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Use of the internet in the treatment of obesity and prevention of type 2 diabetes in primary care

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Cardiovascular prevention, including emphasising healthy diet and physical activity patterns for weight loss and diabetes prevention, is an important focus of primary care medicine, yet provision of intensive lifestyle counselling in the primary care setting remains uncommon. Online approaches for providing lifestyle counselling are emerging as a new avenue for bringing support to outpatient patient populations. Features of successful programmes include the use of a structured behavioural programme, electronic counselling support and feedback, and uncomplicated user interfaces. Online tools may be used independently or to complement in-person approaches. Limited data also suggest that the internet can be used to support the maintenance of weight loss. In addition, the internet may help overcome various clinical barriers to lifestyle support, including significant time limitations, a need to prioritise acute care and maintain clinical workflow, and the high cost of counselling. Furthermore, the continuity of the primary care patient–provider(s) relationship provides an established source of long-term support which has been difficult to create in other community settings. As the field of online lifestyle counselling matures, nutrition and physical activity experts will face new challenges in providing asynchronous counselling without the assistance of traditional non-verbal communication cues. However, the potential for reaching a wider population in a convenient and accessible manner also creates unique opportunities for providing lifestyle support.

Obesity: Internet: Primary healthcare: Prevention: Weight loss

Although cardiovascular prevention is an important focus of primary care medicine, the translation of intensive lifestyle counselling into the primary care setting remains uncommon. International obesity and diabetes trends have concerning implications for future population health, given the strong links between obesity and chronic disease or impaired physical function^(1–7). In US adults, obesity prevalence has increased from 13% (1960–1962) to 35% (2003–2006)⁽⁸⁾, while recent estimates of obesity prevalence in European countries range from 4 to 28% in men and from 6 to 37% in women⁽⁹⁾. Intensive lifestyle intervention promoting modest, sustained, weight loss has been shown to prevent or delay diabetes onset^(10,11). Yet, commercial and other community-based programmes are clearly not meeting the population's need for weight

management assistance. Commercial weight-loss programmes often lack evidence of effectiveness and are prohibitively expensive for many patients^(12,13). Other popular weight-loss strategies may have only marginal effectiveness^(14,15) or have raised safety concerns⁽¹⁶⁾. In addition, community-based programmes are not privy to relevant health information from clinicians (e.g., dietary constraints or conditions impacting physical activity safety), and lack avenues to provide feedback to an individual's healthcare team.

Health care providers may play an important role in helping to manage body weight in the interest of long-term health. Primary care providers (PCP) are more likely than specialists to counsel on weight and exercise^(17,18) and many PCP consider cardiovascular prevention counselling⁽¹⁹⁾,

Abbreviation: PCP, primary care provider.

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Table 1. Summary of randomised trial data with at least 12 months of follow-up, published 2000–2012

	Follow-up months	Sample	Attrition	Intervention(s)	Mean weight change at ≥ 1 year
Appel ⁽⁴⁴⁾	24	415 obese adults with ≥ 1 CVD risk factor (i.e., hypertension, diabetes and hyperlipidaemia)	13%	Usual care Remote support (phone, website and email) only; website included learning modules, self-monitoring tools and feedback on weight loss progress Remote + in-person support	–0.8 kg (SE 0.6) –4.6 kg (SE 0.7) –5.1 kg (SE 0.8) <i>P</i> <0.001 for comparing each intervention with control group; no significant difference between intervention arms
Bennett ⁽⁴⁵⁾	24	365 obese primary care patients with BMI ≤ 50, receiving pharmacologic treatment for hypertension at one of three Boston community health centres serving a predominately racial/ethnic minority patient population	14%	Behavioural intervention using e-Health or telephonic support, including self-monitoring support, behavioural advice, problem-solving support and telephone counselling Usual care	–1.53 kg (SE 0.37) –0.5 kg (SE 0.35) Group difference <i>P</i> <0.05
Winett ⁽⁴⁶⁾	16	1071 overweight or obese adults, 33% male; 23% African American, members of 14 Baptist or United Methodist Churches (those with chronic illness needed medical clearance for the physical activity portion of the intervention)	13%	Guide to Health (GTH) online intervention only, including self-monitoring, automated lifestyle advice and problem-solving support GTH with church-based supports Waitlist control	–0.17 kg (SE 0.42) –0.25 kg (SE 0.40) +0.07 kg (SE 0.45) No differences by treatment at follow-up
McConnon ⁽⁴⁷⁾	12	221 obese adult primary care UK patients aged 18–65 years, with weekly internet access and able to read and write in English	41%	Internet: website with automated (tailored) advice on diet, physical activity, behavioural therapy; email reminders Usual care: advice for the patient to continue his/her usual approach to weight loss, plus printed information reflecting the type of information available within primary care	–1.3 kg –1.9 kg Group difference <i>P</i> = 0.56
Micco ⁽⁴⁸⁾	12	123 relatively healthy non-smoking adults with computer access, >98% white, BMI 25–39.9, recruited via newspaper ads	21%	Internet only: weekly online group meetings × 6 months then bi-weekly online meetings × 6 months, and use of a website including structured education, automated advice, self-monitoring and problem-solving support and other tools to support weight loss. Internet + in-person support (IPS): same website plus monthly in-person meeting in place of an online chat (led by a different therapist than the online facilitator)	–5.1 (SD 7.1) kg –3.5 (SD 5.1) kg No significant group × time differences (<i>P</i> = 0.15)
Morgan ⁽⁴⁹⁾	12	65 overweight and obese adult men who were staff and students at an Australian university	29%	Internet intervention, including self-monitoring support, behavioural advice and an option to post questions which were answered for the group Information booklet only	–5.3 kg –3.1 kg Group difference non-significant
Tate 2003 ⁽⁴¹⁾	12	92 relatively healthy, non-pregnant overweight or obese adults with at least one other risk factor for type 2 diabetes; recruited via newspaper ads from a single centre	16%	Basic programme: online tutorial on weight loss; a new tip and link each week; directory of selected Internet weight loss resources. Basic plus behavioural e-counselling (five emails per week in first month; weekly email for next 11 months)	–2.0 kg (SD 5.7) –4.4 kg (SD 6.2) Group difference <i>P</i> = 0.04

Table 1 (Continued)

	Follow-up months	Sample	Attrition	Intervention(s)	Mean weight change at ≥ 1 year
Turnin ⁽⁵⁰⁾	12	557 non-diabetic adult patients with BMI ≥ 27 , enrolled from diabetes and nutrition centres in France	59%	Standard 'medical and dietetic visits' (seven in year) Above plus access to 'Nutri-Expert' system at home, which provided self-monitoring support and automated behavioural advice	-2.04 kg/m ² -1.98 kg/m ² Group difference non-significant
Womble ⁽⁵¹⁾	12	47 healthy women with daily Internet access, recruited from a pool of respondents to public service announcements and newspaper ads describing university-affiliated weight loss programmes	34%	E-diets commercial internet weight loss programme, including self-monitoring tools, automated advice, feedback from online counsellors, online support groups LEARN Programme for Weight Control 2000 manual	-1.1 (sd 4.0) % -4.0 (sd 5.1) % Group difference P<0.05
Wylie-Rosette ⁽⁵²⁾	12	588 adults with BMI ≥ 25 enrolled from a US Health Maintenance Organization	16-22% per arm	Workbook alone Workbook + tailoring from computer kiosk Workbook + kiosk + in-person consult	-1.00 kg -2.13 kg -3.36 kg Group difference P = 0.003; pair-wise tests show a significant difference between workbook alone v. workbook + kiosk + in-person (P = 0.012) and a non-significant difference between workbook alone v. workbook + kiosk.

and specifically dietary counselling⁽²⁰⁾, to be important. Involving an individual's physician in lifestyle change helps ensure that people with health concerns will not initiate physical activity in an unsafe manner. Furthermore, theoretical models in primary care medicine are consistent with the support of lifestyle change. For example, the Chronic Care Model, one of the most accepted approaches for delivering high-quality primary care, embraces a model of well-coordinated team-delivered care which would naturally extend to including lifestyle counsellors⁽²¹⁻²⁴⁾. Likewise, clinical initiatives emphasising chronic care self-management and patient-centred care aim to empower patients to be active participants in their health, consistent with taking control of their lifestyle decisions^(25,26).

Although various evidence-based guidelines have recommended clinical attention for obesity⁽²⁷⁻²⁹⁾, and obesity treatment is an important complement to pharmacotherapy in cardiovascular prevention⁽³⁰⁾, interventions to treat obesity in primary care settings are lacking⁽³¹⁻³⁴⁾. Unfortunately, even those who receive some advice may not receive comprehensive information; in one study, while 48% of obese patients reported that their physicians had advised them to lose weight, only 30% reported receiving exercise advice and 27% reported specific dietary advice⁽³⁵⁾.

Online approaches for promoting healthy lifestyles are emerging as a potentially important new avenue for providing evidence-based lifestyle support

Approach to the literature evaluating online lifestyle interventions

To date, weight loss data from internet-based efficacy studies are limited, often relatively short-term⁽³⁶⁻³⁸⁾, and sometimes negative⁽¹³⁾. Publicly available programmes are often not based on rigorous scientific principles⁽³⁹⁾. While the field is new, promising data for altering obesity-related health behaviours⁽⁴⁰⁾, and promoting weight loss^(37,40,41) or weight-loss maintenance^(42,43) in adults suggest that further attention is warranted. To this end, we examined weight-change data from randomised controlled trials in adults, published between 2000 and 2012, in which at least one of the evaluated interventions included an online component to promote weight loss. Because weight loss is often transient, we only considered studies with a minimum of 12 months follow-up.

Summary of the interventions

We identified ten studies meeting these criteria, most reporting their outcomes in terms of kilogram change (Table 1), with the exception of one using body weight percentage⁽⁵¹⁾ and another reporting kg/m²⁽⁵⁰⁾. The interventions varied considerably in design, with the internet used in some to deliver an automated intervention while in others it enabled remote communication with lifestyle experts or supplemented in-person counselling or community-based support. The most commonly reported online programme elements include self-monitoring of weight, dietary intake and/or physical activity^(41,44-46,48-52), automated advice^(44,46-48,50-52), structured education^(41,44,46,48,49,52),

problem-solving support^(45,46,48–50), online lifestyle coaching^(41,44,48,51) and reminder emails^(41,44,47,51). A few programmes reported additional features such as links to community or internet resources^(41,45,46), online peer-to-peer support^(48,51), participant contests⁽⁴⁸⁾, physician feedback⁽⁴⁵⁾ or counselling by telephone^(44,45).

Weight loss data over at least 1 year of follow-up

Among the ten weight-loss studies we examined, the weight change in each arm varied between a 5.3 kg loss (an online intervention)⁽⁴⁹⁾ to a 0.1 kg gain (a waitlist control arm; see Fig. 1)⁽⁴⁶⁾. When the difference between study arms for each study was calculated (by designating as referent the study arm most similar to usual care or to a non-internet approach, and subtracting its outcome from that of the other study arm(s)), variability persisted but point estimates most often favoured online intervention. Although only about half of the studies showed a significant difference in weight loss between study arms, the non-significant findings are partially mitigated by the fact that some studies compared more than one active study arm^(41,48,50).

Studies examining combinations of in-person and online support. Four studies examined different combinations of in-person and online support^(44,48,50,52). One examined the effect of adding online tools to the standard schedule of seven medical and dietetic visits employed by a group of European diabetes and nutrition centres. It found that adding self-monitoring and automated problem-solving support and dietary advice to this in-person approach led to no improvement in 1-year weight loss⁽⁵⁰⁾. Similar findings were also reported for a subset of participants at 5 years follow-up. Two of the studies we examined found clinically significant weight loss with online interventions, which was similar regardless of whether an in-person component was present or not^(44,48). One of these studies employed online group meetings, in contrast to most of the interventions we reviewed which typically utilised individualised asynchronous counselling. The researchers compared the use of a website plus internet-based chat sessions with the use of the same website plus monthly in-person meetings in place of the online chats⁽⁴⁸⁾. Although session attendance was initially better in the fully online programme, there was no significant group effect on weight loss at either 6 or 12 months, with mean weight loss of 5.1 kg in the internet-alone arm and 3.5 kg in the internet plus in-person treatment arm at 12 months. The second study compared usual care with (a) remote support via website, telephone and email; and (b) a combination of remote and in-person support. It showed that each remote intervention led to more weight loss at the end of a year that this benefit persisted at 2 years follow-up with a mean weight change from baseline of -0.8 kg in the control group, -4.6 kg in the remote-support-only arm and -5.1 kg in the group receiving in-person support. Each intervention arm led to significantly more weight loss than the control⁽⁴⁴⁾. Last, one study examined three levels of support: workbook-based education alone, the same workbook plus tailored automated advice from a computer kiosk, or both those supports plus in-person counselling.

The researchers found a significant group effect at 12 months, with a dose response across the levels of support (-1.0 , -2.1 and -3.4 kg, respectively)⁽⁵²⁾.

Studies examining online support alone. Among studies that did not include any in-person support, three incorporated online counselling from lifestyle experts. In one, significant weight loss was found in both arms receiving access to an online tutorial on weight loss, weekly tips and links, and a directory of selected internet weight-loss resources. However, individuals receiving e-counselling in addition to this automated programme lost an additional 2.4 kg at the end of one year⁽⁴¹⁾. In a small study that enrolled staff and faculty at an Australian university, an online behavioural curriculum led to a 5.3 kg loss, which was not significantly different than the 3.1 kg lost among control participants⁽⁴⁹⁾. In another study, a commercial weight loss programme led to less weight loss than dissemination of a weight-control manual⁽⁵¹⁾. One study combined an automated website and telephone counselling with PCP feedback, and links to community resources. It found a small but clinically significant weight loss at the end of 1 year that could still be detected at 2 years follow-up (-1.03 kg more than usual care at 24 months)⁽⁴⁵⁾.

Two studies employed neither an in-person component nor online counselling; neither showed a significant weight-loss effect. One compared automated online advice and education delivered with or without church-based supports (e.g., prompts and reminders from the pulpit and in church bulletins) to a control arm, finding minimal weight change in any arm at the end of 16 months follow-up⁽⁴⁶⁾. The other study found that automated tailored advice and email reminders showed no difference in weight change from usual care over one year⁽⁴⁷⁾.

Data specific to the primary care setting

Owing to the limited amount of published data on online weight-loss interventions specific to the primary care setting, we examined all identified articles for this population, regardless of follow-up duration or study design. In two short-term studies, internet intervention led to significantly more weight loss than did control arms. For example, in one, completers among 101 obese adults with hypertension lost 2.71 kg over 12 weeks (3.05 kg more than usual care; 95% CI -4.24 , -1.85)⁽⁵³⁾. Likewise, among 2862 clients of a large integrated managed care consortium, online programme participants lost 3.0% (v. 1.2% in information-only group) over 6 months ($P < 0.001$)⁽⁵⁴⁾. Two year-long studies showed mixed results. In one, an online version of a behavioural lifestyle intervention including lessons, self-monitoring and lifestyle coaching led to 4.9 kg (95% CI 2.22, 7.36) weight loss among obese primary care patients with weight-related cardiovascular risk factors. However, among general practice patients in the UK, a website providing automated lifestyle advice and email reminders led to similar weight change as did usual care (-1.3 v. -1.9 kg; $P = 0.56$)⁽⁴⁷⁾. Two 24-month studies, as described earlier, also focused on primary care patients. One found that disadvantaged, largely ethnic minority, urban patients using an online behavioural intervention lost 1.05 kg more

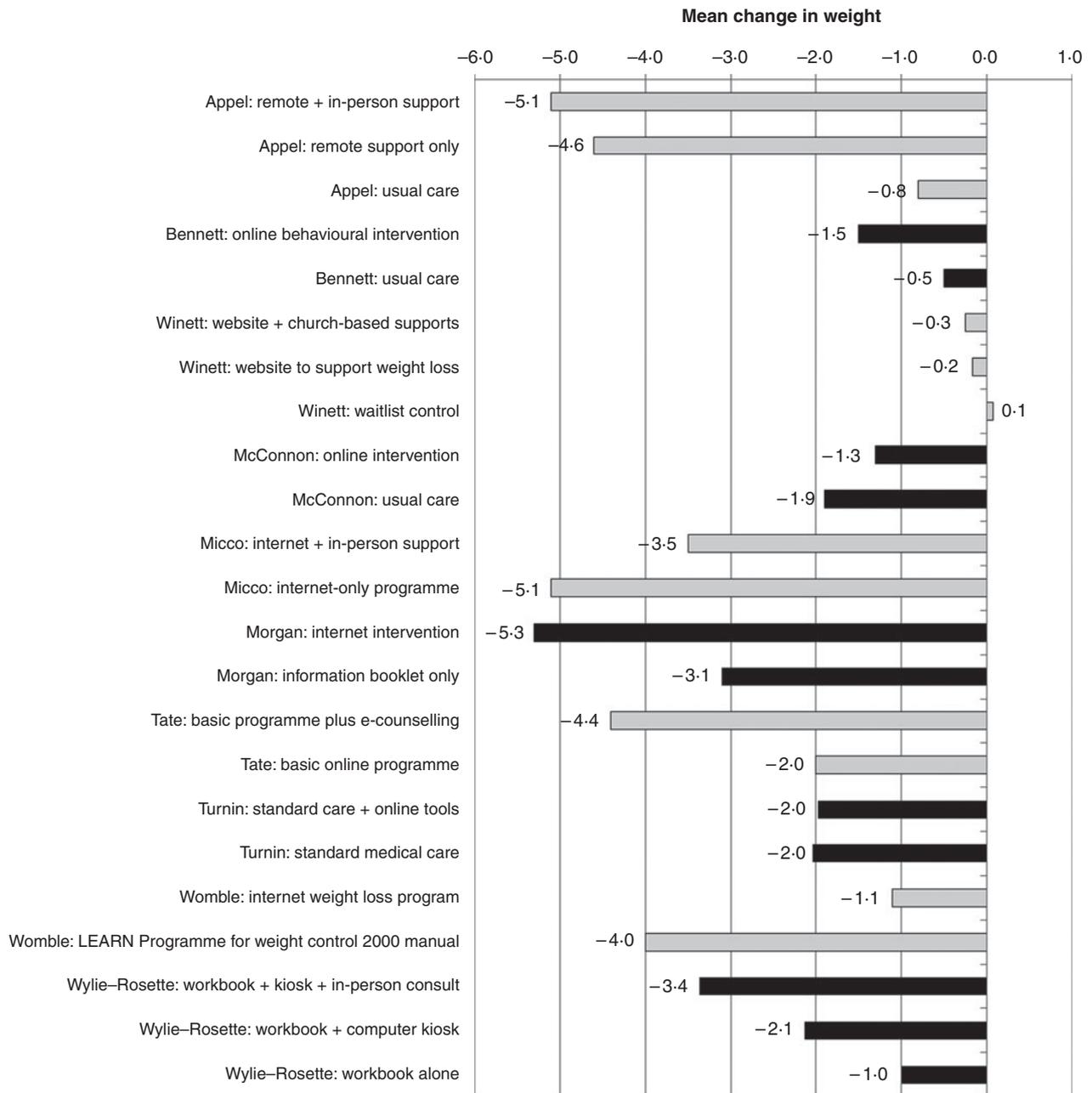


Fig. 1. Summary of weight change from baseline to follow-up for the ten randomised trials examining online approaches for promoting weight loss and healthy lifestyles. The weight change for each study arm is graphed separately, and studies are differentiated by bar colour. Most studies show weight loss at 12 months, but one indicates results at 16 months⁽⁴⁶⁾ and two show 24-month data^(44,45). All results are displayed as change in kilograms with the exception of one using body weight percentage (Womble⁽⁵¹⁾) and another reporting kg/m² (Turnin⁽⁵⁰⁾).

than those with usual care over 1 year and maintained this effect over a second year of follow-up⁽⁴⁵⁾. In the other, remote support or a combination of remote and in-person support both led to more weight loss at 2 years than did usual care⁽⁴⁴⁾.

Application to the maintenance of weight loss

While diverse intervention strategies can promote short-term weight loss, the maintenance of weight loss is a key challenge if lifestyle intervention is to promote long-term

health. The behavioural principles involved in successful weight maintenance have been examined in few randomised clinical trials examining online intervention approaches, mostly with promising results. One study found that there was no difference in weight maintenance effectiveness, whether participants were provided with frequent in-person support, minimal in-person support, or internet support⁽⁴²⁾. In it, the frequency of losing and maintaining 5% of initial body weight at 18 months in the three groups was 62, 46, and 49%, respectively. A second randomised controlled trial, evaluating face-to-face v.

Table 2. Barriers to counselling* for obesity treatment in clinical settings

Physician-related barriers
Perceived lack of effectiveness ^(61,62)
Inadequate training
Lack of training in counselling ^(20,62)
Lack of nutrition or physical activity knowledge ^(20,62,63)
Lack of emphasis in credentialing ⁽⁶⁴⁾
Low confidence in counselling ability ^(19,20)
Preference for one-on-one care v. group empowerment approaches ⁽⁶³⁾
Negative attitudes towards obese patients ⁽⁶³⁾
Patient-related factors
Patient non-compliance ⁽²⁰⁾ or lack of interest ⁽¹⁹⁾
Language or communication barriers ^(19,63)
Patients' financial and other practical barriers ⁽⁶³⁾
Doctor-patient cultural differences ⁽¹⁹⁾
System-related factors
Lack of time ^(19,20,62,63)
Lack of reimbursement ^(20,61,62)
Need to prioritise ongoing medical therapy ⁽⁶³⁾
Lack of support of colleagues ⁽⁶³⁾
Inadequate staff/management support ⁽⁶³⁾
Inadequate teaching materials ⁽²⁰⁾
Missing information in patients' charts ⁽¹⁹⁾

*One source refers to counselling for CVD prevention, rather than obesity alone⁽¹⁹⁾.

internet weight maintenance (with a newsletter control group), focused on promoting daily self-weighing with weekly reporting (self-regulation) in a group of individuals who had lost 10% of their body weight⁽⁴³⁾. Individuals in all three arms regained weight but those in the self-regulation arms had better weight maintenance, particularly in the face-to-face group⁽⁴³⁾. A third study examined personal contact v. interactive technology weight maintenance strategies (comparing these strategies with a self-directed control) and found that monthly personal contact provided a modest benefit for weight maintenance. The interactive technology strategy provided early, but transient benefit⁽⁵⁵⁾. Additional analyses showed that participants with consistent website use were more successful at maintaining long-term weight loss⁽⁵⁶⁾. A fourth study found that a web-based programme initiated after an initial 4-month weight-loss programme was no more effective than was self-directed weight maintenance⁽⁵⁷⁾.

Features of successful online lifestyle change programmes

With such heterogeneity in both the online interventions themselves, and their associated effectiveness, it is essential to understand which programme features are associated with successful lifestyle change and weight loss. A number of studies have begun to provide insight into this question. For example, one 6-month intervention found that access to structured behavioural treatment programme (i.e., links to web-based resources, electronic lessons and online counselling) was more effective at promoting weight loss than provision of links to educational websites⁽³⁷⁾. The inclusion of electronic counselling and feedback,⁽⁴¹⁾ and behavioural lessons⁽⁵⁸⁾ also promote weight-loss success.

As described earlier, the data are inconsistent regarding the value of combining online and in-person counselling. Complicated programme structure is a barrier to use⁽¹²⁾ and in-person sessions may be preferred to internet-based ones by some patients⁽⁵⁹⁾. Among users of one multi-component web interface, an evaluation using factor analysis revealed that 'feedback features' (e.g., progress charts, physiologic calculators and tools for journaling) most strongly predicted weight loss over 6 months, while 'social support features' (e.g., web chats, biographical information and email addresses of participants) best predicted success during the lifestyle maintenance phase⁽⁶⁰⁾.

Any primary care weight-loss initiative faces diverse clinical barriers

The movement towards the use of online counselling in the primary care setting is largely in response to the considerable barriers to traditional obesity treatment approaches that exist in clinical practice (Table 2). Indeed, among some general practitioners and practice nurses, such barriers are cited in justification of an opinion that the detection and management of risk for type 2 diabetes is inappropriate for the primary care setting⁽⁶⁵⁾. Clearly, they must be understood and addressed if lifestyle support is to be integrated into a primary care practice.

Physician-related barriers

Physicians often perceive obesity treatment as lacking effectiveness⁽⁶¹⁾ and they may lack the skills or knowledge to counsel effectively^(19,20,63). They may also hold negative attitudes towards obese patients⁽⁶³⁾.

Patient-related barriers

Although published patient-related barriers include a perceived lack of patient compliance or interest^(19,20), other data indicate considerable patient interest in lifestyle change⁽⁶⁶⁾. In fact, patients generally report they would be comfortable discussing weight with their physician and would particularly like assistance with specific dietary and exercise recommendations as well as help setting realistic weight goals⁽³⁵⁾. Yet many patients are less satisfied with their physicians' expertise regarding weight control than they are with their general health care⁽⁶⁷⁾, and look to their doctor for help with weight control 'not at all' (46%) or only 'a slight amount' (30%)⁽⁶¹⁾. In addition, many patients lack knowledge of weight-related health risk. For example, many patients with diabetes overestimate the healthiest weight for their height⁽⁶⁸⁾, which is important since perceiving weight as a health risk is associated with readiness for lifestyle change⁽⁶⁶⁾. On the other hand, patients can also overestimate the amount of weight loss needed for health benefit; in one study, 42% of participants believed this figure to be >10%⁽⁶⁹⁾. Furthermore, travel and scheduling constraints can make adherence to intensive in-person counselling difficult for patients.

System-related barriers and potential solutions

Systemic factors such as a lack of reimbursement or time are the most-frequently cited^(19,20,61,63), and among the most daunting, barriers to clinical obesity treatment. The available time for preventive services is often inadequate. For example, fulfilling all the US Preventive Service Task Force's recommendations alone is estimated to take 7.4 h/d⁽⁷⁰⁾. In fact, prevention is often delivered during acute care visits, at which the acute issue must be prioritised^(63,71) and primary care visits already address multiple problems⁽⁷²⁾. Adding intensive obesity counselling to the physician's docket may thus not be realistic. Furthermore, depending on the health-care system, counselling costs (which can be substantial for an intensive behavioural intervention) may be difficult to cover. For example, in the US, health insurance coverage for lifestyle counselling for obesity is very limited⁽⁷³⁾.

The internet may help overcome diverse clinical barriers to implementing lifestyle support into primary care medicine

Internet delivery may decrease cost and increase convenience of lifestyle interventions, particularly for people with time or travel constraints⁽⁷⁴⁾. Patients can access programmes online at times which fit into their busy schedules. Furthermore, the ability to access the programme from different sites frees patients from the need to travel to a fixed counselling site. They may log on to the programme from a variety of locations; from home, at the library, or even while travelling. By using online tools to supplement brief PCP advice or adding an online counsellor to the healthcare team, physicians' inadequate training in lifestyle counselling can be mitigated as can the time limitations of the typical physician-patient visit. Furthermore, internet delivery of counselling may be compelling for its potential to (a) reduce staffing needs by enabling electronic transmission of standardised educational materials, including some automated counselling; (b) facilitate communication between patients and health providers; (c) provide a forum for collection, management and presentation of data, such as self-monitoring information; and (d) facilitate individualised tailoring of advice, either automatically, or via electronic communication with experts.

Limited data examine PCP perspectives on the use of online behavioural interventions in primary care. One qualitative study addressing this issue emphasises the importance of using an evidence-based approach and that of educating PCP of its content and effectiveness⁽⁷⁵⁾. Many providers had not utilised online weight-loss programmes because they were not familiar with them and/or raised concerns of efficacy. They also were wary that programmes would attempt to sell unsafe or untested weight-loss medications. The 'ideal' programme that emerged from their perspectives was a free resource using a structured, behavioural curriculum with assistance with goal setting, self-monitoring tools, motivational and peer support. Reception to the concept of PCP feedback was mixed and emphasised the need for a streamlined approach.

A referral model is one approach that has allowed smooth integration of evidence-based lifestyle counselling into primary care practice^(76,77). To ensure minimal impact on patient flow or costs, and maximise the likelihood of staff and administrative support, it utilises existing clinical processes and resources. Likewise, existing infrastructure of the clinical setting (e.g., scheduling, communication and record-keeping practices) can be adapted for the provision of lifestyle support⁽⁷⁶⁾. In this model, the clinician initiates a referral for weight-loss treatment, akin to ordering a mammogram or a dermatology consultation. Routine referral processing mechanisms are then used to connect the patient with the online intervention staff, who provide occasional provider feedback. One study found that among patients who had completed an online 1-year weight loss intervention, accessed via referral from their PCP, physician feedback was reported by 89%, and 80% stated that the programme helped them to follow their physician's advice⁽⁷⁸⁾.

Internet access is an important consideration for determining the reach of an online approach

Online interventions are not appropriate for patients who lack access to the internet at home or in public locations. However, internet access has expanded rapidly, with 68% of households in the European Union having broadband internet access in 2011 compared with 30% in 2006⁽⁷⁹⁾. In the US, approximately 74% of adults were using the internet at the end of 2009 and 60% reporting broadband connections at home⁽⁸⁰⁾. Furthermore, the greatest growth in broadband adoption in 2009 occurred in population subgroups that have historically shown below-average internet use, including senior citizens, low-income Americans and rural adults⁽⁸¹⁾. Web use in minority groups in the US has also considerably expanded⁽⁸¹⁻⁸⁵⁾. The internet is already often used to find health information, particularly to augment limited health resources. For example, fairly high health-related internet use (often from non-home access sites) has been found in samples with a high proportion of poor, urban, minority individuals⁽⁸⁶⁻⁸⁸⁾. Clearly, there is interest in and increasing access to the internet. In addition, primary care patients find computer-based preventive medicine tools to be usable and acceptable in routine medical care⁽⁸⁹⁾. Such momentum should be parlayed into better population health.

As the field of interactive behaviour change technology matures, nutrition and physical activity experts will face new challenges

One major challenge in online counselling is that we do not fully understand how best to create a therapeutic alliance in an online counselling context⁽⁹⁰⁾. It is clear that textual communication lacks non-verbal cues, so may lead to a higher rate of misinterpretation or miscommunications than does in-person conversation^(91,92). In particular, the communication of empathy may be particularly difficult via text⁽⁹³⁾. Some options for promoting empathetic communication include the counsellor openly stating their

emotional reactions to participant statements or describing their non-verbal reactions (e.g., 'I have been smiling for the last few minutes because it seems like you are really making progress with problem-solving for healthier eating')⁽⁹³⁾. The use of emoticons has also been suggested, but raises concerns that such simplistic symbols may be insufficient for conveying the level of empathy needed for a true therapeutic relationship⁽⁹³⁾. Asynchronous online communication also introduces the problem of time delay into the counselling process; unexplained delays in a lifestyle expert's response can lead to participant anxiety⁽⁹²⁾. In addition, the option of counselling participants who are geographically dispersed adds the challenge of coaches understanding and appropriately responding to local variations of word usage and colloquial expressions⁽⁹⁰⁾.

Another consequence of remote communication is that in the online counselling setting, it may be more difficult to assess and intervene in an emergency^(92–94). Therefore, patients who pose a danger to themselves or others may not be good candidates for online counselling (e.g., substance abusers, the severely depressed⁽⁹³⁾) while those with serious physical health problems should be medically evaluated regarding their ability to safely undertake unsupervised physical activity and dietary change prior to enrolment. Because of the potential for health emergencies, online counsellors should be trained in how to respond to potential safety concerns, should know the identity of any client that they work with and should be aware of emergency services in that person's area. In addition, emergency procedures should be discussed before intervention begins and patient consent obtained at that time⁽⁹³⁾.

For effective online communication, both the counsellor and the patient need strong writing skills, as well as skills in the use of computers and the internet^(91–93). In addition, measures should be taken to verify the identity of online participants (e.g., password-protected websites)⁽⁹²⁾, to ensure safe data transfer (e.g., data encryption)⁽⁹³⁾ and to inform patients of any limitations for protecting confidential information⁽⁹³⁾. Furthermore, training is needed for the development of online counselling skills, and supervision (including the review of online counselling transcripts) is helpful to ensure the maintenance of such skills⁽⁹³⁾. While a limited literature is beginning to emerge for the training and oversight of online lifestyle counsellors⁽⁹⁴⁾, further work is needed in this area.

The potential for reaching a wider population in a convenient and accessible manner will also create unique opportunities for providing lifestyle support

Accessing care via the internet can substantially increase convenience for those with transportation or scheduling barriers. In addition, online counselling may be a more acceptable approach than in-person counselling for those who feel stigmatised by the counselling process⁽⁹²⁾. Likewise, a disinhibiting effect of online communication or the act of writing itself may promote self-reflection⁽⁹²⁾. Furthermore, while changing the BMI of an individual whose friends/family are obese is difficult because neighbours pull the individual back to their original weight⁽⁹⁵⁾, the internet can help with the formation of new networks that

are supportive of healthy lifestyles. Indeed, users of one large internet weight-loss community report that the forum provides them with encouragement and motivation, information and shared experiences⁽⁹⁶⁾. Finally, online counselling may open new opportunities for lifestyle experts, such as increased flexibility of work hours or locations.

Conclusions

Internet delivery has the potential for overcoming longstanding clinical barriers to lifestyle counselling, so may represent an innovative approach for diabetes prevention and obesity treatment, as well as new opportunities and challenges for those with expertise in nutrition and physical activity counselling. To date, interventions that have been studied vary considerably in design (e.g., fully automated interventions, online asynchronous counselling, or web-based tools supplementing in-person counselling or community-based support). Studies show considerable heterogeneity in the effectiveness of online interventions to promote behaviour change and weight loss or the maintenance of weight loss. This was true for wholly online approaches as well as for interventions that combined in-person and online approaches. This finding contrasts with a recent review including shorter-duration studies which concluded that adults receiving computer-based care in addition to standard treatment lost, on average, 1.5 kg more than those receiving a more standard (typically in-person) treatment approach⁽⁹⁷⁾. This discrepancy with our findings may reflect the small number of longer-duration studies or the fact that short-term effectiveness may be transient. Among the studies we reviewed, interventions without personalised in-person or online counselling were not effective. With so much variability in intervention effectiveness, it is essential to gain a better understanding of which programme components are linked with lifestyle success. A structured behavioural curriculum, electronic counselling and feedback mechanisms have been identified as useful features for weight loss, while social support features may be particularly important for supporting the maintenance of weight loss. The fact that internet-based care can provide effective online support in the primary care setting is encouraging, as studies engaging patients typically enrolled less selected samples than is typical in efficacy studies. In addition, clinical data indicate that there may be value of using an online approach among ethnic minority⁽⁵⁴⁾ and under-served populations⁽⁴⁵⁾.

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References

1. Wild S, Roglic G, Green A *et al.* (2004) Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care* **27**, 1047–1053.

2. Must A, Spadano J, Coakley EH *et al.* (1999) The disease burden associated with overweight and obesity. *JAMA* **282**, 1523–1529.
3. NHS Centre for Reviews and Dissemination (1997) The prevention and treatment of obesity. *Eff Health Care* **97**, 1–12.
4. NHLBI Obesity Education Initiative (1998). *Clinical guidelines on the identification, evaluation and treatment of overweight and obesity in adults: the Evidence Report*. NIH Publication No. 98-4083. Bethesda, MD: U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health, National Heart, Lung and Blood Institute.
5. McTigue KM, Harris R, Hemphill B *et al.* (2003) Screening and interventions for obesity in adults: summary of the evidence for the U.S. Preventive services task force. *Ann Intern Med* **139**, 933–949.
6. Peeters A, Bonneux L, Nusselder WJ *et al.* (2004) Adult obesity and the burden of disability throughout life. *Obes Res* **12**, 1145–1151.
7. Messier SP, Loeser RF, Miller GD *et al.* (2004) Exercise and dietary weight loss in overweight and obese older adults with knee osteoarthritis: the Arthritis, Diet, and Activity Promotion Trial. *Arthritis Rheum* **50**, 1501–1510.
8. National Center for Health Statistics (2012) *Health, United States, 2011: with special feature on socioeconomic status and health*. Hyattsville, MD. <http://www.cdc.gov/nchs/data/hus/hus11.pdf> Accessed October 2012.
9. Berghofer A, Pischon T, Reinhold T *et al.* (2008) Obesity prevalence from a European perspective: a systematic review. *BMC Public Health* **8**, 200.
10. Tuomilehto J, Lindstrom J, Eriksson JG *et al.* (2001) Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med* **344**, 1343–1350.
11. Knowler WC, Barrett-Connor E, Fowler SE *et al.* (2002) Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* **346**, 393–403.
12. Anhoj J & Jensen AH (2004) Using the internet for life style changes in diet and physical activity: a feasibility study. *J Med Internet Res* **6**, e28.
13. Tsai AG & Wadden TA (2005) Systematic review: an evaluation of major commercial weight loss programs in the United States. *Ann Intern Med* **142**, 56–66.
14. Heshka S, Anderson JW, Atkinson RL *et al.* (2003) Weight loss with self-help compared with a structured commercial program: a randomized trial. *JAMA* **289**, 1792–1798.
15. Gardner CD, Kiazand A, Alhassan S *et al.* (2007) Comparison of the Atkins, Zone, Ornish, and LEARN diets for change in weight and related risk factors among overweight premenopausal women: the A TO Z Weight Loss Study: a randomized trial. *JAMA* **297**, 969–977.
16. American Heart Association (2002) Media Advisory: American Heart Association Statement on High-Protein, Low-Carbohydrate Diet Study Presented at Scientific Sessions, 19 November 2002.
17. Frank E & Kunovich-Frieze T (1995) Physicians' prevention counseling behaviors: current status and future directions. *Prev Med* **24**, 543–545.
18. Livaudais JC, Kaplan CP, Haas JS *et al.* (2005) Lifestyle behavior counseling for women patients among a sample of California physicians. *J Womens Health (Larchmt)* **14**, 485–495.
19. Tsui JJ, Dodson K & Jacobson TA (2004) Cardiovascular disease prevention counseling in residency: resident and attending physician attitudes and practices. *J Natl Med Assoc* **96**, 1080–1083, 1088–1091.
20. Kushner RF (1995) Barriers to providing nutrition counseling by physicians: a survey of primary care practitioners. *Prev Med* **24**, 546–552.
21. Hung DY, Rundall TG, Tallia AF *et al.* (2007) Rethinking prevention in primary care: applying the chronic care model to address health risk behaviors. *Milbank Q* **85**, 69–91.
22. Wagner E (1996) Organizing care for patients with chronic illness. *Milbank Q* **74**, 511–544.
23. Wagner EH (1998) Chronic disease management: what will it take to improve care for chronic illness? *Eff Clin Pract* **1**, 2–4.
24. Wagner EH (2004) Effective teamwork and quality of care. *Med Care* **42**, 1037–1039.
25. Wagner EH, Bennett SM, Austin BT *et al.* (2005) Finding common ground: patient-centeredness and evidence-based chronic illness care. *J Altern Complement Med* **11**, Suppl. 1, S7–S15.
26. Toop L (1998) Primary care: core values. Patient centred primary care. *Br Med J* **316**, 1882–1883.
27. National Institute for Health and Clinical Excellence National Collaborating Centre for Primary Care (2006) *Obesity: The Prevention, Identification, Assessment and Management of Overweight and Obesity in Adults and Children*. Available at: <http://www.nice.org.uk/nicemedia/live/11000/38294/38294.pdf>. Accessed July 2012.
28. Douketis JD, Feightner JW, Attia J *et al.* (1999) Periodic health examination, 1999 update: 1. Detection, prevention and treatment of obesity. Canadian Task Force on Preventive Health Care. *CMAJ* **160**, 513–525.
29. Manson J, Skerrett P, Greenland P *et al.* (2004) The escalating pandemics of obesity and sedentary lifestyle. A call to action for clinicians. *Arch Intern Med* **164**, 249–258.
30. Libby P (2005) The forgotten majority: unfinished business in cardiovascular risk reduction. *J Am Coll Cardiol* **46**, 1225–1228.
31. Scott JG, Cohen D, DiCicco-Bloom B *et al.* (2004) Speaking of weight: how patients and primary care clinicians initiate weight loss counseling. *Prev Med* **38**, 819–827.
32. Ruser CB, Sanders L, Brescia GR *et al.* (2005) Identification and management of overweight and obesity by internal medicine residents. *J Gen Intern Med* **20**, 1139–1141.
33. Simkin-Silverman LR, Gleason KA, King WC *et al.* (2005) Predictors of weight control advice in primary care practices: patient health and psychosocial characteristics. *Prev Med* **40**, 71–82.
34. Wee CC, McCarthy EP, Davis RB *et al.* (1999) Physician counseling about exercise. *JAMA* **282**, 1583–1588.
35. Potter MB, Vu JD & Croughan-Minihane M (2001) Weight management: what patients want from their primary care physicians. *J Fam Pract* **50**, 513–518.
36. White MA, Martin PD, Newton RL *et al.* (2004) Mediators of weight loss in a family-based intervention presented over the internet. *Obes Res* **12**, 1050–1059.
37. Tate DF, Wing RR & Winett RA (2001) Using Internet technology to deliver a behavioral weight loss program. *JAMA* **285**, 1172–1177.
38. Harvey-Berino J, West D, Krukowski R *et al.* (2010) Internet delivered behavioral obesity treatment. *Prev Med* **51**, 123–128.
39. Miles J, Petrie C & Steel M (2000) Slimming on the Internet. *J R Soc Med* **93**, 254–257.
40. Winett RA, Tate DF, Anderson ES *et al.* (2005) Long-term weight gain prevention: a theoretically based Internet approach. *Prev Med* **41**, 629–641.
41. Tate DF, Jackvony EH & Wing RR (2003) Effects of Internet behavioral counseling on weight loss in adults at risk for type 2 diabetes: a randomized trial. *JAMA* **289**, 1833–1836.

- Available at: <http://www.americanheart.org/presenter.jhtml?identifier=3006728>. Accessed November 2002.
42. Harvey-Berino J, Pintauro S, Buzzell P *et al.* (2004) Effect of internet support on the long-term maintenance of weight loss. *Obes Res* **12**, 320–329.
 43. Wing RR, Tate DF, Gorin AA *et al.* (2006) A self-regulation program for maintenance of weight loss. *N Engl J Med* **355**, 1563–1571.
 44. Appel LJ, Clark JM, Yeh HC *et al.* (2011) Comparative effectiveness of weight-loss interventions in clinical practice. *N Engl J Med* **365**, 1959–1968.
 45. Bennett GG, Warner ET, Glasgow RE *et al.* (2012) Obesity treatment for socioeconomically disadvantaged patients in primary care practice. *Arch Intern Med* **172**, 565–574.
 46. Winett RA, Anderson ES, Wojcik JR *et al.* (2007) Guide to health: nutrition and physical activity outcomes of a group-randomized trial of an Internet-based intervention in churches. *Ann Behav Med* **33**, 251–261.
 47. McConnon A, Kirk SF, Cockroft JE *et al.* (2007) The Internet for weight control in an obese sample: results of a randomised controlled trial. *BMC Health Serv Res* **7**, 206.
 48. Micco N, Gold B, Buzzell P *et al.* (2007) Minimal in-person support as an adjunct to internet obesity treatment. *Ann Behav Med* **33**, 49–56.
 49. Morgan PJ, Lubans DR, Collins CE *et al.* (2011) 12-month outcomes and process evaluation of the SHED-IT RCT: an internet-based weight loss program targeting men. *Obesity (Silver Spring)* **19**, 142–151.
 50. Turmin MC, Bourgeois O, Cathelineau G *et al.* (2001) Multicenter randomized evaluation of a nutritional education software in obese patients. *Diabetes Metab* **27**, 139–147.
 51. Womble LG, Wadden TA, McGuckin BG *et al.* (2004) A randomized controlled trial of a commercial internet weight loss program. *Obes Res* **12**, 1011–1018.
 52. Wylie-Rosett J, Swencionis C, Ginsberg M *et al.* (2001) Computerized weight loss intervention optimizes staff time: the clinical and cost results of a controlled clinical trial conducted in a managed care setting. *J Am Diet Assoc* **101**, 1155–1162; quiz 1163–1154.
 53. Bennett GG, Herring SJ, Puleo E *et al.* (2010) Web-based weight loss in primary care: a randomized controlled trial. *Obesity (Silver Spring)* **18**, 308–313.
 54. Rothert K, Strecher VJ, Doyle LA *et al.* (2006) Web-based weight management programs in an integrated health care setting: a randomized, controlled trial. *Obesity (Silver Spring)* **14**, 266–272.
 55. Svetkey LP, Stevens VJ, Brantley PJ *et al.* (2008) Comparison of strategies for sustaining weight loss: the weight loss maintenance randomized controlled trial. *JAMA* **299**, 1139–1148.
 56. Funk KL, Stevens VJ, Appel LJ *et al.* (2010) Associations of internet website use with weight change in a long-term weight loss maintenance program. *J Med Internet Res* **12**, e29.
 57. Cussler EC, Teixeira PJ, Going SB *et al.* (2008) Maintenance of weight loss in overweight middle-aged women through the Internet. *Obesity (Silver Spring)* **16**, 1052–1060.
 58. Gold BC, Burke S, Pintauro S *et al.* (2007) Weight loss on the web: A pilot study comparing a structured behavioral intervention to a commercial program. *Obesity (Silver Spring)* **15**, 155–164.
 59. Harvey-Berino J, Pintauro SJ & Gold EC (2002) The feasibility of using Internet support for the maintenance of weight loss. *Behav Modif* **26**, 103–116.
 60. Krukowski RA, Harvey-Berino J, Ashikaga T *et al.* (2008) Internet-based weight control: the relationship between web features and weight loss. *Telemed J E Health* **14**, 775–782.
 61. Foster GD, Wadden TA, Makris AP *et al.* (2003) Primary care physicians' attitudes about obesity and its treatment. *Obes Res* **11**, 1168–1177.
 62. Hebert ET, Caughy MO & Shuval K (2012) Primary care providers' perceptions of physical activity counselling in a clinical setting: a systematic review. *Br J Sports Med* **46**, 625–631.
 63. Melin I, Karlstrom B, Berglund L *et al.* (2005) Education and supervision of health care professionals to initiate, implement and improve management of obesity. *Patient Educ Couns* **58**, 127–136.
 64. Treyzon L (2005) Assessment of obesity management in medical examination. *Nutr J* **4**, 10.
 65. Williams R, Rapport F, Elwyn G *et al.* (2004) The prevention of type 2 diabetes: general practitioner and practice nurse opinions. *Br J Gen Pract* **54**, 531–535.
 66. Wee CC, Hamel MB, Davis RB *et al.* (2004) Assessing the value of weight loss among primary care patients. *J Gen Intern Med* **19**, 1206–1211.
 67. Wadden TA, Anderson DA, Foster GD *et al.* (2000) Obese women's perceptions of their physicians' weight management attitudes and practices. *Arch Fam Med* **9**, 854–860.
 68. McTigue KM, Hess R, Bryce CL *et al.* (2006) Perception of "healthy" body weight by patients with diabetes. *Diabetes Care* **29**, 695–697.
 69. Katz S, Feigenbaum A, Pasternak S *et al.* (2005) An interactive course to enhance self-efficacy of family practitioners to treat obesity. *BMC Med Educ* **5**, 4.
 70. Yarnall KS, Pollak KI, Ostbye T *et al.* (2003) Primary care: is there enough time for prevention? *Am J Public Health* **93**, 635–641.
 71. Getz L, Sigurdsson JA & Hetlevik I (2003) Is opportunistic disease prevention in the consultation ethically justifiable? *Br Med J* **327**, 498–500.
 72. Flocke SA, Frank SH & Wenger DA (2001) Addressing multiple problems in the family practice office visit. *J Fam Pract* **50**, 211–216.
 73. Tsai AG, Asch DA & Wadden TA (2006) Insurance coverage for obesity treatment. *J Am Diet Assoc* **106**, 1651–1655.
 74. Ahern DK, Phalen JM & Mockenhaupt RE (2003) Science and the advancement of eHealth: a call to action. *Am J Prev Med* **24**, 108–109.
 75. Hwang KO, Stuckey HL, Chen MC *et al.* (2012) Primary care providers' perspectives on online weight-loss programs: a big wish list. *J Med Internet Res* **14**, e16.
 76. McTigue KM, Conroy MB, Bigi L *et al.* (2009) Weight loss through living well: translating an effective lifestyle intervention into clinical practice. *Diabetes Educ* **35**, 199–204, 208.
 77. McTigue KM, Conroy MB, Hess R *et al.* (2009) Using the internet to translate an evidence-based lifestyle intervention into practice. *Telemed JE Health* **15**, 851–858.
 78. McTigue KM, Bhargava T, Bryce CL *et al.* (2011) Patient perspectives on the integration of an intensive online behavioral weight loss intervention into primary care. *Patient Educ Couns* **83**, 261–264.
 79. Eurostat Press Office (2011) Internet access and use in 2011: almost a quarter of persons aged 16–74 in the EU27 have never used the internet. *Eurostat News Release*. <http://europa.eu/rapid/pressReleasesAction.do?reference=STAT/11/188&type=->. Accessed August 2012.
 80. Pew Internet and American Life Project (2009) Internet, broadband, and cell phone statistics. <http://www.pewinternet.org/Reports/2010/Internet-broadband-and-cell-phone-statistics.aspx?r=1>. (accessed 15 June 2010).
 81. Horrigan J (2009) Home Broadband Adoption 2009. *Pew Internet and American Life Project* <http://pewinternet>.

- org/Reports/2009/10-Home-Broadband-Adoption-2009.aspx (accessed 14 June 2010).
82. Nielsen/NetRatings (2002) Hispanics are the fastest growing ethnic group online, according to Nielsen/netratings. New York 16 July 2002. http://www.nielsen-online.com/pr/pr_020716.pdf. Accessed February 2008.
 83. Smith A (2010) Home Broadband 2010. *Pew Internet and American Life Project 2010*. <http://pewinternet.org/Reports/2010/Home-Broadband-2010.aspx>
 84. Nielsen Wire (2008). An Overview of Home Internet Access in the U.S. December 2008. http://blog.nielsen.com/nielsenwire/online_mobile/home-internet-access-continuing-to-grow-but-big-differences-among-demographics/ (accessed 14 April 2009).
 85. Nielsen Wire (2011). What you think you know vs. what you need to know about U.S. Hispanics and Media. http://blog.nielsen.com/nielsenwire/media_entertainment/what-you-think-you-know-vs-what-you-need-to-know-about-u-s-hispanics-and-media/
 86. Bleakley A, Merzel CR, VanDevanter NL *et al.* (2004) Computer access and Internet use among urban youths. *Am J Public Health* **94**, 744–746.
 87. Kind T, Huang ZJ, Farr D *et al.* (2005) Internet and computer access and use for health information in an underserved community. *Ambul Pediatr* **5**, 117–121.
 88. Mandl KD, Feit S, Pena BM *et al.* (2000) Growth and determinants of access in patient e-mail and Internet use. *Arch Pediatr Adolesc Med* **154**, 508–511.
 89. Hess R, Santucci A, McTigue K *et al.* (2008) Patient difficulty using tablet computers to screen in primary care. *J Gen Intern Med* **23**, 476–480.
 90. Barnett JE (2005) Online counseling: new entity, new challenges. *Counsel Psychol* **33**, 872–880.
 91. Ensher EA, Heun C & Blanchard A (2003) Online mentoring and computer-mediated communication: New directions in research. *J Voc Behav* **63**, 264–288.
 92. Rochlen AB, Zack JS & Speyer C (2004) Online therapy: Review of relevant definitions, debates, and current empirical support. *J Clin Psychol* **60**, 269–283.
 93. Mallen MJ, Vogel DL & Rochlen AB (2005) The practical aspects of Online counseling: Ethics, training, technology, and competency. *Couns Psychol* **33**, 776–818.
 94. Simkin-Silverman LR, Conroy MB, Bhargava T *et al.* (2011) Development of an online diabetes prevention lifestyle intervention coaching protocol for use in primary care practice. *Diabetes Educ* **37**, 263–268.
 95. Bahr DB, Browning RC, Wyatt HR *et al.* (2009) Exploiting social networks to mitigate the obesity epidemic. *Obesity (Silver Spring)* **17**, 723–728.
 96. Hwang KO, Ottenbacher AJ, Green AP *et al.* (2010) Social support in an Internet weight loss community. *Int J Med Inform* **79**, 5–13.
 97. Reed VA, Schifferdecker KE, Rezaee ME *et al.* (2012) The effect of computers for weight loss: a systematic review and meta-analysis of randomized trials. *J Gen Intern Med* **27**, 99–108.