



DETERMINANTS OF COMPLIANCE WITH IRON SUPPLEMENTATION: SUPPLIES, SIDE EFFECTS, OR PSYCHOLOGY?

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Abstract—Iron deficiency anemia affects over 2 billion people. Particularly at risk are pregnant women and young children. Although distribution of iron supplements is practised in many antenatal care programs in developing countries, it has often been alleged that pregnant women do not take them. Poor compliance arises not only because of patient behavior but also from factors out of the patient's control. This paper presents the results of a review of the literature on medical compliance to determine whether iron supplementation is different from other medications, to assess the known levels of compliance, and to synthesize recommendations for improving compliance relevant to iron supplementation.

The review showed that compliance with iron therapy is a specific case of medical compliance. Reasons for non-compliance with iron deficiency treatment include: inadequate program support (lack of political commitment and financial support); insufficient service delivery (poor provider-user dynamics; lack of supplies, access, training, and motivation of health care professionals); and patient factors (misunderstanding instructions, side effects, frustration about the frequency and number of pills taken, migration, fear of having big babies, personal problems, nausea that accompanies pregnancy, and the subtlety of anemia which makes demand for treatment low). Much has been made about the side effects (nausea, constipation, etc.) that women might experience during iron therapy as *the* cause of poor compliance with iron supplementation without justification according to this review. Instead, unavailability of iron supplements was the most common reason why women did not take iron supplements.

Women bear a disproportionate burden from iron deficiency anemia even though the technology exists to address the problem at low cost. Governments and health care professionals must renew their commitment to iron therapy by monitoring and improving compliance. We can significantly improve compliance by: making sure that iron supplements are available at all times; providing advanced warning about the possibility of side effects; involving the patient in the therapeutic strategy; and providing reminders, such as posters and calendars, about taking supplements.

Key words—iron, supplementation, compliance, anemia

INTRODUCTION

Anemia, largely due to iron deficiency, affects over 2 billion people [1]. In many regions, more than 50% of preschool children and pregnant women are anemic [2]. For women, the consequences of anemia are reduced levels of energy and productivity, impaired immune function, reproductive failure (miscarriage, still births, prematurity, low birthweight, perinatal mortality), and maternal death during childbirth [3]. It is estimated that 20% of maternal deaths are caused by severe anemia [4].

While many antenatal care programs distribute iron supplements to pregnant women, the effectiveness of these interventions in reducing maternal anemia has been inadequate. Some suggest that poor compliance with iron treatment (e.g. failure to take pills) is the probable reason for the ineffectiveness of such programs [5, 6] since adhering to other types of medical regimens (taking medication, following ad-

vice, keeping appointments, etc.) is, for the most part, considered to be the major determinant of recovery from disease [7-10].

Because the prevalence of iron deficiency anemia is so widespread and its effects are so serious, it is important to determine why iron supplementation programs have failed. If compliance is the major obstacle to adequately addressing iron deficiency anemia, ways of improving it must be found. The purpose of this paper is to examine the literature not only to ascertain the importance of patient compliance with iron supplementation, but also to determine other causes of failure of supplementation programs and to suggest ways to improve future effectiveness. In Section I compliance definitions, measurements, rates, and determinants are reviewed and in Section II ways to improve compliance and general performance of iron supplementation programs are discussed.

Table 1. Rates of compliance with selected treatments

Treatment	Compliance rate (%)	Measured by	Country	Reference
Glaucoma	50-70	Taking correct number of doses	Sweden	[44, p. 60]
Leprosy	50	Urine test	Malawi/Burma	[64, p. 14]
	68	continuing in therapy	Tanzania	[38, p. 19]
Oral contraceptives	75	Taking pills (self-reporting)	Thailand	[39, p. 27]
Physical therapy	20-93	Keeping appointments	Canada	[65, p. 29]
Rheumatic fever	33	Adherence penicillin therapy	United States	[38, p. 17]
Tuberculosis	28	Supply of drugs	Kenya	[7, p. 32]
	50	Urine test	N/A	[52, p. 325]
	64	Receiving bacteriological testing	United States	[26, p. 25]
	82	Receiving drugs	United States	[26, p. 25]

I. BACKGROUND

All long-term medical regimens face compliance problems—oral contraceptives, tuberculosis treatment, leprosy treatment, glaucoma treatment, psychopharmaceuticals, and many others. To date, however, insufficient attention has been paid to iron-specific compliance issues. From this review of the literature, compliance with iron supplementation appears to be a specific case of general medical compliance. Causes of poor performance with iron supplementation programs are low accessibility and utilization of antenatal care, insufficient supply and distribution of supplements, inadequate training and motivation of health workers, insufficient and inappropriate counselling of mothers, lack of motivation of mothers, and failure of effective screening and referral procedures [4]. Motivational problems are particularly important because anemia is not a dramatic illness and the gratification most patients receive from adherence to treatment for anemia may be minimal. Moreover, iron supplementation is only effective over a relatively prolonged period and pill taking may be discontinued long before the regimen has a positive impact. Much ado has been made about 'side effects' as the cause of poor compliance with iron supplementation; however, the literature reviewed suggests that side effects are the result of both physiological and psychological responses to iron supplements but do not impede compliance in a major or insurmountable way.

Compliance occurs when a patient follows the medical advice provided (e.g. taking medications, following diets, or making lifestyle changes) [9, p. 1]. When the physician or health care professional (HCP) prescribes iron supplements* and the expected outcome (increased hemoglobin, hematocrit, serum ferritin, etc.) is achieved, it is assumed that the patient is compliant [10, p. 6]. When clients do not recover as expected it is assumed that they did not cooperate with the prescribed treatment. This perspective, however, presumes the patient is solely responsible for the success or failure of medical treatment.

In fact, there are other causes for the success or failure of most types of medical treatments. The treatment may work, not because the patient has taken medication as directed, but because of exogenous factors. Improvements in hemoglobin, for instance, may be due to a change in diet not iron supplementation. In contrast, patients, especially those compliant in other ways (e.g. keeping medical appointments), may have valid reasons for not taking medication other than outright refusal to comply with the treatment plan [12]. For example, the HCP may not give the necessary information for taking medication [13] or the patient may be constrained by the cost of the prescribed medication [10, p. 15]. The promised positive benefits of taking iron (improved strength, energy, etc.) may be so subtle that the patient assumes that the supplements are ineffective and discontinues the regimen. In cases where symptoms are severe, disappearance of them may signal to the patient that she is cured and this may also cause her to stop taking supplements. Prolonged storage of iron tablets under unfavorable conditions (high temperatures and humidity) may lower effectiveness and thus decrease compliance with iron supplementation. This is particularly important to people in developing countries where the capacity to store iron pills under normal conditions is limited. If the provider fails to adjust the treatment to accommodate the patient's lifestyle (by changing the dose of the medication, giving counselling, ensuring the quality of iron pills, etc.), compliance and ultimately the success of the therapy will be jeopardized.

The importance of measuring compliance

In studies that measure the efficacy of iron supplementation programs, rates of compliance are rarely quantified or defined [14-18]. For example, in a recent review of 61 iron interventions for pregnant women, only half mentioned compliance [19].

According to Eraker *et al.* [20] measuring compliance in clinical studies is important since "if only half the patients take as little as 80% of prescribed medications, there is a vast increase in the number of patients needed to show a treatment's efficacy". Because the effectiveness of a drug cannot be judged accurately if compliance rates are unknown, it has been suggested that published results of drug treatment studies must include information on compliance

*It is recommended that iron should be given to all pregnant women in developing countries [4, p. 1]. Supplements of 60 mg of ferrous sulphate (twice daily) and 500 mcg of folic acid (daily) are recommended for pregnant women [11].

Table 2. Rates of compliance with iron supplementation

Compliance rate (%)	Measurement	Country	Reference
65-90	Pill counts, interviews	Burma	[31, p. 289]
87	Questionnaire	France	[48, p. 297]
67	Interviews, serum ferritin	Greece	[28, p. 739]
88	Interviews	Indonesia	[57, p. 38]
70	Missed clinic visits	Nigeria	[32, p. 33]
55	Pill counts	Norway	[37, p. 102]
86	Interviews	South Africa	[66, p. 1047]
86	Pill counts	Sweden	[41, p. 90]
85-90	Supervision, counting tablets	Thailand	[31, p. 282]
96	Pill counts	United Kingdom	[67, p. 184]
95	Urine tests	United States	[68, p. 480]
67	Serum ferritin, pill counts	United States	[24, p. 67]

[20, p. 258]. From a clinical point of view, knowing compliance rates can help monitor and revise therapeutic regimens [13, p. 23].

Expected rates of user compliance

Compliance rates have been measured for a number of different treatments (see Table 1) and for iron supplementation (see Table 2). Rates of compliance with iron therapy compare favorably with compliance rates for other types of medical treatments.

Interest in medical compliance has increased dramatically in the last decade. Only 22 articles on the subject appeared in the literature before 1960 while more than 1100 articles were listed in *Index Medicus* in 1984 and 1985 [21, p. 1299]. Given the vast number of papers available and that not all could be reviewed, the following method was used to select papers to review for this paper. First, a search of several data bases (MedLine and PopLine) was conducted for years 1970-1993. Second, a search for iron-specific compliance issues was conducted by consulting *Index Medicus* from 1970-1993. Third, a literature search of clinical studies to assess the efficacy of iron supplementation was shared with us by the MotherCare Project with John Snow, Inc. [19].

In the medical literature, meta-analyses are often performed on a number of clinical trials to increase structural sensitivity and significance [22, p. 450, 23, p. 508]. Because compliance is a behavioral response to clinical treatment (although there may be physiological reasons why people don't comply), this review of the literature cannot be called a true meta-analysis. However, we have used certain criteria, often established in meta-analyses, for including articles in this literature review. Articles on medical compliance were used if they quantified compliance. We also made use of articles with information on the causes of non-compliance. For iron compliance, we tried to identify every paper in existence that mentions iron compliance in some way. Studies that give reasons why iron supplements were not taken were useful but more weight was given to those studies in which iron compliance was actually quantified in some way. Sample size of studies was not used as a criterion for selection.

Measuring compliance

There are both direct and indirect measures of compliance. Direct measures are usually considered the most accurate since they involve expensive biochemical tests that detect physiologic change [24, p. 58]. Hemoglobin or hematocrit are the most common direct measures of iron status although serum ferritin, while most costly, is better since it detects iron stores. The major disadvantage of direct measures of compliance is that they tend to be intrusive which may compromise the overall treatment program and bias results by inconveniencing the patient [25, 26]. Another disadvantage is that the accuracy of direct measures may be affected by lifestyle changes such as changes in exercise, diet, disease, and stress [24, pp. 57-58, 25].

Indirect measures of compliance include direct observation or supervision of pill taking by the HCP; patient reporting; the HCP counting the number of pills or medication utilized; duration of participation of the client in the program or study; the patient keeping appointments; interviews with the patient to discuss compliance; and utilization of educational materials such as a calendar that is primarily used to remind beneficiaries to take their iron but which they also use to record their intake of iron on [14, p. 430, 17, p. 10, 18, p. 24, 24, 25, 27, 28, p. 740, 29-43].

Because patients tend to over-report how well they comply, patient self-reporting is the least reliable of the indirect measures [20, p. 259, 26, p. 29]. In one study, only 4% of patients reported that they missed two or more drug doses while monitor records showed that 33% missed two or more doses [44].

The accuracy of counting residual pills is variable. Pill counts corroborate physiological measures in only 60% of patients on tuberculosis therapy [26, p. 26]. On the other hand, home pill counts for iron therapy are highly correlated with biochemical assessments [24, p. 55]. In general, measuring compliance by pill counts should be treated with caution since current assessments of the accuracy of counting pills are variable and the number of pills missing does not necessarily equal the number of pills consumed by the patient [34, p. 37].

Determinants of compliance

Somatic causes. Somatic factors (side effects, delays in drug response, dementia, and problems with manual dexterity) are often the cause of non-compliance with treatment [8, p. 1148, 45]. The patient prescribed ineffective or toxic regimens may no longer want to take the medication. Overmedication, which can increase drug resistance (as is true for antibiotics) can have long-term ramifications for community compliance [25, p. 20].

While the nausea, vomiting and constipation that sometimes accompany early pregnancy may be exacerbated by iron supplementation, there is little evidence that side effects are the major cause of non-compliance (see Table 3). In the studies reviewed, non-compliance was most often due to dropping out of clinical studies, caused by an array of factors (outmigration, lack of cooperation, lack of motivation on the part of pill distributors and patients, premature delivery, lack of supplies, and side effects). The proportion of women who stop taking pills due to side effects is small (less than 10%) and probably not the reason for failure of supplementation programs in developing countries. Reviews of iron supplementation programs in India and Thailand report that the major reason women don't take iron supplements is that pills are not available or distributed. Anecdotal evidence from other developing countries contends that supply problems are the main reason why anemia persists.

In Burma only 3% of women stated that side effects were the reason they stopped taking iron supplements [31, p. 291]. While 30% of women in Thailand complained of side effects while taking iron, researchers found that the side effects did not contribute to poor compliance because women were counselled that side effects would subside [43, p. 7]. The evaluation of the Indian iron supplementation program also found that only 1% of women cited side effects as a reason for not taking iron pills [46]. However, HCPs in India had different perceptions on the importance of side effects and claimed that side effects were the reason why 9.6% of women would not take iron supplements. HCPs also stated that 39.2% of women had acceptance problems while only 4.7% of the women said they had acceptance problems. Other studies support the notion that adverse side effects affect compliance only minimally. In Norway women receiving iron supplements complied as well as those receiving a placebo, suggesting that side effects may not have been important [37]. In another study only a small percentage of women were not able to tolerate iron treatment [47]. Still, others have found that side effects from iron therapy cause poor compliance in 10% of women [48] and that only 5% of women complained of mild gastrointestinal problems during iron supplementation [15, p. 726]. In a Caribbean program, side effects were reported by 40% of the participants but program

officials could not ascertain if side effects were the reason women stopped taking iron tablets [4, p. 85].

Dosage and form. Like other types of drug treatments, compliance with iron supplementation decreases as the number of doses and size of the dose increases [49]. The form in which iron tablets are given also affects compliance (color, injection, tablet, liquid, taste, etc.) [5, p. 2,50]. For example, women in Mexico felt that iron injections were more effective than tablets [51] and that red iron pills were more efficacious than white or brown ones because the color red is thought to strengthen and purify the blood [5, p. 2]. In Indonesia, sugar-coated pills are more acceptable than uncoated tablets, probably because sugar disguises the iron taste [50, p. 26].

Utilization of health services and personal beliefs. Physical distance to the clinic, economic constraints (cost of travel or the supplements), and inconvenience of clinic hours may all affect utilization of health services [28, p. 740]. In many developing countries, use of any antenatal care service is often quite low (below 50%), hence access to iron supplementation, usually delivered through the health care system, is equally low.

Beliefs about health and treatment may also interfere with iron compliance. In Thailand some women decided not to take supplements because they thought iron caused bigger babies and difficult deliveries [43, p. 5]. In Mexico, compliance with iron supplementation was better when women sought early prenatal care because many of the late comers felt that iron was only absorbed during the first third of pregnancy and was not effective after the first trimester [51]. If patients view the taking of drugs as a threat to self-reliance, they may turn to alternative ways of receiving care (the family, self-prescription, traditional healers, neighbors, friends and others) [21]. If the HCP has preconceived ideas about these beliefs and fails to customize treatment to meet client needs, the client may choose alternatives to medical advice.

Patient-provider relationship. The quality of the patient-provider relationship is pivotal in determining compliance with medical treatment [52]. However, quality does not necessarily imply that patients are given more information. In fact, patients who master factual information about their disease and the benefits of treatment are not more compliant. People who receive counselling through social support groups do not always comply better than people who attend formal lectures on their disease and treatment [52, p. 328]. Patient involvement, the clarity of the message, and how it is delivered are important in improving patient-provider dynamics. If the patient and HCP work together and successfully negotiate a treatment plan, for example, the regimen is more likely to continue as planned [53]. However, the provider's need for superiority in the relationship with the patient can often get in the way of the therapeutic objective being met. Physicians may

Table 3. Reasons women stop taking iron tablets

Country	Non compliers (%)	Reference
Burma		
Premature delivery	5-15	[31, p. 291]
Side effects ¹	3	
Hospitalization	1	
Caribbean		
Drop outs ²	33	[4, p. 85]
France		
Side effects ³	10	[48, p. 297]
Neglect (forgot to take)	3	
India		
Drop outs (mainly due to lack of supplies)	58	[4, p. 56]
Side effects	1	[46, p. 34]
Drop outs ⁴	30	[69, p. 252]
Side effects	6	
Indonesia		
Lack of supplies	83	[57, p. 38]
Side effects	4	
Norway		
Outmigration	6	[37, p. 102]
Abortion	4	
Side effects	0	
Sweden		
Absorption testing	14	[41, p. 89]
Complications in pregnancy	4	
Outmigration	4	
Spontaneous abortion	4	
Thailand		
(Central: men & non-pregnant women)		
Drop outs ⁵	10-16	[31, p. 282, 284]
Side effects ⁶		
(Northeast: pregnant women)		
Drop outs ⁷	10-15	[31, p. 285, 286]
(Northern: non-pregnant women)		
Drop outs ⁸	35	[31, p. 288, 289]
United Kingdom		
Side effects	6.5	[47, p. 195]
Outmigration	2	[67, p. 184, 188]
Did not keep appointments	2	
Side effects ⁹	0	

¹Side effects were low because pills were administered at meals.

²30-40% reported side effects but researchers could not ascertain if women stopped taking pills because of side effects.

³30% (16% minor and 14% severe alimentary side effects) reported side effects but only 10% stopped taking pills because of side effects.

⁴Lack of cooperation (refusal to have blood drawn), premature delivery.

⁵Outmigration, lack of motivation of pill distributors, fear of obesity.

⁶Side effects were reported only by those who received pills that had been exposed to humidity and had a metallic flavor. These were mild and tended to disappear after a few days. Authors conclude side effects do not affect compliance.

⁷Outmigration, lack of cooperation, premature delivery, illness. 10 (those taking the 120 mg dose)-30 (those taking the 240 mg dose) % mentioned that they experienced side effects during the first 3 days of treatment but midwives and researchers reassured women that side effects would disappear and mothers continued taking pills.

⁸Dropouts due to (in order of importance): unwillingness to take pills, side effects. Authors felt that side effects were higher than in other parts of Thailand because iron was given as a single dose.

⁹Mild side effects were reported but no one stopped taking pills because of side effects.

perceive that working with the patient toward a common goal is a threat to their medical sovereignty over the patient [54].

Supplies. The patient-provider relationship will have no effect on compliance if drug supplies are limited. Supply problems are the major reason why tuberculosis programs fail in developing countries [25, p. 21]. Examination of malaria prophylaxis programs in Zimbabwe revealed that poor compliance with therapy was often attributed to poor availability of drugs, poor registration records, absent HCPs, lack of supervision, and inadequate health education [55].

Although it is a policy in most developing countries to give iron supplements to pregnant women, clients are often not given enough pills to effectively improve their iron status. This may be due to a number of problems that include: lack of overall government resources, a low priority for health expenditures within the government, and a lack of awareness of policy makers about the importance of iron supplements [4, p. 9].

An evaluation of the Indian iron supplementation program showed that only 20% of women and less than 1% of children who were suppose to receive iron supplements actually took them. The majority of women attributed this to lack of supplies, but when they did receive supplements, the pills were of poor quality [56]. Supplies were also a problem in Indonesia where 83% of participants in the Nutrition Development Program said they had never seen iron tablets [57]. On further investigation, it was found that the HCPs had not distributed iron because they did not understand its importance. This was also true in India where only 37.6% of HCPs knew the objectives of the iron supplementation program, 58.4% had incomplete knowledge, and 4% had no idea at all about the objectives.

In the next section, a review of iron supplementation in programs will highlight factors that can improve the effectiveness of iron supplementation programs.

II. IMPROVING IRON COMPLIANCE

The patient-provider relationship

For all types of treatment, patients rate medical care as efficacious when they experience behavior and social gains even if their physical condition does not improve. The most important factor in determining compliance and satisfaction may be the patient's perception about the concern of the provider [58]. Patient satisfaction can be increased by the physician's encouragement such as smiling, asking questions about family and personal situations, and providing a sense of continuity from previous visits (i.e. follow up). When the patient is satisfied with the treatment given by the HCP, adherence to drug usage is positively affected [54, p. 325]. In iron supplementation studies in Thailand and Burma, high compliance levels were attributed to motivated program participants and

HCPs [31, p. 296].

Acknowledging and using patients' perceptions can also be an effective way of involving the patient in treatment and improving patient satisfaction. In Hong Kong when women expressed concern that iron supplements were a 'hot' food, a physician suggested they balance that temperature by eating oranges, a 'cold' food, when taking iron supplements [59]. Acknowledging this belief, instead of ignoring or discounting it, provided a solution to women's concerns and at the same time introduced a food high in vitamin C, which facilitates the absorption of iron.

Helping clients make the connection between iron supplementation and feelings of improved health is important for continued compliance. Feeling better (more energy, more strength, etc.) will reinforce compliance. In some programs side effects did not become a reason for failing to take iron supplements if the provider reassured the patient that the side effects would subside and were not a health hazard [31, p. 285, 43, p. 7, 57, p. 38].

Compliance can be improved by developing appropriate messages and improving communication. In Northeast Thailand a calendar was used to remind women of the importance of taking iron pills and to help them keep track of the supplements they had taken [43, p. 7]. Social marketing can also be used to promote the importance of iron supplementation and address concerns about taste and side effects that might affect compliance [50, p. 26].

Providing empathetic counselling or more information may have little effect when lack of access to resources interferes with compliance. HCPs may need to manage these impediments if their effect is to be minimized. For example, in some countries where women observe purdah, toilet facilities may only be available to them at certain hours after dark. Under these conditions, a sudden attack of diarrhea caused by any medication is an understandable deterrent to continuing a cycle of drugs. The HCP may need to help women increase their access to toilet facilities by encouraging communities to set aside special facilities or areas that are available to women at all hours.

HCP attributes of empathetic counselling, sensitivity to the importance of anemia, and problem solving to remove structural and cultural impediments to taking iron pills can be improved by developing training packages for all levels of HCPs. In addition, patient-provider relationships can be improved through public health campaigns that reinforce the importance of overcoming iron deficiency anemia for both the provider and patient.

Dose, timing and location

Reducing the number of doses of iron per day and the size of the dose will usually improve compliance. In one study, as the number of tablets ingested fell from three times a day to once a day, compliance increased from 67 to 95% [52, p. 329]. In the Burmese/Thai studies, reducing the frequency and

size of iron doses improved compliance and hemoglobin response [31, p. 292, 296].

Ways to encourage people to keep their appointments to restock their iron supplements include: eliminating long waiting lines, giving appointment reminders, expanding services to evenings and weekends, locating health centers in the community, developing accessible transportation services, providing appropriate language services, providing child care facilities, bringing treatment programs to the workplace, and using the private sector (pharmacies, private practitioners, traditional birth attendants, etc.) as a distribution network. The private sector may be effective because it often has more credibility in countries where the public health care system is inefficient. When a treatment service was offered in their place of work, 85% of workers with hypertension participated in a blood pressure control program [52, p. 327]. Community-based support programs are the most convenient and help improve patient involvement and compliance [52, p. 327].

Side effects

Although there is little evidence to suggest side effects are a major deterrent to compliance with iron supplementation, they should not be ignored and consideration of them should be part of the treatment plan. It is known that iron can cause a number of side effects that include nausea, dizziness, abdominal discomfort, fatigue, diarrhea, constipation and headaches [27]. Although these side effects are infrequent and usually mild, if beneficiaries are warned that side effects might occur and reassured that they will subside with time, they will probably react less strongly to unpleasant side effects. Doses should be reduced or built up over time if women insist that side effects are intolerable. Training HCPs about the importance of iron supplementation will help them warn patients about side effects. In fact, in Indonesia women who had side effects were not bothered by them because they had been warned they might occur [57, p. 38].

Giving a good supplement along with iron tablets may be an effective (though costly) way to increase compliance. In the Philippines 90% of women took their pills when they were given with food while only 67% took their pills when they were distributed without food [61]. In addition, increases in hemoglobin tripled when iron was combined with food supplementation. It isn't clear if the food increased the compliance of beneficiaries because the availability of food made taking the pills more attractive (reduced side effects) or if absorption of iron improved [24], although the latter possibility is unlikely since food usually interferes with iron absorption.

Side effects due to iron supplementation may also be reduced by using a controlled-release daily iron supplement. In some studies these preparations have been shown to have fewer side effects [61] although the cost of these supplements may be considerably

higher than tablets [62]. In a program in the Philippines there was no significant difference in compliance between controlled-release and fast-release preparations although absorption was improved with the controlled-release type [27]. This may be because side effects are not affected with the delayed-release formulas [63].

Supervision

When the HCP watches the patient take the iron supplement, compliance does improve although program costs increase because such supervision is expensive. In one study, supervising the ingestion of 60 mg of elemental iron produced a significant increase in hemoglobin of pregnant women but giving the same amount in a self-regulated situation produced no effect [27]. It was estimated from this study that in order to positively affect iron status, the dose would have to be doubled in unsupervised programs. In Burma and Thailand, unsupervised women receiving 120 mg of iron/day had significantly greater increases in hemoglobin than with those prescribed 240 mg/day indicating more compliance problems with larger doses. In a study of adolescents in the United States, a high compliance rate with iron therapy was attributed to the supervision given by the families of patients [24, p. 58].

Supplies and costs

Some studies show that the availability of supplies is the major constraint in iron supplementation programs. Reasons for lack of supplies are the underestimation of the need for iron at the village level, distribution bottlenecks as pills travel from central to district levels of government, and mistargeting (e.g. school children instead of pregnant women) [4, p. 9]. To assure an adequate supply, needs assessments must be conducted from the district level up to the national level and 25% should be added as a buffer stock to this amount [4, p. 10]. To ensure the maintenance of supplies, budgetary provisions need to be made for iron supplements, quality control is necessary to ensure potency and authenticity, timely restocking is required (1 month supplies at village health posts and 3 month supplies at district hospitals), regular monitoring of supplies is needed, the tablets must be stored properly to mitigate deterioration at high temperatures and humidity, and internal and external supplies must be reliable [4, p. 10]. It is important to work on resolving supply problems at all levels for all essential drugs and to set priorities on the choice of drugs that must be available in sufficient quantity and of adequate quality to be effective. This will improve responsiveness to local conditions and accuracy in estimating the supplies and resources needed to supply needed drugs at all levels [4, p. 10].

It is not clear if making patients pay for any medication will increase their compliance. Charging for medication may decrease accessibility for some

Table 4. Ways to improve iron compliance and supplementation programs

Action	By
Improving the awareness of the policy maker	Training, social marketing
Improving the awareness of the provider	Training at all levels, counselling, social marketing
Improving the awareness of the patient	Improve one-on-one counselling, public health campaigns
Improving the patient-provider relationship	Increasing patient involvement Increasing provider empathy to: <ul style="list-style-type: none"> ● acknowledge belief/lifestyles/constraints ● provide continuity ● nonverbal encouragement ● provide flexibility
Providing quality service	Using tested, appropriate messages Using educational aids Reassuring that side effects will subside Advising to consume food with iron when possible Reducing the number of doses, size of the dose as needed Improve timing by: <ul style="list-style-type: none"> ● giving appointment reminders ● expand services to off hours ● reduce waiting lines ● providing childcare services ● multiple language services ● bring treatment to the workplace community
Providing quality product	Culturally appropriate color, taste, and texture of supplements, form of iron (pill, injection, elixir), packaging
Ensuring availability of supplies	Providing buffer stocks Allocating proper budgetary provisions Monitoring quality Providing proper storage Decentralizing delivery Non-central government procurement Competitive procurement

patients. For example, it has been recommended that tuberculosis chemotherapy be free to improve patients' access to drugs [49, p. 28]. However, there is no evidence that removing fees has any significant effect on compliance [52, p. 327]. Paying some nominal fee for treatment may actually increase compliance by giving the treatment economic value to the patient.

Policy/research

That anemia is not perceived as a major health problem by policy makers, district health officials, primary health care managers, village health workers and even anemic women is a major constraint to program success. Until there is clear priority in public health policy on iron deficiency anemia control, increasing compliance will remain a half-hearted effort by HCPs at all levels. More operational research is needed to document psychological and cultural factors affecting compliance followed by different approaches to overcome the problems identified. Solutions will include advocacy, training, and social marketing. Operational research is also needed to identify appropriate service delivery modalities. Such solutions are cost-effective and work to eliminate wastage of costly supplies and to improve compliance.

The technology can be improved as well. Decreasing the number and frequency of doses and improv-

ing color, coating, and packaging will be an important factor in increasing the efficacy of iron supplementation programs worldwide. Research in this area is imperative to improving the iron status of women in developing countries where iron deficiency anemia has severe ramifications on the quality and length of life.

CONCLUSIONS

Despite viable ways to treat iron deficiency anemia, the disease is still the most prevalent nutritional deficiency in the world. While giving iron supplements to pregnant women is part of most public health regimens, there has been little success in decreasing high rates of iron deficiency anemia. In developing countries, failure of these programs is usually due to the unavailability of iron tablets at all levels of the health system, but problems with miscommunication between patients and providers, and product and service quality are also at issue.

A summary of ways to improve iron compliance and supplementation programs is provided in Table 4. The conclusions of this paper are that much can be done to improve existing iron supplementation programs in developing countries by ensuring that pills of good quality are available at all levels of health care. This can be done by making better estimates of those in need of iron supplements,

allocating sufficient resources to cover needs at all levels in the health system, monitoring quality, decentralizing delivery, and sensitizing policy makers, HCPs, and consumers as to the importance of iron deficiency anemia.

HCPs need to sharpen their skills in counselling women to take iron pills by involving patients in the design and implementation of their treatment plans and providing solutions to physical and cultural obstacles that keep them from taking their pills. Developing and testing educational aids and messages will reinforce one-on-one counselling. At present, side effects do not seem to be the major reason for non-compliance with iron therapy. Concerns about side effects should not be ignored, however. HCPs should counsel women about side effects and the benefits of compliance. If side effects do not disappear, HCPs should lower the number or size of the dose and suggest that women consume iron pills with food, if possible.

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