Insulin Use in Primary Care: Moving Forward

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Independent Lecturer Practitioner: Diabetes
www.betapresentations.com
High quality, evidenced based in-house diabetes training aimed at improving clinical outcomes

Evidenced based management of Type 2 diabetes

Psychological issues and health beliefs

Insulin management in Type 2 diabetes

Effective clinic skill mix and patient follow up

Patient Notes Review – team case analysis

Costs may be largely offset by pharmaceutical sponsorship – please discuss

Phone: 01430 860 973 or email: paul@betapresentations.com
Aim of this morning

• To give an overview of current insulin therapy

• To provide some insights into supporting and advising those ALREADY on insulin treatment

• To be able to interpret (and support patient in interpreting) blood glucose readings

• To increase confidence in insulin dose adjustment
Insulin in Type 2 Diabetes

• 25-30% of people with T2DM will require insulin therapy
  
  Mayfield, 2004 American Family Physician Aug.

• Insulin resistance and beta cell dysfunction mean that T2DM is progressive.

• Around 50% of beta cell output is lost by time of diagnosis of T2DM.

• Mean duration from diagnosis to insulin is 7 years (although large range).

• Increasingly insulin management in T2DM is the remit of primary care.

• Principle of once or twice daily insulin treatment is straight-forward although there are some important principles to follow.
Normal insulin secretion

Instant insulin release followed by insulin pulse followed by ‘maintenance dose’

In the stimulated phase, serum insulin levels increase with seconds of ingestion and return to basal level within 2 hours
Insulin action

Soluble insulin:
Human Actrapid / Humulin S

Rapid acting analogue insulin:
NovoRapid / Humalog / Apidra

Intermediate acting (isophane) insulin:
Insulatard / Humulin I
Insulin action

Long acting analogue insulin: Glargine or Levemir:

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Replacing insulin secretion

Conventional twice daily mix:
Human Mixtard 30 or Humulin M3
Replacing insulin secretion

Twice daily analogue mix:
Novomix 30 or Humalog Mix 25

Serum insulin concentration (microunits/ml)

0 40 80

06.00

30% 70%

30% 70%
Replacing insulin secretion

For high dose, very insulin resistant patients (*much less commonly*) three times daily analogue mix:
Novomix 30 or Humalog Mix 25
Long acting only insulin regimes – Glargine or Levemir
Insulin choices - Summary

• Loads of insulin types – but in Type 2 Diabetes – 3 main choices:
• 30/70 soluble mix, given 20-30 minutes before eating.
• 30/70 analogue mix, given immediately before (or after) eating.
• Once daily Glargine or Levemir – but this may not effectively manage prandial blood glucose excursions.
Matching name and group
Match insulin type with group

- 1/ Human Mixtard 30
- 2/ NovoMix 30
- 3/ Levemir
- 4/ Actrapid or Humulin S
- 5/ Hypurin Porcine neutral
- 6/ Humalog Mix 25
- 7/ Humulin M3
- 8/ Glargine
- 9/ Insulatard

- A/ Short acting (soluble) insulin
- B/ Short acting / Isophane mix
- C/ Analogue mix
- D/ Long-acting isophane
- E/ Long-acting analogue
- F/ Short acting animal insulin
Answers to: Match insulin type with group

• 1/ Human Mixtard 30 (B)
• 2/ NovoMix 30 (C)
• 3/ Levemir (E)
• 4/ Actrapid or Humulin S (A)
• 5/ Hypurin Porcine neutral (F)
• 6/ Humalog Mix 25 (C)
• 7/ Humulin M3 (B)
• 8/ Glargine (E)
• 9/ Insulatard (D)

• A/ Short acting (soluble) insulin
• B/ Short acting / Isophane mix
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• F/ Short acting animal insulin
Match insulin type with (most common) use

1/ Human Mixtard 30
2/ NovoMix 30
3/ Levemir
4/ Actrapid or Humulin S
5/ Hypurin Porcine neutral
6/ Humalog Mix 25
7/ Humulin M3
8/ Glargine
9/ Insulatard

A/ As part of multiple injection therapy
B/ Twice a day (older regime)
C/ Twice a day (more recent regime)
D/ Once or twice daily (older regime)
E/ Once daily (more recent regime)
F/ Twice daily mixed with long-acting (much older regime)
Answers to: Match insulin type with (most common) use

1/ Human Mixtard 30 (B)
2/ NovoMix 30 (C)
3/ Levemir (A or less commonly E)
4/ Actrapid or Humulin S (A or F)
5/ Hypurin Porcine neutral (A or F)
6/ Humalog Mix 25 (C)
7/ Humulin M3 (B)
8/ Glargine (A or E)
9/ Insulatard (A or D)

A/ As part of multiple injection therapy
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Insulin adjustment principles
David – 54. T2DM for 6 years

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Started on b.d. NovoMix 30. 16 // 10 units, 6 weeks ago. What guidance can you give him on adjusting his own insulin doses.
David - Summary

- New to insulin – looks like he steadily needs to increase insulin doses.
- Ideally should be starting to adjust his own insulin now.
- Blood sugars generally ‘high’ - needs to increase both insulin doses by 2 units or 10%. 2 units on a weekly or twice weekly basis if often regarded as easier by patients.
- On gardening or other sustained physically active days needs to reduce morning insulin dose by possibly 25% or eat more or if very active, possibly both. He will know if this works by his home blood tests.
- If overweight may be better to reduce morning insulin or at least to think of eating more as mid-morning and mid-afternoon fruit.
Jane – 66. T1DM for 48 years

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On twice daily Human Mixtard 30. 34 units a.m. 26 units p.m. HbA_1c 8.6%. Pre-proliferative retinopathy. Problem with night-time hypoglycaemia occasionally requiring paramedics. Lives with partner.
Jane - Summary

- Night-time hypo’s really on quite a regular basis.
- Night hypo’s can tend to pre-dispose to further night-hypo’s.
- Can be scary for patient and partner although rarely cause actual harm.
- Encourage pre-bed snack if not already take and reduce evening insulin by 20%.
- She may need to slowly re-increase evening insulin dose according to blood glucose levels.
- May be better on a shorter analogue mix such as NovoMix 30 or Humalog Mix 25.
- Husband should be trained in GlucoGel and Glucagon use, latter if willing.
- Seek specialist advice if do not resolve.
Basic twice daily insulin regimes

Human Mixtard 30 or Humulin M3
More recent twice daily insulin regimes

NovoMix 30 or Humalog Mix 25
### Steve – 31. T1DM. Builder

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On twice daily Humulin M3 42 // 34. HbA<sub>1c</sub>’s generally run between 9 and 10%. Wants to try and take charge of his diabetes. Finds present insulin inflexible.
Steve - Summary

- Seems keen to take control of his diabetes.
- Discuss possible benefits of switching to a 4 or 5 a day multiple injection therapy (MIT) regime, also termed Basal Bolus.
- This will give him much more flexibility to vary timing of his meal-time injections and vary his doses according to his activity.
- Clearly he will need to blood glucose monitor frequently and become adept at adjusting his own insulin.
- If his background (basal) insulin is split between morning and evening, this will also give him the flexibility to alter the morning doses of long-acting basal according to how busy he believes he is going to be during the day.
Steve - Summary

• This is a fairly complex transition and needs expert guidance so for most health professional in general practice it will be a case of having the discuss in surgery as to the dramatically increased flexibility he will gain from an MIT regime and then referring on to secondary care diabetes service.

• Nevertheless there is no reason why this initial conversion can not happen in GP practice.
MIT
With rapid and long-acting analogues

Glargine or Levemir with Humalog, NovoRapid or Apidra
MIT
Only as flexible as you make it
Carl – 40. T1DM for 27 years

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NovoMix 30 26 units a.m. 22 units p.m.
Carl - Summary

• Could be many reasons for his erratic blood glucose control but he has a steady job and predictable lifestyle so it is fairly unusual to experience such erratic blood glucose readings.
• Could be alcohol or activity related but he has had his diabetes for 27 years so you must exclude over-used injection sites.
• The clue for this is often erratic pre-breakfast readings. These if anything usually the most stable of the day.
• Check injection sites. If overused he must be advised on alternate sites and advised to make dramatic reduction of insulin due to much better absorption of insulin from new sites if existing sites very over-used.
• Needs to blood glucose monitor very closely over next few days, be prepared for hypo’s and adjust insulin doses according to pattern of glucose after switch to new sites.
• If not happy to offer this advice, advise to continue with present insulin and present sites but phone for guidance from specialist diabetes service and / or urgent appointment to given him guidance
Lipohypertrophy

Insulin injection poorly absorbed in dense fatty ‘lipo’. Insulin much more quickly and effectively absorbed from surrounding are or other non-lipo sites.

Significant 30-50% reduction of insulin doses for new injection sites regardless of HbA$_{1c}$
Sara – 24. T1DM

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On MIT of Glargine and NovoRapid. Wants to start a family. HbA1c 8.4%. Struggling to tighten her diabetes control – very worried about her test results.
Sarah - Summary

- Erratic blood glucose levels.
- Again could be many reasons but I suspect the reasons might be in ‘struggling to tighten her diabetes control – very worried about high tests’
- I suspect she is over-reacting to high and low blood tests she is experiencing and as a consequence, for example in correcting a low blood glucose level of 4.1 mmols/l on the 28th she overcompensated by over-eating or excessive reduction of her insulin and consequently was later too high at 15.3 mmols/l.
- Needs some close support to reduce over-compensation (also known as ‘fire-fighting’) and possibly to reduce the number of insulin correction doses she is making to gain a better underlying picture.
- Also need to double check injection sites.
- If encountering Sarah in general practice, you would be as well to send her to a specialist centre partly as she is also planning pregnancy.
- Usual pre-conceptual advice including high strength folic acid pre-conceptually and to use reliable contraception until tight HbA1c achieved.
James (74) – T2DM on bd Mixtard 30

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Feels unwell – thinks it might be his diabetes. Recent nocturia x3-4
Doses: 46 units a.m. 14 units p.m.
James - Summary

- Simply not enough information to go on.
- Main message here was, however often patients choose to test their blood glucose levels, clearly if they sense something is wrong, increasing blood glucose monitoring to perhaps 3 or 4 times daily for a few days and importantly adding in comments as to any symptoms, changes in lifestyle, worries etc can be invaluable in ruling diabetes on or out as possible causes.
Vera – 68.

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</table>

On twice daily Human M3.
Recently started Prednisolone for PMR. Plan to remain on this for several weeks. Feels unwell.
Vera - Summary

- Recently started on Prednisolone and this appears to have a dramatic effect on her blood glucose levels.
- Typically, if steroids are taken in the morning, as is usual practice,. Blood glucose levels tend to dramatically increase during the day, settling down again by the following morning.
- Easiest option is to keep on increasing her morning dose of insulin every 2 – 3 days to start to pin down rising blood glucose levels later in the day.
- Remember you are not aiming for perfect glucose control, but to pin down blood glucose to possibly under 12 or 14 mmols/l.
- She MAY need a more aggressive 50 / 50% mix of insulin in the morning if above advice does not work but in this case, seek specialist advice.
- MUST reduce insulin doses steadily as steroids treatment is reduced.
- She needs to glucose monitor closely and will, need close (probably over the ‘phone) support regarding insulin doses.
# Tom – T2DM – 64 years

<table>
<thead>
<tr>
<th>Date</th>
<th>Before breakfast</th>
<th>2 hours after b’fast</th>
<th>Before lunch</th>
<th>2 hours after lunch</th>
<th>Before eve meal</th>
<th>2 hours after eve meal</th>
<th>Before bed</th>
<th>Comment</th>
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<tbody>
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<td>Thurs 13th</td>
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</table>

Commenced o.d. Glargine 2 years ago. HbA1c then 7.6% now 8.9%. Currently on 34 units pre-bed. Also on Metformin 1 gr b.d. and Gliclazide 160mg b.d.
Tom - Summary

• Glargine, which perhaps had been working well does not now appear to be controlling blood glucose levels later in the day.
• Could look at lifestyle, whether his diet has slipped on activity reduced but it is more likely to be an effect of steadily deteriorating beta cell function and subsequent rising blood glucose values.
• You could add in rapid acting insulin to prevent meal time rises of blood glucose but it may be preferable to convert him to a twice daily mixture of insulin.
• So, his present 34 units once daily of long acting Glargine might be converted to a 30% / 70% (M3, Mixtard 30 or NovoMix 30) insulin or 25% / 75% (Humalog Mix 25) insulin.
• Doses would be a split of his current 34 units but with a slightly higher dose I the morning:
• 20 units a.m., 14 units p.m.
Carol 2 years – T1DM

MIT – once daily pre-bed Levemir and NovoRapid

<table>
<thead>
<tr>
<th>Date</th>
<th>Before breakfast</th>
<th>2 hours after b’fast</th>
<th>Before lunch</th>
<th>2 hours after lunch</th>
<th>Before eve meal</th>
<th>2 hours after eve meal</th>
<th>Before bed</th>
<th>Comment</th>
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<td>7.6</td>
<td>Hypo</td>
<td>3.6</td>
<td>Late</td>
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<td>2.7</td>
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<td>8.9</td>
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<td>Day off</td>
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<td></td>
<td>Nights</td>
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</table>

Care Assistant. Works shifts. Overall diabetes control recently been good (HbA₁c 7.2%) but troubled by frequent hypoglycaemia. Advanced microvascular complications.
Insulin Pump Therapy
Type 1 diabetes. Strict NICE criteria. Motivated patient. Education++
Carol - Summary

- She is already on an MIT (Multiple Injection Therapy) regime with analogues insulin.
- Her shift patterns would appear to be making things difficult for her indeed 3 shift patterns can be very difficult to cope with.
- Needs specialist diabetes input and education to check she is adjusting her insulin along the right lines.
- May be appropriate for her to discuss with Occupational Health regarding reducing her 3 shift pattern.
- May well benefit from discussion from specialist centre regarding possibility of insulin pump therapy – CSSI (Continuous Subcutaneous Insulin Infusion) and she would appear to meet NICE (National Institute for Clinical Excellence) criteria for this although funding of insulin pumps varies widely across the United Kingdom.
Educational Issues
Injection sites

- Generally now legs and abdomen only
- Most chaps struggle to use legs – lack of subcut fat.
- But – rotate well within sites.
Driving and hypoglycaemia

Progressive hypoglycemia’s impact on driving simulation performance. Occurrence, awareness, and correction

<table>
<thead>
<tr>
<th>Variable</th>
<th>Blood glucose level (mmol/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.0 - 3.4</td>
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<tr>
<td>Composite driving impairment score</td>
<td>0.83a</td>
</tr>
<tr>
<td>Subjects who detected hypoglycaemia (%)</td>
<td>15</td>
</tr>
<tr>
<td>Subjects who took corrective action (%)</td>
<td>5</td>
</tr>
</tbody>
</table>

\[ a \quad p<0.01 \]
\[ b \quad p<0.005 \]

Diabetes Care 2000; 23(2): 163–70.
Driving and hypo risk

• DUK guidance on hypo avoidance for those on insulin and OHA’s (*Diabetes UK, 2004*):
  • Never driving for more than two hours without stopping for snack.
  • Don’t delay or miss meal or snack
  • Check blood glucose before and during a journey.
  • Hypoglycaemia rate: 1.23 per 100 person-years for sulphonylureas and 2.76 among insulin users. (*Shorr et al, 1997*)

Danger is usually not collapse but unawareness of danger!
The diabetes balancing act

Fears for now
- Disabling hypoglycaemia
- Living a ‘normal’ life

Fears for the future
- Diabetes complications
- ‘Complying’ to a treatment regimen