Appendix

Business rules for clinical indicators

Data relating to the Quality and Outcomes Framework is automatically drawn from practices' clinical computing systems and collated in a central database (QMAS). In order to determine the number of patients for whom each target has been achieved, the computing systems follow a unique algorithm for each quality indicator. The example of indicator BLOOD PRESSURE 4 (patients with hypertension with a record of blood pressure) is given in **figure A1**. At year end, individual patients with the relevant condition – in this case hypertension – are assigned to one of three categories (as denoted by the grey boxes in **figure A1**): i) exception reported; ii) target missed; or iii) target achieved.

The first assignment step in every algorithm is whether the target was achieved (in this case whether blood pressure was measured in the last nine months). If the target was achieved the patient is assigned directly to both the denominator (the indicator is deemed appropriate for the patient) and the numerator (the target was achieved), and the exception reporting rules are bypassed. If the target was not achieved, the patient passes through a series of assignment steps to determine if one of the exception reporting criteria was satisfied. If any relevant exception code is attached to the patient record then the patient is counted as having been exception reported for the first reason encountered in the algorithm [1]. If no exception code is attached to the patient, they are assigned to the

[1] Different software suppliers may use different rules for determining the first exception reason, and therefore may not necessarily follow the standard algorithm.

denominator (the indicator is deemed appropriate for the patient) and are also counted as having missed the target.

For some indicators, including BLOOD PRESSURE 4, there are effectively two opportunities to be counted as having given informed dissent. The patient can either refuse the particular intervention (e.g. having their blood pressure measured) or can give informed dissent for the particular disease domain (e.g. opting out of all hypertension indicators). Because the business rules are followed independently for each indicator, a patient can be counted as having been exception reported for reasons of informed dissent for one indicator and not for another, even if they have given informed dissent for the whole disease domain.

The operation of the business rules can be illustrated by some hypothetical patients:

i) A patient is diagnosed with hypertension one month before the end of the year following a routine blood pressure check.

This patient is eligible to be exception reported for logistical reasons (recent diagnosis) but the target was nevertheless achieved as blood pressure was checked. Following the business rules, rather than being counted as exception reported, the patient is assigned directly to the denominator (i.e. is considered to be appropriate for the indicator) and also to the numerator (target achieved).

ii) A patient with a history of hypertension registers with the practice one month before the end of the year. The patient refuses to have his blood pressure monitored and the practice has no record of a recent blood pressure measurement.

The patient meets two exception reporting criteria: logistical (recent registration) and refusal to be monitored. Patient refusal is the first of these criteria encountered in the algorithm, therefore the patient is counted as having been exception reported for reasons of refusal. The patient is not counted as a logistical exception.

iii) A patient with hypertension does not meet any of the exception reporting criteria and their most recent blood pressure reading is from 10 months before the end of the year.

Under the business rules the patient is assigned to the denominator and counted as having missed the target.

iv) A patient with hypertension expresses her wish not to be monitored or treated by the practice for her condition. Whilst attending the practice two months before the end of the year for another complaint she nevertheless allows the nurse to take her blood pressure, which is 160/100 mmHg.

Although an informed dissent exception code exists for this patient, under the business rules she is counted in the denominator and the numerator for indicator BLOOD PRESSURE 4 (i.e. the target was achieved). She is still, however, counted as having given informed dissent for all other hypertension indicators. Although her blood pressure is not controlled she therefore is counted as

exception reported for indicator BLOOD PRESSURE 5 (blood pressure ≤150/90 mmHg), rather than as having missed the target.

Estimating financial gain from exception reporting

The financial 'gain' (G_i) from exception reporting can be estimated for each indicator as the difference between the number of points actually scored by the practice and the number of points the practice would have scored had it not excepted any patients, converted into pounds. This is calculated as:

$$((\min[UT, \max(LT,RA)] - LT)/(UT-LT) - (\min[UT,\max(LT,PA)] - LT)/(UT-LT)) \times P \times £126$$

Where 'UT' is the upper payment threshold; 'LT' is the lower payment threshold; 'RA' is reported achievement – the proportion of non-excepted patients for whom the target was achieved (calculated as N_i / D_i , where N_i is the number of patients for whom the relevant target was achieved); 'PA' is population achievement – the proportion of eligible patients, including those exception reported, for whom the target was achieved (calculated as $N_i / (E_i + D_i)$); and 'P' is the points available for the indicator.

Clinical indicators excluded from the main analysis

Due to the inability of the QMAS database to differentiate between different reasons for exception reporting, 25 quality indicators were excluded from the main analyses (see

table A1). The overall exception reporting rate across excluded indicators was higher than for included indicators – median 8.8% (interquartile range 6.9% - 10.9%) compared to median 2.7% (interquartile range 1.9% - 3.9%) – reflecting the high proportion of treatment indicators in the excluded group of indicators and high proportion of measurement indicators in the included group.

Some reasons for exception reporting are identifiable for the 25 excluded indicators: logistical exceptions, clinical – patient unsuitable and patient refusal to be reviewed. However, the central QMAS database conflates clinical contraindications with the patient refusing to have a specific investigation or treatment. This generates a category of exceptions for which the precise reason for exclusion is unknown (see **figure A2**).

Assuming that *none* of the unknown exceptions were due to patient refusal, the median rate of informed dissent for the 25 excluded indicators was 0.73% (interquartile range: 0.23% - 1.7%), and ranged from 0.0% (for ATRIAL FIBRILLATION 3, CORONARY HEART DISEASE 2, 9 & 11, HEART FAILURE 3, CHRONIC KIDNEY DISEASE 5, CHRONIC OBSTRUCTIVE PULMONARY DISEASE 8, 11 & 12, DIABETES 15, MENTAL HEALTH 5 & 6, STROKE 8, 10 & 12, and THYROID 2) to 0.96% for DIABETES 17 (patients with diabetes with total cholesterol ≤5 mmHg). In this case, the overall median rate of informed dissent for all 62 clinical indicators, both included and excluded, would be 0.53% (interquartile range: 0.18% - 1.3%).

Conversely, assuming that *all* of the unknown exceptions were due to patient refusal, the median rate of informed dissent for the 25 excluded indicators was 4.8% (interquartile range: 3.6% - 6.3%), and ranged from 0.0% (for CORONARY HEART DISEASE 2, CHRONIC OBSTRUCTIVE PULMONARY DISEASE 11 & 12, DIABETES 15, MENTAL HEALTH 5 & 6, STROKE 8 & 12, and THYROID 2) to 21.9% for CORONARY HEART DISEASE 10 (patient with coronary heart disease treated with a beta blocker). In this case, the overall median rate of informed dissent for all 62 clinical indicators, both included and excluded, would be 1.7% (interquartile range: 1.2% - 2.5%).