inpatient prescriptions themselves. For all patients the GP, inpatient medical team, or DSN with independent prescribing qualifications would be responsible for prescribing the insulin.

Competencies Required

DSNs working within the diabetes team.
RDs band 6 and above with a recognised role and experience in the field of diabetes.

It is expected that the above staff will have understanding of;

- Normal glucose metabolism
- The time action profile of various types of insulin
- The effect of food and digestion on capillary blood glucose (capillary BG) levels of patients who require insulin.
- The action of oral hypoglycaemic agents and incretin mimetics on capillary BG.

They will also have skills in;

- Education to patients on carbohydrate counting and insulin dose adjustment
- Interpretation of capillary BG results within the context of the patients lifestyle
- Sharing knowledge of other aspects of diabetes care in regard to insulin (exercise, alcohol, site rotation, injection technique, needle length, device use).

Each practitioner is responsible for ensuring their knowledge and skills are kept up to date and training attended as relevant.

- The NPSA e-learning tool on the safer use of insulin must have been completed.
- Additional training will have been completed in insulin pump therapy before advising on insulin dose adjustment for people using an insulin pump.

The competency frameworks for dietitians and nursing staff produced by Diabetes UK in 2011 and 2015 should also be referred to (see references page 11).

Part 1 - Principles of the Guideline

This guideline applies to adult patients with type 1 or 2 diabetes mellitus requiring insulin excluding patients who are unable to interpret instructions and/or give the doses recommended.

- Dose changes are often expressed as 10-20%. This is for clinician guidance and should be expressed as a number of units when giving instructions to patients.
- To avoid insulin errors 'units' should always be written in full and not abbreviated to 'u'. Also a range should be written 1 to 2 units, not 1-2.

1. Description of treatment

- Each patient will be assessed individually and recommendations tailored according to their food preferences, lifestyle and physiological requirements. The role of this document is to provide staff with adequate structure to support their role in recommending insulin dose adjustments to patients with diabetes treated with insulin. It will enable the patient to be empowered to take control of their own diabetes when shown how to adjust doses to meals safely. The process will ensure patients are assessed and treated effectively and efficiently and that a high standard of care is maintained and delivered at all times.

- This guideline authorises a RD or DSN to make insulin dose recommendations to the patient in order to:
  - Match food boluses more closely to meals to resolve post-meal hyper and hypoglycaemia.
  - Improve diabetes control overall by adjusting basal and mixed insulin doses.
  - Minimise hypoglycaemia / risk of hypoglycaemia through food and eating, alcohol, exercise and insulin dose adjustment.

  Adjustment to insulin already prescribed to the patient and covered by this document will include:

	Human	**Analogue**
Mixtures	Humulin M3®, Insuman Comb 15/25/50®	Novomix 30®, Humalog Mix 25®, Humalog Mix 50®
Intermediate/ Long acting	Humulin I®, Insulatard®, Insuman Basal®	Lantus®, Levemir®, Tresiba®, Abasaglar®, Toujeo®
Quick acting	Actrapid®, Humulin S®, Insuman Rapid®	NovoRapid®, Humalog®, Apidra®

  Adjustments to insulin doses may include a range of dose suggestions for human/analogue insulin and background insulin depending on whether the goal of care is to minimise hypo/hyperglycaemia or improve diabetes control.
  - Dose recommendations are expected to be small for patients who are sensitive to insulin (i.e. 1 to2 units).
  - Dose recommendations are expected to be higher for patients, who are not sensitive to insulin, e.g. patients with Type 2 diabetes mellitus or who are overweight.

People with type 1 and type 2 diabetes mellitus have very differing needs in terms of education and insulin requirements. This needs to be taken into account when advising on insulin dose adjustment.

2. Blood Glucose monitoring

Blood glucose targets need to be individually tailored to the individual patient taking account of usual BG control, frequency and awareness of hypoglycaemia, presence of complications of diabetes etc. Rapid improvements in control should be avoided.

- NICE target for HbA1c 48mmol/l (Type 1 diabetes), 53mmol/mol (type 2 diabetes on insulin) (although this may be individualised and set higher for specific patients)
- Capillary BG targets- general 5-7mmol/l before meals
- It is often advisable to aim for slightly higher capillary BG readings before bed and the DAFNE capillary BG targets may be useful for some patients
    - Before breakfast 5.5-7.5 mmol/l
    - Before other meals 4.5-7.5 mmol/l
    - Before bed 6.5-8.0 mmol/l

Insulin dose adjustment should be based on trends in capillary BG not one off readings. Capillary BG meters are only accurate to within 15%.

3. Records

- Patients should receive written confirmation and express verbal agreement with advice recommended at the time of their appointment (Written confirmation is not possible with telephone consultations but patients should be asked to repeat back the advice to confirm understanding). A note of recommended doses in their monitoring diary or on their diet sheet is adequate.
- A summary of the clinic visit (including dose decisions) will be placed in the Trusts dietetic or DSN notes. If a DSN is advising for an inpatient they will also document in the Trust's main clinical notes.
- Dietitians advising on dose adjustment of basal or mixed insulin's will communicate the advice given to the referrer (patients DSN or GP within 48 hours). Adjustment of bolus ratios to be communicated if relevant.
- After attending X-PERT insulin or DAFNE a letter will be sent to the GP highlighting that patients may be self-adjusting doses.
- Patients will be encouraged to update and carry with them their insulin passport.

4. Clinical Supervision

1. It is the responsibility of the professionals covered by this policy to seek clinical supervision on an on-going basis and to discuss any specific patients who deviate from this guideline.
2. Clinical supervision should be obtained from the:
    - Consultant Diabetologist
    - Senior DSN and
    - Senior Specialist Diabetes Dietitian
3. Clinical supervision can occur at team meetings or on a 1:1 basis as required.

5. Inpatients

- Dietitians will not advise on insulin dose adjustments to be made during the inpatient period. They may educate an inpatient on self-management and dose adjustment following discharge.
- Diabetes nurses without prescribing qualifications will not alter inpatient prescriptions but may make recommendations to the prescriber.
- Any advice/ recommendations will be documented in the patients' medical notes.
- Any principles relating to Think Glucose will be adhered to/promoted.

Part 2 - Guidance For Diabetes Specialist Nurses And Registered Dietitians Adjusting Insulin Doses

The RD/ DSN should encourage patients to use a systematic approach to analysing their capillary BG. The following is the stepwise approach encouraged on the DAFNE course and it can be applied to other patients.

1. What is the problem?
    - Which capillary BGs are out of target?
2. What are the possible causes of the problem?
    - Exclude causes such as carbohydrate estimation, snacks, alcohol, exercise, overtreatment of hypoglycaemia
3. Wait 48 hours to look for patterns
    - Unless hypoglycaemic episodes occur overnight when a change should be made without waiting for a pattern
4. Which insulin(s) may be responsible?
    - Review the action profile of the insulin(s)
5. Adjust the responsible insulin as below
6. Review capillary BG over at least the next 48 hours to ensure that the insulin dose change was appropriate

Adjusting Meal Insulin Doses

The dose of insulin a patient gives for a meal should take into account a number of factors:

- What type of insulin regimen is used (BD, TDS or MDI and the effect of background/basal insulin at meal times).
- Insulin sensitivity.
- Pre meal capillary BG.
- Total amount of carbohydrate in the meal (i.e. 3 egg-sized potatoes = 30g CHO needs less insulin for meals than 100g of pasta = 70g CHO).
- Digestion (based on total carbohydrate and other meal factors such as fat, fibre, protein in slowing digestion).
- Secondary digestive disorders (gastroparesis, enteral feeding, coeliac disease)
- Exercise – pre or post meal.
- Alcohol.
- Injection technique and timing of dose (overuse of sites leads to unpredictable absorption of insulin dose).
- Likelihood of pre-meal capillary BG being affected by hypoglycaemia or rebound hyperglycaemia.

Basal bolus regimen/ multiple daily injections (MDI)

Adjusting quick acting insulin (NovoRapid®, Humalog®, Apidra®, Actrapid®, Humulin S®, Insuman Rapid®)

- Usually with type 1 diabetes mellitus 1 unit of quick acting insulin for every 10g carbohydrate is a good starting place. People with type 2 diabetes mellitus often require more insulin and an accurate insulin to carbohydrate ratio may not be able to be established. Carbohydrate awareness may be more appropriate than carbohydrate counting for many people with type 2 diabetes mellitus.
- Review food diary/ assess carbohydrate intake and capillary BG to confirm whether insulin doses need adjustment.

- Dose adjustments should be based on trends in capillary BG results and not one off readings.
- If capillary BG is high before lunch increase breakfast insulin. If capillary BG is high before evening meal increase lunch insulin and if capillary BG is high before bed increase evening meal insulin.
- If capillary BG is low before lunch reduce breakfast insulin. If capillary BG is low before evening meals reduce lunch insulin and if capillary BG is low before bed reduce evening meal insulin.
- Different insulin to carbohydrate ratios may exist across the day. It is typical to need more insulin at breakfast time due to the dawn phenomenon.
- Increase or decrease quick acting insulin by 0.5 units to 10g carbohydrate (or 2-5g carbohydrate per unit of insulin) for one mealtime only initially.
- An 'average' person with type 1 diabetes mellitus will require 1 unit of quick acting insulin for 10g carbohydrate and 24 units of background insulin. Roughly half the insulin dose tends to be quick acting and half basal depending on carbohydrate intake.

Giving additional 'correction doses' (type 1 diabetes mellitus)

- Additional quick acting insulin may be given at mealtimes to correct for high blood glucose.
- Initially assume 1 unit of quick acting insulin will reduce blood glucose by 2-3mmol/l and monitor the effects.
- Initially give a maximum of 4 units as a correction whilst specific sensitivity is established.
- 'Corrections' should not be given between meals or closer than 3-4 hours apart unless sick day rules advice is being followed.
- If corrections are regularly required then insulin to carbohydrate ratio may need to be recalculated.
- Corrections may be given safely at bedtime provided
    - Background insulin doses are correct (capillary BG stable between bedtime and pre breakfast)
    - In the absence of alcohol and exercise
    - Bedtime is at least 3-4 hours after the evening meal/previous dose of quick acting insulin
    - The patient understands their insulin action
- Corrections pre bed should be recommended with great caution in patients on steroid therapy, impaired renal function, and over the age of 70 as capillary BG levels tend to fall rapidly overnight in these groups of patients.
- A similar approach to the above can be used with caution in type 2 diabetes mellitus. Larger insulin doses may be required.

Adjusting Basal / Background Insulin

(Lantus®, Levemir®, Tresiba®, Humulin I®, Insulatard®, Insuman Basal®, Abasaglar®, Toujeo®)

If background insulin dose is correct then fasting capillary BG levels will be similar to pre bed capillary BG (within 1-2mmol/l)

Hyperglycaemia: If the trend is for capillary BG to increase overnight, basal insulin may need to be increased by 10-20%. This increased dose should be maintained for 3 days before further dose increases (of 10-20%). With Tresiba® it is more appropriate to wait for 5 days before further increasing the dose. This applies in the absence of ketones or need for sick day rules. In the presence of ketones, dose increases may be suggested as per WHAT-

END-001 'Guideline for the Treatment of Diabetic Ketoacidosis'. With type 2 diabetes on larger doses of insulin it may be advisable to increase doses in increments less than 10% of the usual dose.

- If on once daily basal insulin taken in the morning consider whether the insulin may not be lasting 24hours. In which case an increase in dose will not be appropriate. Consider a change to BD basal insulin or moving the time of the basal insulin to later in the day. If changing the time the usual dose is omitted and then given at the new later time. Any hyperglycaemia can be managed with corrections of quick acting insulin as above.
- A 3am capillary BG test should be advised to rule out the possibility of night time hypoglycaemia before an increase in background insulin is made.

If **hypoglycaemia** is verbally described or recorded in a capillary BG diary (nocturnal or dawn hypoglycaemia) basal insulin should be reduced by 20%. If the trend is for capillary BG pre breakfast to be more than 1 or 2 mmol/l lower than prebed, or if bedtime snacks are regularly required then basal insulin should be reduced by 10-20%.

- Typically a person with type 1 diabetes mellitus with a healthy BMI will require around 24 units of background insulin. People with type 2 diabetes mellitus may require substantially more.
- If people have to snack to prevent hypoglycaemia, insulin doses need to be reduced.
- When background insulin doses are reduced quick acting insulin may need to increase- often in line with more accurate carbohydrate counting.

Once daily insulin regimens

(Lantus®, Levemir®, Tresiba®, Humulin I®, Insulatard®, Insuman Basal®, Abasaglar®, Toujeo®)

Adjusting insulin for patients with type 2 diabetes mellitus on basal insulin only

Intermediate or long acting basal insulin is normally given at night to combat insulin resistance.

- If fasting hyperglycaemia, increase dose by a maximum of 10% every 3 days until waking capillary BG is 6-8 mmol/l. With Tresiba® increase the dose a maximum of every 5 days. The dose would generally be increased in 2, 4 or 6 unit increments dependent on the existing doses and improvement in BG required. For example for a 2-3 mmol/l improvement increase dose by 5% initially and for greater than a 5 mmol/l improvement increase dose by 10%. If nocturnal or waking hypoglycaemia review capillary BG levels during the day. If low in the day reduce insulin dose by 20%. If elevated during the day move time of injection to waking. (Omit night time dose on day 1 and give in the morning on day 2 and so on).

Mixed insulin regimens

(Novomix 30®, Humalog Mix 25®, Humalog Mix 50®, Humulin M3®, Insuman Comb 15/25/50®

- Relevant doses should be increased by 10% if hyperglycaemic or reduced by 20% in the case of hypoglycaemia. The dose would generally be increased in 2, 4 or 6 unit increments dependent on the existing doses and improvement in BG required. For example for a 2-3 mmol/l improvement increase dose by 5% initially and for greater than a 5 mmol/l improvement increase dose by 10%. Clinical judgement and experience to be used.
- If capillary BG is high at lunchtime or evening meal increase the morning insulin. If capillary BG is high at bedtime or breakfast increase the evening insulin. If capillary

BG is low at lunchtime or evening meal decrease the morning insulin. If capillary BG is low at bedtime or breakfast decrease the evening insulin

- Adjustment of any dose of mixed insulin will affect capillary BG levels for the next 12 hours following that dose therefore capillary BG levels for the whole of this period need to be considered before any adjustment is made.

More concentrated insulins

Standard insulin strength in the UK is U100 (100 units per ml). An increasing range of insulins are available in a more concentrated form. For example Humalog® is available as U100 and U200, Tresiba® as U100 and U200. Toujeo® is a U300 insulin.
These insulins are often used when large doses are required and poor absorption is suspected. It is therefore important to be cautious when increasing doses when someone has recently changed to one of these insulins.

Dose Adjustment for Exercise

If exercising within 90 minutes after quick acting insulin it is possible to reduce insulin dose before exercise by up to 30-50%. If exercising immediately before a meal the dose at this meal could be reduced by up to 30%. Background (or basal) insulin could also be reduced by 10-20% if on BD levemir (or CSII) to avoid delayed or night time hypoglycaemia.
See leaflet 'Exercise and diabetes- a guide for people with type 1 diabetes mellitus'.

Dose Adjustment for sick day rules

Additional quick acting insulin may be required during illness especially with type 1 diabetes mellitus when ketones are present. See WHAT-END-001 'Guideline for the Treatment of Diabetic Ketoacidosis'.

Management of hypoglycaemia

See WAHT-END-004 'Guideline for the Management of Hypoglycaemia'.

Initiation of insulin

See WAHT-END-006 and CP-END-001 'Care Pathway for the Management of the Initiation of Insulin'.

Insulin dose adjustments for patients on continuous subcutaneous insulin infusion (CSII):

Further training in insulin pump therapy is required before advising on dose adjustment for patients on CSII.

Adjusting Basal Rates

- If hypoglycaemia is occurring and it appears to be due to the basal rates (e.g. occurring overnight or just before mealtimes) the basal rate should be reduced by 20% in the time block commencing 90-120 minutes before the problem arises.

- With hyperglycaemia RDs would not normally increase basal rates. DSNs would increase basal rates by 10% from 90-120 minutes before the period of raised capillary BG.

Adjusting Bolus Rates

The following test should be done to verify if the insulin: carbohydrate ratio is correct.
NOTE: this test should not be done on a day that the patient feels un well, stressed or more exercise than usual is planned.

1. Test capillary BG pre-meal. An insulin bolus should not be given during the previous 4 hours before this meal

2. Ensure the carbohydrate (CHO) value in the meal is correctly counted. Less than 50g CHO or 6 units of insulin should be taken so that a normal bolus can be used during this test.
3. Use the usual insulin to carbohydrate ratio to calculate insulin bolus.
4. Check capillary BG at 2 and 4 hours post meal.
5. The 2 hour post meal capillary BG should be no more than 3 mmol/l higher than the pre-meal value and at 4 hours should be no more than 2 mmol/l different from the pre-meal value.
6. If the capillary BG is out of target, review the insulin to carbohydrate ratio.
7. The CHO per 1 unit of insulin is increased or decreased by 1 or 2 grams, depending on change in capillary BG pre- to 4 hour post meal.
8. If at any stage during the test the capillary BG drops below 4 mmol/l, stop the test and treat the hypoglycaemic episode.
9. Repeat the test to confirm the result

Part 3 - Educating Patients To Self-Manage Their Diabetes

RDS and DSNs have a key role in educating and supporting patients to self-manage their diabetes and make adjustments to their insulin doses in groups and 1:1 settings.

Diabetes Structured Education programmes are evidence based programmes where the educators have undergone specific training and on-going assessment. Patients may be encouraged to adjust their insulin doses and changes may be made to their insulin regimens. Patients should be encouraged to carry their insulin passport with them.

DAFNE
This is an evidence based approach for people with type 1 diabetes mellitus on a basal bolus insulin regimen or CSII, designed to promote autonomy and self-care of diabetes, the principles of which are to adjust insulin doses dependent on the chosen carbohydrate intake. Patients attend a 5 day course and receive on-going support from DAFNE educators.
DAFNE educators (Diabetes Specialist Dietitians and DSNs) receive competency based training and on-going assessment in the form of both internal and external peer review.

X-PERT INSULIN
As with DAFNE this is a nationally accredited diabetes structured education programme with recognised training and quality assurance of educators.
Over the duration of the 6 week course patients may be advised to and/or learn how to adjust their insulin doses. These changes would normally be in line with the guidance in this document.

NICE guidance states that patients should have the opportunity to attend Diabetes Structured Education. The RD or DSN should refer appropriate patients to these programmes.

Monitoring Tool

This guideline will be followed for all patients unless clinical judgement suggests this is inappropriate. When the guideline is deviated from the practitioner will advise the band 7 DSN or patients GP of the dose adjustment recommendations advised within 48 hours.

How will monitoring be carried out?
PDR, clinical supervision, review of patient notes.

Who will monitor compliance with the guideline?

The diabetes team and the dietetic department.

STANDARDS	%	CLINICAL EXCEPTIONS
Insulin dose adjusted according to the guideline	90	More drastic changes indicated in extreme hypo/hyperglycaemia. Regular follow up given and liaison with senior DSN.
Patents educated to self-manage insulin dose adjustment according to the guideline	100	

References

- The DAFNE Collaborative (2014). DAFNE- Curriculum for people with Type 1 Diabetes
- The DAFNE Collaborative (2014). DAFNE Pump Curriculum for people with Type 1 Diabetes
- An integrated career and competency framework for Diabetes Nursing produced by the Diabetes UK professional education working group and TREND . 4th Edition 2015.
- An integrated career and competency framework for Dietitians and frontline staff produced by the Diabetes UK professional education working group in 2011.
- NICE guideline (NG28) Type 2 diabetes in adults: management. Dec 2015
- NICE guideline (NG17) Type 1 diabetes in adults: diagnosis and management. August 2015

Contribution List

Key individuals involved in developing the document

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Circulated to the following CD's/Heads of dept for comments from their directorates / departments

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Circulated to the chair of the following committee's / groups for comments

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Supporting Document 1 - Equality Impact Assessment Tool

To be completed by the key document author and attached to key document when submitted to the appropriate committee for consideration and approval.

		Yes/No	Comments
1.	**Does the policy/guidance affect one group less or more favourably than another on the basis of:**		
	• Race	No	
	• Ethnic origins (including gypsies and travellers)	No	
	• Nationality	No	
	• Gender	No	
	• Culture	No	
	• Religion or belief	No	
	• Sexual orientation including lesbian, gay and bisexual people	No	
	• Age	No	
2.	**Is there any evidence that some groups are affected differently?**	No	
3.	**If you have identified potential discrimination, are any exceptions valid, legal and/or justifiable?**	n/a	
4.	**Is the impact of the policy/guidance likely to be negative?**	No	
5.	**If so can the impact be avoided?**	n/a	
6.	**What alternatives are there to achieving the policy/guidance without the impact?**	n/a	
7.	**Can we reduce the impact by taking different action?**	n/a	

If you have identified a potential discriminatory impact of this key document, please refer it to Human Resources, together with any suggestions as to the action required to avoid/reduce this impact.

For advice in respect of answering the above questions, please contact Human Resources.

Supporting Document 2 – Financial Impact Assessment

To be completed by the key document author and attached to key document when submitted to the appropriate committee for consideration and approval.

	Title of document:	Yes/No
1.	Does the implementation of this document require any additional Capital resources	No
2.	Does the implementation of this document require additional revenue	No
3.	Does the implementation of this document require additional manpower	No
4.	Does the implementation of this document release any manpower costs through a change in practice	No
5.	Are there additional staff training costs associated with implementing this document which cannot be delivered through current training programmes or allocated training times for staff	No
	Other comments:	

If the response to any of the above is yes, please complete a business case and which is signed by your Finance Manager and Directorate Manager for consideration by the Accountable Director before progressing to the relevant committee for approval