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Competing interests

None declared.

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Diagnosis of gestational diabetes during the pandemic: what is the risk of falling through the net?

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The latest Royal College of Obstetricians and Gynaecologists guidance for diagnosis of gestational diabetes mellitus (GDM) recommends avoiding the 'gold standard' 2-h oral glucose tolerance test (OGTT) for the duration of the COVID-19 pandemic [1]. To avoid prolonged waiting in large groups the suggested alternative diagnostic pathway involves four simpler tests, in women at greater risk of developing GDM according to the National Institute for Health and Care Excellence (NICE) checklist. Random glucose and HbA_{1c} tests are stipulated at booking, followed by HbA_{1c} and fasting glucose testing (or random glucose if a fasting sample is not feasible) at 24–28 weeks, with an elevation of any of these test results constituting a positive diagnosis. The broader range of tests could cause overdiagnosis (false-positives), but of greater concern is the danger of underdiagnosis (false-negatives) due to incomplete OGTTs, potentially leaving a considerable number of women untreated. This led us to use Bayesian modelling in generating an estimate of the number of women at risk of 'falling through the net' in a typical UK maternity unit.

Under the circumstances of an incomplete OGTT the relevant clinical question is, 'What is the likelihood of a woman not having GDM if the isolated fasting result is normal?'. The answer lies in the negative predictive value of the test, which is the numerical probability of a woman not having the disease, given that the test result is negative. Negative predictive values are useful when considering the value of a test to a clinician, but are dependent on the prevalence of the disease in the population of interest. Conversely, negative likelihood ratios give the change in the odds of a woman having GDM if the test is negative and are not influenced by prevalence, thereby offering greater adaptability [2].

The dataset used was obtained from our retrospective review of 75-g antenatal OGTT results (fasting, 1-h and 2-h glucose levels) of 3805 women, all completed at 24–28 weeks

Table 1 Sensitivity, specificity and negative likelihood ratio of fasting glucose thresholds according to different diagnostic criteria for gestational diabetes.

	Sensitivity, %	Specificity, %	Negative likelihood ratio
OGTT diagnostic threshold			
WHO 2013 (fasting: 5.1 mmol/l, 1-h: 10.0 mmol/l, 2-h: 8.5 mmol/l)	63.8	100	0.362
NICE 2015 (fasting: 5.6 mmol/l, 2-h: 7.8 mmol/l)	35.9	100	0.64
WHO 1999 (fasting: 6.0 mmol/l; 2-h: 7.8 mmol/l)	21.5	100	0.785
WHO 1999/2013 hybrid (fasting: 6.0 mmol/l; 1-h: 10.0 mmol/l; 2-h: 7.8 mmol/l)	14.9	100	0.851

Negative likelihood ratio = $\frac{100 - \text{sensitivity}}{\text{specificity}}$

Total number of complete OGTT results at 24–28 weeks gestation = 3805.

between 1 January 2009 and 31 December 2013 when 15 029 women delivered in our unit [3]. The project was part of an approved service evaluation, designed to assess the impact of new OGTT thresholds (WHO 2013 and NICE 2015) on future workload. Our fresh analysis has revealed that 694 of the 3805 OGTTs were abnormal based on WHO 2013 diagnostic thresholds [4], constituting a prevalence of 18.2% in women with risk factors for developing GDM, and equating to a pre-test probability of 0.182. This was associated with a negative likelihood ratio of 0.362 (negative predictive value 92.6%) for an isolated normal fasting glucose result <5.1 mmol/l (Table 1). Applying the NICE 2015 thresholds [5] made 460 of the 3805 OGTTs abnormal, constituting an alternative prevalence of 12.1%. This in turn was linked to a negative likelihood ratio of 0.64 (negative predictive value 91.9%) for an isolated normal fasting glucose result <5.6 mmol/l (Table 1).

The Bayesian modelling steps were as follows:

1. Convert pre-test probability of GDM to pre-test odds:

$$= \text{pre-test probability}/1 - \text{pre-test probability}$$
$$= 0.182/1 - 0.182$$
$$= 0.22$$

2. Generate post-test odds following normal fasting glucose at 24–28 weeks:

$$= \text{pre-test odds} \times \text{negative likelihood ratio}$$
$$= 0.22 \times 0.362$$
$$= 0.080$$

3. Convert post-test odds back to probability:

$$= \text{post-test odds}/1 + \text{post-test odds}$$
$$= 0.080/1 + 0.080$$
$$= 0.074$$

The implication for our local population is that, after a normal fasting glucose result, the probability of underlying GDM drops to 0.074, indicating that 7.4% of women who would otherwise have tested as positive will be deemed negative. Applying our NICE 2015 data to the same formula generates a post-test probability of 0.081 (8.1%). Further extrapolations are based on our average monthly number of 42 WHO 2013-based positive OGTT results between January and March 2020, a predicted failed detection rate of 7.4% and an assumed duration of 6 months. This amounts to approximately three women per month (18 women over 6 months) 'falling through the net'.

The story does not end here, however, because the new pathway also includes a random glucose and two HbA_{1c} tests which should improve negative predictive validity. A literature search identified negative likelihood ratios of 0.59 for random glucose <8.5 mmol/l at booking [6], 0.825 for HbA_{1c} <41 mmol/mol (5.9%) at booking [7] and 0.903 for HbA_{1c} <39 mmol/mol (5.7%) at 24–28 weeks [8], in relation to positive WHO 2013 OGTT results. This suggests that negative results of all three additional tests could potentially reduce the probability of underlying GDM by a further 15% (slight reduction). Reassuringly, these were also high specificity tests (range 97–99.5%), offering low false-positive (overdiagnosis) rates of no more than 3% [6–8].

In conclusion, such small numbers do not raise great concern and the timing of this predicted period of underdiagnosis fortuitously counteracts the reported tendency to overdiagnose GDM during the hotter months [9]. For these reasons we have implemented the new guidelines and encourage other UK units to do the same.

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