EVIDENCE BASED PUBLIC HEALTH POLICY AND PRACTICE

Deprivation and quality of primary care services: evidence for persistence of the inverse care law from the UK Quality and Outcomes Framework

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Objective: To examine whether the quality of primary care measured by the 2004 contract varies with socioeconomic deprivation.

Design: Retrospective analysis of publicly available data, comparing quality indicators used for payment that allow exclusion of patients (payment quality) and indicators based on the care delivered to all patients (delivered quality).

Setting and participants: 1024 general practices in Scotland.

Main outcome measures: Regression coefficients summarising the relationships between deprivation and payment and delivered quality.

Results: Little systematic association is found between payment quality and deprivation but, for 17 of the 33 indicators examined, delivered quality falls with increasing deprivation. Absolute differences in delivered quality are small for most simpler process measures, such as recording of smoking status or blood pressure. Greater inequalities are seen for more complex process measures such as diagnostic procedures, some intermediate outcome measures such as glycaemic control in diabetes and measures of treatment such as influenza immunisation.

Conclusions: The exclusions system succeeds in not penalising practices financially for the characteristics of the population they serve, but does not reward the additional work required in deprived areas and contributes to a continuation of the inverse care law. The contract data collected prevent examination of most complex process or treatment measures and this analysis is likely to underestimate the extent of continuing inequalities in care. Broader lessons cannot be drawn on the effect on inequalities of this new set of incentives until changes are made to the way contract data are collected and analysed.

A major part of the new General Medical Services contract implemented across the UK from April 2004 is the Quality and Outcomes Framework (QOF), under which up to a quarter of the general practitioners' income depends on practice performance measured against 146 clinical and organisational indicators.[1] Indicators are assigned a fixed number of points, which weight them according to perceived workload and importance, each point being worth £75 to an average practice in 2004–5. A total of 76 indicators and 550 of the 1050 points relate to the management of 10 chronic diseases. The indicators capture the maintenance of a disease register, recording of risk factors, recording and achievement of intermediate outcomes, and delivery of recommended treatments. Payment is triggered once performance on each clinical indicator exceeds 25% and increases linearly until performance exceeds 90% for most process measures and 50–70% for most intermediate outcome measures.

Much of the early coverage of the QOF has been on the high average number of points achieved, with widespread coverage at both national and regional levels, indicating that quality of care is generally high, with relatively little variation between practices.[2] However, two caveats apply to this conclusion. Firstly, maximum points can be achieved for percentages of the target population ranging from 50% to 90% depending on the indicator. Examining quality in terms of the actual percentages of patients achieving particular targets may therefore show variations that are not apparent in the distribution of points. Secondly, practices are allowed to exclude from the measurement of achievement those patients who are unsuitable for any chronic disease management or for particular indicators. Box 1 lists the acceptable reasons for exclusion.[3 4] The intention is to avoid financially penalising practices for the characteristics of the population they serve. However, these reasons to exclude patients are likely to be more common in deprived populations (eg, through less response to invitations to attend clinics on chronic disease management). Measuring quality using payment percentages that account for exclusions may therefore conceal continuing inequalities in service provision[5–8] and perpetuate them by failing to reward practices for the additional work required to bring deprived populations into systematic care.

Surprisingly, there has been little focus on the possible effect of allowing practices to exclude patients. This paper therefore examines how the quality of primary care varies by levels of deprivation, comparing two measures of the quality of care. ''Payment quality'' is the percentage of non-excluded patients who achieve a particular target (eg, have their blood pressure measured, have their cholesterol controlled or have an influenza vaccination). This is the measure that determines payment under the QOF. ''Delivered quality'' is the percentage of all patients with the disease who achieve a particular target (box 2). This informs consideration of whether the QOF has helped exclude longstanding inequalities in care.[5 6]

Abbreviations: CHD, congestive heart disease; COPD, chronic obstructive pulmonary disease; QOF, Quality and Outcomes Framework; QMAS, Quality Management and Analysis System

Box 1 Acceptable reasons for exclusion of patients[4]

Exception reporting can be applied for the following:

- Patients who have been recorded as refusing to attend a review or who have been invited on at least three occasions during the preceding 12 months;
- patients for whom it is not appropriate to review the specific chronic disease parameters due to particular circumstances—for example, terminal illness and extreme frailty;
- patients newly diagnosed within the practice or who have recently registered with the practice, who should have measurements made within 3 months and delivery of clinical standards within 9 months—for example, blood pressure or cholesterol measurements within target levels;
- patients who are on maximum tolerated doses of a drug and whose levels of outcome remain suboptimal;
- patients for whom prescribing a drug is not clinically appropriate—for example, those who have an allergy, another contraindication or have experienced an adverse reaction;
- where a patient has not tolerated a drug;
- where a patient does not agree to investigation or treatment (and after a reasonable discussion or written advice they have given their informed dissent) and this dissent has been recorded in their medical records;
- where the patient has a supervening condition that makes treatment of their condition inappropriate—for example, cholesterol reduction where the patient has liver disease;
- where an investigative service or secondary care service is unavailable.

An exception code may apply to an entire clinical domain or to specific indicators. In either case, patients are added back into both the numerator and denominator if they achieve the indicator.

METHODS

Using publicly available data on QOF achievement for each practice,[9] we calculated payment quality and delivered quality for clinical indicators, where the true denominator was all patients with the disease (box 2). Table 1 shows the indicators used for calculating payment quality and delivered quality.

Numerators and denominators for payment were measured on 31 March 2005. As prevalence determines payment level (pounds per point), the number of patients on the disease register was recorded by the Quality Management and Assessment System (QMAS).[10] For most practices, these prevalence levels were extracted on 14 February 2005, ''National Prevalence Day''. Initial analysis indicated that in some practices, the reported register size on 14 February was smaller than the denominators for each indicator on 31 March, indicating that it is unreliable. The two may differ because

- individuals with a diagnosis leave the practice or die;
- new individuals with a diagnosis arrive at the practice;
- new cases are diagnosed between 14 February and 31 March; and
- cases diagnosed on 14 February are found inaccurate and deleted by 31 March.

Box 2 Definitions of payment quality and delivered quality

For each indicator, payment quality is defined as: Payment quality = $n/(d-e+ea)$

where n is the number of patients for which the indicator was achieved; d is the number on the disease register (all patients eligible before exclusions); e is the total number with an exclusion code for that indicator; and e_a is the number of excluded patients for which the indicator was achieved anyway.

We define delivered quality as the proportion of all patients who receive the care defined by each indicator:

Delivered quality = n/d

For each clinical area, the Quality Management and Assessment System (QMAS) reports the number of patients on the disease register on 14 February. For each indicator within a domain, QMAS reports n and $(d-e+e_a)$ on 31 March. However, for many indicators d is the number of patients on the disease register and for these indicators delivered quality can be estimated by the maximum value of the denominator within the disease area.

We therefore estimated the register size on 31 March using the maximum value of any denominator in the relevant clinical domain. This assumes that each practice has not excluded anyone from at least one of its indicators. It will therefore underestimate the true register size on 31 March and overestimate delivered quality. For the purpose of this analysis, the key issue is whether the estimate is systematically related to deprivation. No systematic relationship was found between deprivation and differences between the reported register size on 14 February and our estimate of register size on 31 March, which indicates that our results are unlikely to be due to bias in this method for estimating the total register size.

Our measure of practice deprivation is derived from the income domain of the Scottish Index of Multiple Deprivation, 2004.[11] We chose the income domain rather than the overall score or other domains, because it receives the highest weight in the calculation of the overall index and is highly correlated with it, is available for small geographical areas representing between 500 and 1000 people and does not undergo transformations, making it easily interpretable. Average values for practices were calculated on the basis of the geographical distribution of registered populations.

QOF data were available for 1024 practices, although not all practices participated in each of the clinical domains examined, and one practice was excluded because no deprivation data were available. We provide results for payment quality (based on payment denominators) and delivered quality (based on total register size) for indicators where the true denominator is for all patients with the disease, for five clinical areas—coronary heart disease (CHD), stroke and transient ischaemic attack, diabetes mellitus, hypertension and chronic obstructive pulmonary disease (COPD; table 1). The chosen indicators represent 294 (53%) of the 550 points available for clinical quality.

We estimated the size and statistical significance of the trend across deprivation using regression analysis. We used linear regression throughout, estimated using Stata V.8 with robust standard errors. The calculation of mean values and the regression coefficients were weighted by population size.

Table 1 Mean payment quality and delivered quality for 33 clinical indicators

Disease area	Indicator definition	Payment range (%)	No of practices	Mean payment quality (%)	Mean delivered quality (%)	Difference between means p<t
CHD	Record of smoking status in the previous 15 months	25–90	1020	95.0	95.0	0.96
Stroke	Record of smoking status in the previous 15 months	25–90	1020	93.3	93.0	<0.001
Hypertension	Record of smoking status since diagnosis	25–90	1021	95.0	94.6	<0.001
Diabetes	Record of smoking status in the previous 15 months	25–90	1020	97.1	97.0	<0.001
COPD	Record of smoking status in the previous 15 months	25–90	1019	94.4	94.7	0.01
CHD	Record of blood pressure in previous 15 months	25–90	1020	95.0	94.7	0.39
Stroke	Record of blood pressure in previous 15 months	25–90	1020	94.0	93.5	<0.001
Hypertension	Record of blood pressure in previous 9 months	25–90	1021	88.7	88.4	<0.001
Diabetes	Record of blood pressure in the previous 15 months	25–90	1020	97.6	97.3	<0.001
CHD	Record of total cholesterol in previous 15 months	25–90	1020	88.0	86.0	<0.001
Stroke	Record of total cholesterol in previous 15 months	25–90	1020	83.8	80.3	<0.001
Diabetes	Record of total cholesterol in previous 15 months	25–90	1020	94.4	92.9	<0.001
Diabetes	Record of retinal screening in the previous 15 months	25–90	1020	86.4	78.6	<0.001
Diabetes	Record of peripheral pulse test in the previous 15 months	25–90	1020	84.8	80.0	<0.001
Diabetes	Record of neuropathy testing in the previous 15 months	25–90	1020	83.1	78.2	<0.001
Diabetes	Record of serum creatinine testing in the previous 15 months	25–90	1020	94.5	92.9	<0.001
COPD	Diagnosis confirmed by spirometry	25–90	1019	74.8	63.6	<0.001
COPD	Record of FEV_1 in previous 27 months	25–70	1019	69.7	57.2	<0.001
Outcome						
CHD	Blood pressure recorded in previous 15 months ⩽150/90	25–70	1020	84.9	82.8	<0.001
Stroke	Blood pressure recorded in previous 15 months ⩽150/90	25–70	1020	82.7	79.3	<0.001
Hypertension	Blood pressure recorded in previous 15 months ⩽150/90	25–70	1021	72.3	69.3	<0.001
Diabetes	Blood pressure recorded in previous 15 months ⩽145/85	25–55	1020	75.0	70.0	<0.001
CHD	Total cholesterol recorded in previous 15 months ⩽5 mmol/l	25–60	1020	69.3	63.7	<0.001
Stroke	Total cholesterol recorded in previous 15 months ⩽5 mmol/l	25–60	1020	63.3	55.8	<0.001
Diabetes	Total cholesterol recorded in previous 15 months ⩽5 mmol/l	25–60	1020	74.2	67.1	<0.001
Diabetes	HbA1c recorded in previous 15 months ⩽7.4%	25–55	1020	56.9	49.9	<0.001
Diabetes	HbA1c recorded in previous 15 months ⩽10%	25–85	1020	89.9	85.6	<0.001
Treatment						
CHD	Aspirin, alternative antiplatelet or anticoagulant being taken	25–90	1020	89.5	87.6	<0.001
CHD	Treated with β-blocker	25–50	1020	70.0	52.9	<0.001
CHD	Record of influenza immunisation in previous flu season	25–85	1020	86.6	75.8	<0.001
Stroke	Record of influenza immunisation in previous flu season	25–85	1020	83.7	71.6	<0.001
Diabetes	Record of influenza immunisation in previous flu season	25–85	1020	86.7	73.4	<0.001

CHD, coronary heart disease; COPD, chronic obstructive pulmonary disease; HbA1c, glycosylated haemoglobin; FEV_1, forced expiratory volume in 1 s.

The regression coefficients represented the change in quality associated with a one-point increase in the percentage of the practice population receiving state benefits on the grounds of low income. We compared the regression coefficients when quality was measured by payment quality and delivered quality. Where the coefficient on delivered quality minus the coefficient on payment quality is negative, the implied exclusion rates are higher in more deprived practices. Exclusion rates are lower in deprived practices if the coefficient on delivered quality minus the coefficient on payment quality is positive.

RESULTS

Table 1 gives the definitions, payment stages and national mean values for both payment quality and delivered quality. Absolute differences between payment quality and delivered quality for simpler process measures such as recording of smoking status, blood pressure, cholesterol and creatinine are generally small. Larger differences are found for indicators for more complex processes such as foot and eye screening in diabetes, and spirometry in COPD, and for intermediate outcomes. The largest differences are found for treatment indicators with β-blockers falling 17.1% and the three immunisation indicators for CHD, stroke and diabetes falling 10.8%, 12.1% and 13.3%, respectively.

On the process indicators (table 2), payment quality is significantly ($p<0.05$) higher in more affluent practices for two of the 18 indicators, significantly ($p<0.05$) higher in more deprived practices for seven indicators and not significantly different for the remaining nine indicators. By contrast, delivered quality of care is better in more affluent practices on eight indicators, better in more deprived practices on one indicator and not significantly different on the remaining nine indicators. The most dramatic differences are for the two diagnostic indicators for COPD. For the monitoring of patients with COPD using forced expiratory volume in 1 s (FEV_1), the regression coefficient changes from 0.35 for payment quality to −0.45 for delivered quality. The range in deprivation is 40.89 points, so this equates to a maximum change in measured quality of 32.7% (payment quality being 14.3% higher in the most deprived practices, whereas delivered quality is 18.4% lower). Three complex process diabetes measures (vascular and neuropathic foot screening, and eye screening) show similar reversals.

On the intermediate outcome indicators (table 3), payment quality is significantly higher in more affluent practices for one of the nine indicators and higher in more deprived practices on four indicators. Delivered quality is higher in more affluent practices on four indicators, and higher in more deprived practices on three indicators (although for two of these, the relationship is weakened). Only cholesterol control in patients with CHD shows a stronger negative relationship with deprivation on payment quality than with delivered quality. Three indicators have a positive relationship with deprivation on both payment and delivered quality. The indicators reflecting blood pressure control for patients with hypertension and HbA1c levels <10% for patients with diabetes both become more negatively and significantly related to deprivation under delivered quality. The indicator reflecting HbA1c levels <7.4% for patients with diabetes is the only outcome indicator that moves from having a significant positive relationship with deprivation on payment quality to a significant and negative relationship with deprivation on delivered quality.

On the treatment indicators (table 4), payment quality is significantly higher in more affluent practices for two of the

Table 2 Regression coefficients for process indicators

Indicators	Payment quality (%)		Delivered quality (%)	
	Regression coefficient*	p Value	Regression coefficient*	p Value
CHD—smoking status recorded	−0.01	0.61	−0.01	0.56
Stroke—smoking status recorded	0.01	0.53	0.01	0.53
Hypertension—smoking status recorded	0.03	0.11	0.03	0.11
Diabetes—smoking status recorded	0.03	0.03	0.02	0.21
COPD—smoking status recorded	0.07	<0.001	0.07	<0.001
CHD—blood pressure recorded	−0.07	<0.001	−0.09	<0.001
Stroke—blood pressure recorded	−0.03	0.18	−0.03	0.03
Hypertension—blood pressure recorded	0.04	0.27	0.02	0.61
Diabetes—blood pressure recorded	0.01	0.24	0.00	0.78
CHD—cholesterol recorded	−0.10	0.01	−0.11	<0.001
Stroke—cholesterol recorded	0.05	0.33	0.05	0.76
Diabetes—cholesterol recorded	0.07	<0.001	0.01	0.64
Diabetes—retinal screening recorded	0.07	0.17	−0.52	<0.001
Diabetes—peripheral pulses recorded	0.13	0.02	−0.17	0.01
Diabetes—neuropathy testing recorded	0.13	0.03	−0.18	0.01
Diabetes—creatinine recorded	0.04	0.20	−0.03	0.40
COPD—diagnosis by spirometry	0.32	<0.001	−0.35	<0.001
COPD—record of recent FEV_1	0.35	<0.001	−0.45	<0.001

CHD, coronary heart disease; COPD, chronic obstructive pulmonary disease; FEV_1, forced expiratory volume in 1 s.
*Reflects the effect of a one-point increase in the percentage of patients receiving state benefits on the grounds of low income on the percentage of patients achieving the indicator. There is a 40.9-point range in the deprivation measure, and 90% of practices lie in a 30-point range.

six indicators and higher in more deprived practices for just one indicator. Delivered quality is higher in more affluent practices for five indicators. None of the indicators show a significant positive relationship between deprivation and delivered quality. Only the taking of aspirin or equivalent drugs for patients with CHD shows a significant negative relationship between deprivation and delivered quality. Both influenza vaccination indicators for diabetes and COPD move from having a significant positive relationship with payment quality to a significant and negative relationship with delivered quality. The taking of β-blockers for patients with CHD becomes more negatively and significantly related to deprivation on delivered quality and influenza immunisation of patients with CHD becomes more negatively related to deprivation and remains significant.

DISCUSSION

The introduction of the new General Medical Services reflects international interest in using financial incentives as a method of improving primary care. As such, the results of the new UK contract will attract much interest.[12]

This is the first study to compare quality using the measures that drive payment with quality measured in terms of the actual care delivered. Its major limitation reflects the way that data are held in the payment system. Delivered quality can only be estimated for a limited number of indicators because QMAS does not record either the true denominators for every indicator or the register size on the same date that the indicator data are extracted. The method we have used overestimates delivered quality but is not biased in terms of estimating the effect of deprivation.

At face value, new contract data for Scotland indicate that there is little systematic difference between practices serving populations with different levels of deprivation. It is consistent with financial incentives for quality such as the QOF mitigating previous inequalities in care.[5–8 13 14] However, such conclusions based on payment quality are misleading. For 17 of the 33 indicators, delivered quality is systematically lower in practices serving more deprived populations. It is higher for only four indicators. This indicates that the exclusions system of the QOF conceals continuing inequalities in service provision. The absolute differences are relatively small for simpler process measures that can be delivered opportunistically (measurement of blood pressure and cholesterol and recording of smoking status), but are considerably larger for many diagnostic, intermediate outcome and treatment indicators.

There are two main explanations for these patterns. Firstly, more deprived populations may have more legitimate reasons for exclusion, such as not attending routine care, having

Table 3 Regression coefficients for outcome indicators

Indicator	Payment quality (%)		Delivered quality (%)	
Outcome	Regression coefficient*	p Value	Regression coefficient*	p Value
CHD—blood pressure controlled	−0.02	0.53	−0.04	0.28
Stroke—blood pressure controlled	0.05	0.2	0.05	0.64
Hypertension—blood pressure controlled	−0.05	0.14	−0.08	0.01
Diabetes—blood pressure controlled	0.31	<0.001	0.16	<0.001
CHD—cholesterol controlled	−0.13	0.01	−0.12	0.01
Stroke—cholesterol controlled	0.13	0.03	0.13	0.04
Diabetes—cholesterol controlled	0.31	<0.001	0.10	0.01
Diabetes—HBA1c ⩽7.4%	0.21	<0.001	−0.15	<0.001
Diabetes—HBA1c ⩽10%	−0.02	0.57	−0.20	<0.001

CHD, coronary heart disease; FEV_1, forced expiratory volume in 1 s; HbA1c, glycosylated haemoglobin.
*Reflects the effect of a one-point increase in the percentage of patients receiving state benefits on the grounds of low income on the percentage of patients achieving the indicator. There is a 40.9-point range in the deprivation measure, and 90% of practices lie in a 30-point range.

Table 4 Regression coefficients for treatment indicators

Indicators	Payment quality (%)		Delivered quality (%)	
	Regression coefficient*	p Value	Regression coefficient*	p Value
CHD—on aspirin or equivalent	0.01	0.78	0.03	0.2
CHD—on β-blocker	−0.06	0.21	−0.14	<0.001
CHD—had influenza vaccination	−0.17	<0.001	−0.31	<0.001
Stroke—had influenza vaccination	−0.09	0.05	−0.09	<0.001
Diabetes—had influenza vaccination	0.09	0.03	−0.14	<0.001
COPD—had influenza vaccination	0.02	0.59	−0.31	<0.001

CHD, coronary heart disease; COPD, chronic obstructive pulmonary disease.
*Reflects the effect of a one-point increase in the percentage of patients receiving state benefits on the grounds of low income on the percentage of patients achieving the indicator. There is a 40.9-point range in the deprivation measure, and 90% of practices lie in a 30-point range.

Policy implications

- The exclusions system in the contract offers little incentive for the extra work required to deliver care to deprived populations and contributes to a continuation of the inverse care law.
- Changes in the way contract data are collected and analysed are required before inequalities in care can be identified accurately and acted on appropriately.

What this paper adds

- We compare performance for quality indicators used for payment that allow for the exclusion of patients (''payment quality'') and indicators based on the care delivered to all patients (''delivered quality'').
- Under payment quality, there is little evidence that more deprived populations receive worse care.
- However, based on delivered quality 17 of the 33 measures examined show markedly worse care for more deprived populations.

greater comorbidity, and moving and therefore changing practice more often. Secondly, practices serving more deprived populations may be of lower quality generally and use exclusions to maximise payment. This is facilitated by the relative lack of definition of exclusions compared with the clarity of the indicators themselves.

Identifying which of these explanations is true will require more detailed examination than is possible in this study. The first explanation is plausible, but many reasons for exclusion that are legitimate under the contract (such as poor attendance at routine clinics) are potentially amenable to health service intervention.[15 16] Moreover, if the problem was a result of greater ''no show'' rates among the disadvantaged, it is hard to see why the implied exclusion rates differ across the same indicator for different diseases.

The payment system can be considered to have been successful in not penalising practices financially for the populations that they serve. However, it highlights that the contract does not reward for the extra work involved in delivering equal outcomes and treatments to disadvantaged populations. Furthermore, the indicators focus on levels of outcome, rather than changes in outcome. As some patients may achieve the outcome indicators without intervention, particularly in more affluent areas, practices may be rewarded for levels of outcome that are not attributable to their services.

What is already known

- The inverse care law predicts that good-quality health services will be less available to those populations that need them most.
- The new contract for primary medical services introduced across the UK in 2004 included financial incentives directly linked to the quality of care provided.
- For payment purposes, general practices are allowed to exclude patients from the indicators used to calculate the quality of their care.

This study also highlights the limitations of QMAS data in examining the distribution of quality of care using different assumptions about exclusions. Notably, many of the diagnostic and treatment indicators do not have a recoverable true denominator (eg, most of the diagnostic indicators and some treatment indicators are limited to new diagnoses and the smoking advice indicator is based on the denominator of current smokers). As inequalities are greatest for similar indicators where we can recover a true denominator, the results presented here are likely to underestimate the extent of inequalities in delivered care.

In conclusion, this paper has shown that despite payment data indicating a relatively equitable distribution of quality under the 2004 general practice contract, the inverse care law still applies with persistent inequalities in the care actually delivered.[5 6] Analysis of this inequality is hampered by the lack of information about exclusions in QMAS in 2004–5. The inclusion of data on exclusions in QMAS for the 2005–6 contract year will allow a more accurate analysis of inequalities in care across socioeconomic groups. Only then will the full effect of these financial incentives on equity be understood, and practices and primary care organisations be informed to make an appropriate response. Meanwhile, the lack of information on the reasons for exclusion limits the lessons that can be learned in other countries about the effect of this innovative set of incentives in improving the equity and quality of care.

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SPEAKER'S CORNER

Health and social consequences in the quest for comfort, convenience and pleasure

As the holiday season approaches, we are bombarded with gift ideas in catalogues and advertisements. This year, as always, there are new models of home theatres and entertainment systems, computers, electronic games, power tools, toys and gadgets. Science and technology is helping us move towards ultimate comfort, convenience and pleasure. There are several new products that are quite thought provoking.

Imagine the convenience of turning on lamps and small appliances from up to 20 m away, even through walls, floors and doors. By using a remote control switch, you don't have to get up from your chair or go downstairs. A robotic floor vacuum unit with remote control cleans and sweeps automatically, even when you're asleep or out of the house! All you do is press a button and the unit goes to work. Guided by infrared sensors, it steers away from stairs and navigates around obstacles. When it has finished, it automatically docks to a home base to recharge. For the kitchen, innovation is a recipe for convenience. A user-friendly electric wine-bottle opener pops the cork in seconds. A microwave unit allows you to scan, cook and eat. Full power or half, 2 min or 3 min? Now you don't have to worry. This microwave will figure it out for you. Simply use the wand attached to the microwave to scan product Universal Product Codes to determine the cooking power and time.

Modern machines and ready meals have revolutionised our life styles. As a result, we are changing our physical activities and dietary patterns, as well as our social behaviours. At a birthday dinner I recently attended, adults and children were seated at their own tables. Whereas the adults were talking and joking at their tables, it was a totally different scenario with the children—no running around, no laughter. The children sat quietly, busily operating their own hand-held computer games.

Just 50 years ago, cooking from scratch was an essential skill: how else could you feed a family? Nowadays, cooking has become an art and is no longer a necessity. Ready-made foods are available at the grocery store. With cans that come with new easy-pop tops and pre-assembled food that comes in easy-peel packages, which allow us to heat and eat from freezer to table in 3 min, ready-to-eat foods are attractive alternatives to cooking.

Although science and technology bring us comfort, convenience and pleasure, they also bring us diseases of comfort, such as those chronic diseases caused by obesity, physical inactivity and energy-dense food,[1] and changes in social behaviours. Examples of these adverse consequences abound: people driving from one store to another right next door, consumers buying and eating mostly food that is either ready-to-eat or microwaveable, fewer families sitting down together to eat home-cooked meals.

Of course, there is no turning back in history, in civilisation, and in science and technology. No one would choose to go back to the dark ages of hunting and gathering or the pioneer days of living off the land. However, the adverse health and social consequences of science and technology must be dealt with before it is too late.

Besides education and legislation,[1] the solution to the health and social problems of science and technology can be science and technology themselves. For example, should science and technology be required to add health and social considerations to their goals? In addition to the development of a new product, should research and development be encouraged to invest at least an equal amount, if not more, in researching and minimising the adverse health and social effects? These and other questions must be dealt with in our continued quest for comfort, convenience and pleasure.

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Reference

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