Enhancing colorectal cancer screening evaluation: a proposal of comprehensive indicators

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BACKGROUND

Evaluation and interpretation of screening outcomes are fundamental to identify whether a colorectal cancer (CRC) screening programme is achieving the goals for which it was established. It is recognised that the context and logistics of screening programmes will differ by country and even by region and that their organisational aspects will influence their outcomes and their interpretation. The European guidelines recommended a minimum set of defined variables and indicators to be registered and calculated. However, these are being measured and calculated inconsistently by different national and regional programmes, thus further hindering their comparability. In the **Catalan Colorectal Cancer Screening Programme** (CatCRCSP), moreover, the way some indicators are being calculated, particularly uptake and coverage, together with the temporary exclusion of people undergoing opportunistic screening and those with a normal colonoscopy outcome, is altering the meaning of the indicators as well as the target and the eligible population. Furthermore, people with a previously diagnosed or a screen detected advanced neoplasia (among others) are being excluded and thus falling out of the screening programme's oversight. We present a proposal of "comprehensive indicators" intended to address all these issues and a simulation of their values over a 20-year horizon.

METHODS

We first present the proposed classification of the population to screen and the comprehensive proposed set of indicators, decomposing for each of them the numerator and the denominator and their different components. Using a discrete-event simulation model, we compare the values of the different categories and the proposed indicators over 10 screening rounds.

The discrete-event simulation model was built to represent a colorectal cancer screening programme for a target population of 100,000 women and men aged 50 to 69 years. The conceptual model for the screening process (**Figure 1**) was based on the European Guidelines, which recommend biennial screening with immunochemical faecal occult blood test (iFOBT) and colonoscopy for positives of iFOBT.

Age and sex-specific parameters for both initial and successive screenings were estimated from the areas corresponding to the **Colorectal Cancer Screening Programme of Barcelona** between 2009 and 2013 (1st and 2nd round). Follow-up after adenoma removal differed according to findings of each colonoscopy classified by risk of adenomas. A 20-year horizon was simulated. The model used the Catalan demographic structure and included the population ageing and time to death based on published data on Catalan population and deaths.

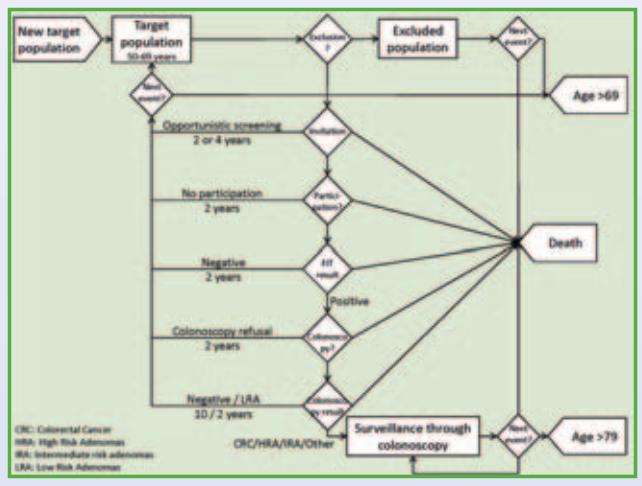


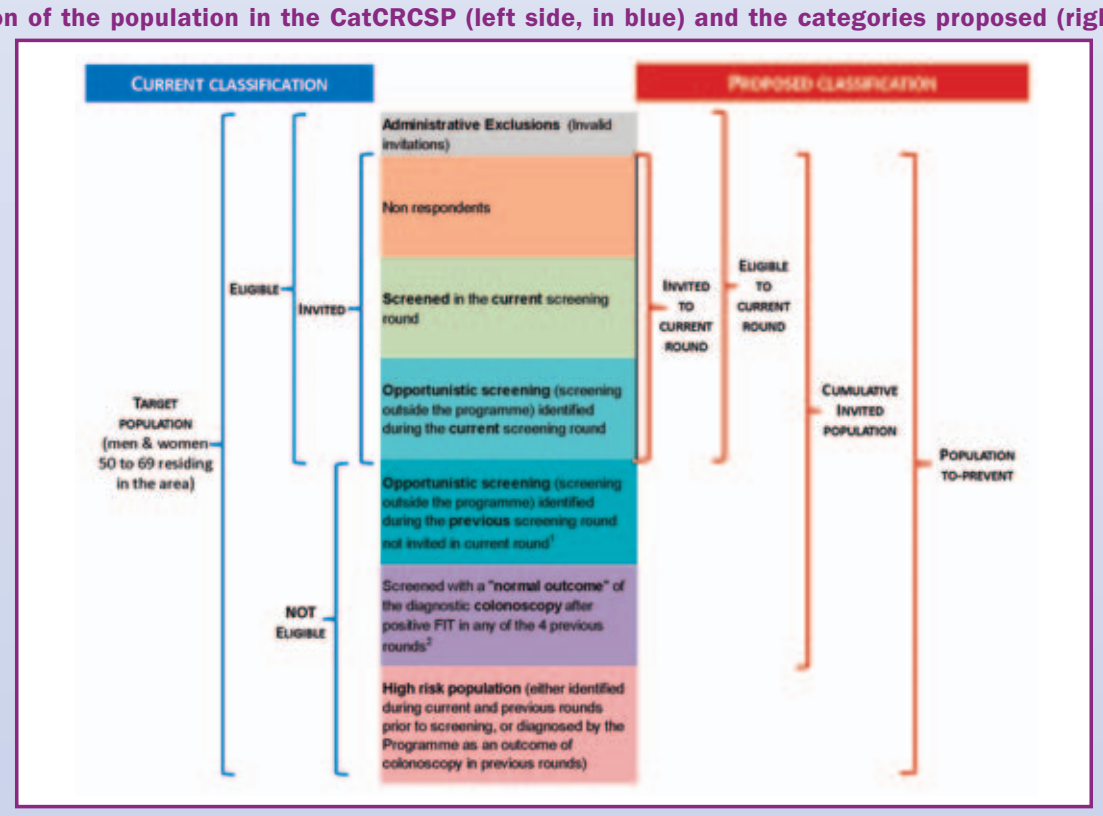
Figure 1. Simplified conceptual model of the CRC screening process.

RESULTS

Most screening programmes can divide their target population in the categories shown as "coloured-boxes" in **Figure 2**. This figure also shows how the CatCRCSP currently considers these categories (in blue), and the proposed classification (in red). Current indicators do not take into account opportunistic screening beyond the concomitant screening round, people waiting for 10 years to be re-invited after a colonoscopy with normal outcome, nor the high risk population. We propose the term *cumulative invited population* to refer to all people who are eligible in the current round plus the people who have been given a longer screening interval and are thus waiting to be invited. We also suggest to track the high risk population instead of just consider them non-eligible, and we propose the term "*population to prevent*" as a more comprehensive group that includes all people who are subject of CRC-prevention.

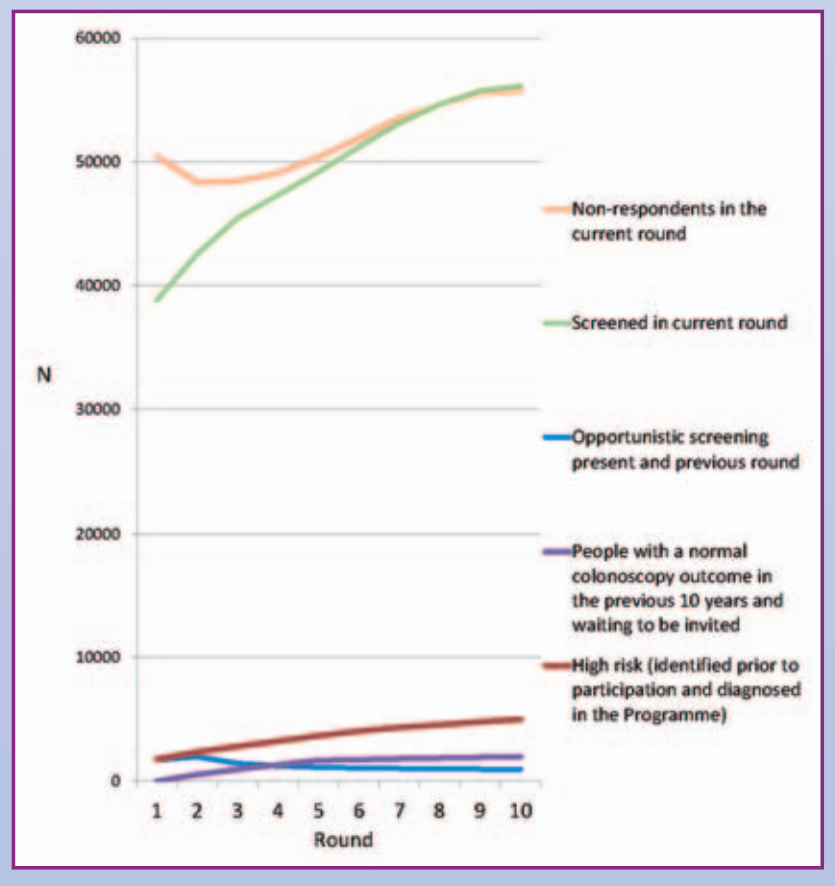
The number of people in the different categories of a screening programme during a 10 rounds (20 years) scenario is shown in **Figure 3**. The increase of both non-respondents and screened is explained by the overall predicted increase of the Catalan population between 50 and 69 years. The increase in the screened is further related to the increasing proportion of people under successive screening, with a higher uptake rate (adherence). Similarly, opportunistic screening decreases after the 2nd round because successive screenees have a lower rate of screening outside the programme than those invited for the first time. Volume of people with a normal colonoscopy outcome waiting to be re-invited to the programme 10 years later reasonably increases until the 5th round, in which it stabilises. Finally, the high risk population presents a steady increase.

Figure 2. Diagram of the different categories of the target population of a screening programme (coloured boxes), the current classification of the population in the CatCRCSP (left side, in blue) and the categories proposed (right side, in red).



1. In the Catalan Programme people with a previous screening colonoscopy should wait 5 years before being screened again. Therefore, people who report having had a screening colonoscopy in the last 2 years, are set to skip present and next round.
2. In the Catalan Programme people who have a normal outcome of the diagnostic colonoscopy are invited again to the programme for a FIT 10 years later, i.e. skip 4 screening rounds.

Figure 3. Evolution of the number of the categories depicted in figure 2 (same colours). The discrete-event simulation model used represents a CCRSP for a target population of 100,000 women and men aged 50 to 69 years.



The following indicators are proposed: *Programme's screening rate* (includes people temporarily excluded because of normal colonoscopy outcome), *Overall screening rate of average risk population* (includes opportunistic screening), *High-risk surveillance rate* (the adherence to surveillance of those identified by the programme as high risk prior to screening and those diagnosed after a positive FIT), and *Prevention rate* (includes all of the above). **Figure 4** shows the formulae of the proposed set of comprehensive indicators. **Figure 5** shows the predicted values over 10 rounds of the Programme's screening rate , Overall screening rate of average risk population and Prevention rate in a scenario of 100% and 50% High risk surveillance rate. Overall screening rate and Programme's screening rate tend to converge over time. Halving the High-risk surveillance rate has an increasing impact over the Prevention rate over the years.

Figure 4. Formulae of the proposed indicators.

$$\text{Uptake (participation) rate } \textit{(current round)} = \frac{\text{Screened in the current screening}}{\text{Invited current round}}$$

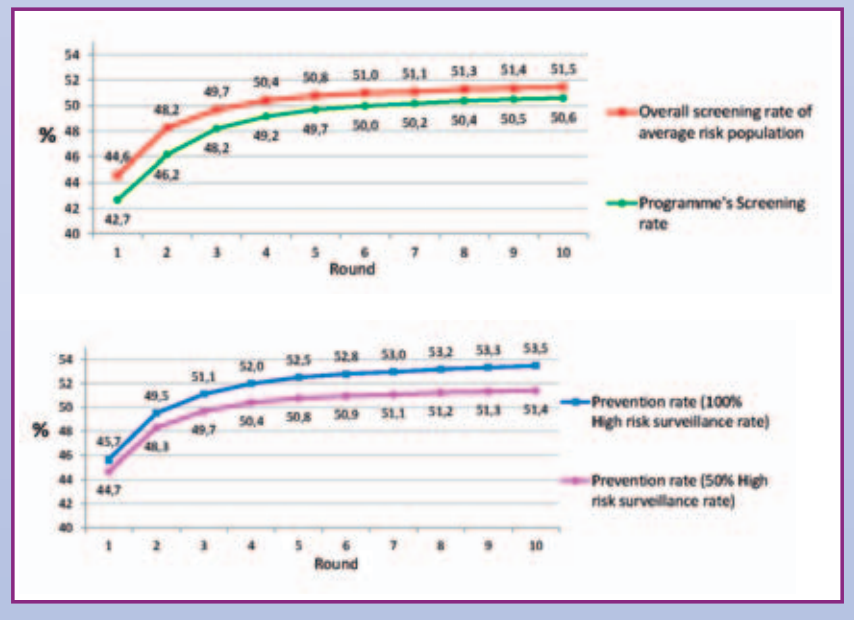
$$\text{Programme's Screening rate} = \frac{\text{Screened in the current screening + Screened with "normal outcome" colonoscopy in 4 previous rounds}}{\text{Cumulative invited population}}$$

$$\text{Overall Screening rate of average risk population} = \frac{\text{Screened in the current screening + Screened with "normal outcome" colonoscopy in 4 previous rounds + Opportunistic current screening + Opportunistic screening previous round}}{\text{Cumulative invited population}}$$

$$\text{High risk Surveillance rate} = \frac{\text{High risk population under surveillance}}{\text{High risk population}}$$

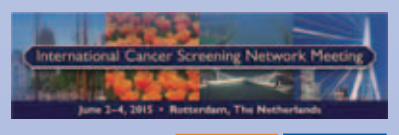
$$\text{Prevention rate} = \frac{\text{Screened in the current screening + Screened with "normal outcome" colonoscopy in 4 previous rounds + Opportunistic current screening + Opportunistic screening previous round + High risk population under surveillance}}{\text{"To-prevent" population}}$$

Figure 5. Comprehensive indicators over the rounds (see Figure 3 for



CONCLUSIONS

The new set of indicators allows for a more comprehensive evaluation and interpretation of the outcomes and could also enhance comparability among Spanish (and other national) programmes. Results show that the volume of high risk population will increase considerably, and recent unpublished data suggests that in our area their adherence to recommended surveillance protocols is poor (around 60%). We believe that the programmes' impact on public health could be increased if the high risk population are kept under the programmes' oversight and control.



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