Safety, acceptability, and feasibility of a single-visit approach to cervical-cancer prevention in rural Thailand: a demonstration project

*Royal Thai College of Obstetricians and Gynaecologists (RTCOG) and the JHPIEGO Corporation Cervical Cancer Prevention Group**

Summary

Background To increase screening and treatment coverage, innovative approaches to cervical-cancer prevention are being investigated in rural Thailand. We assessed the value of a single-visit approach combining visual inspection of the cervix with acetic acid wash (VIA) and cryotherapy.

Methods 12 trained nurses provided services in mobile (village health centre-based) and static (hospital-based) teams in four districts of Roi-et Province, Thailand. Over 7 months, 5999 women were tested by VIA. If they tested positive, after counselling about the benefits, potential risks, and probable side-effects they were offered cryotherapy. Data measuring safety, acceptability, feasibility, and effort to implement the programme were gathered.

Findings The VIA test-positive rate was 13·3% (798/5999), and 98·5% (609/618) of those eligible accepted immediate treatment. Overall, 756 women received cryotherapy, 629 (83·2%) of whom returned for their first follow-up visit. No major complications were recorded, and 33 (4·4%) of those treated returned for a perceived problem. Only 17 (2·2%) of the treated women needed clinical management other than reassurance about side-effects. Both VIA and cryotherapy were highly acceptable to the patients (over 95% expressed satisfaction with their experience). At their 1-year visit, the squamocolumnar junction was visible to the nurses, and the VIA test-negative rate was 94·3%.

Interpretation A single-visit approach with VIA and cryotherapy seems to be safe, acceptable, and feasible in rural Thailand, and is a potentially efficient method of cervical-cancer prevention in such settings.

Lancet 2003; **361:** 814–820

Introduction

Worldwide, over 470 000 new cervical cancer cases occur yearly—about the same as the number of maternal deaths every year.[1,2] Tragically, although this disease is preventable by screening linked with treatment, most women die because few developing countries (where most cases arise) have successful prevention programmes, attributable in large part to the complex infrastructure needed for traditional cytology-based programmes.[3–6]

To address this health inequity, effective practical alternatives to cytology for detection of precancerous lesions are being investigated. Research has established the viability of visual inspection with acetic acid (VIA) to identify precancerous lesions.[7–15] Besides its high sensitivity and low-cost, VIA is simple enough for nurses to provide at low levels of the health-care system, with locally available supplies. Because results are immediate, loss to follow-up is kept to a minimum.[5,16–18]

Showing whether VIA can be efficiently and safely linked to treatment in low-resource settings is the logical next step in assessment of its potential role in developing country programmes. One way to achieve the best secondary prevention in low-resource settings is to couple testing with an immediate offer of diagnosis, treatment, or both for test-positive cases; essentially, a single-visit approach.[19] A VIA-based, single-visit approach differs from the traditional approach in that diagnostic referral—eg, for colposcopy or biopsy—is restricted only to cases ineligible for treatment immediately post-testing.

Some people feel that this approach is inappropriate for developing countries, because the safety of non-physicians treating precancerous lesions in low-resource settings has never been established.[20] Additionally, writers of a *Lancet* Commentary[15] noted that identification of many women with low-grade lesions (with VIA) might not be cost effective. To address these information gaps, a team from the USA (JHPIEGO Corporation) and Thailand (Royal Thai College of Obstetricians and Gynaecologists [RTCOG]), in collaboration with the Thai Ministry of Public Health (hereafter Ministry), initiated a multisite demonstration project in rural Thailand, where screening coverage remains low. The project aimed to establish the safety, acceptability, and feasibility of efficiently implementing a VIA and cryotherapy-based, single-visit approach to cervical-cancer prevention in a rural, low-resource setting. Cryotherapy was selected because it: has a cure rate comparable to other common outpatient procedures;[21–23] is easily learned; does not need electricity; requires few consumables; has a documented history of low complication rates;[22,24] and has an established performance record in the hand of non-physicians in developed countries.[25] We

*Members listed at end of report

Correspondence to: Dr Lynne Gaffikin, Cervical Cancer Prevention Programme, JHPIEGO Corporation, 1615 Thames Street, Suite 200, Baltimore, MD 21231, USA
(e-mail: lgaffikin@jhpiego.net)

describe key results of this demonstration project with an alternative, field-based, resource-appropriate approach to cervical-cancer prevention.

Methods

The project was done in four districts in Roi-et Province, Thailand, because it is mostly rural, services have been unsuccessful here in the past, and a tertiary referral facility is reasonably close (Ministry of Public Health). The project recruited women between February, 2000, and October, 2000, and was approved by two Institutional Review Boards (Johns Hopkins Bayview Medical Center, USA, and Ministry of Public Health, Thailand), and received official support of the Ministry.

Provider training

12 nurses with some reproductive health experience were trained in VIA and cryotherapy during a 2-week, competency-based course with classroom and clinical practice (supervised by experienced US and local medical consultants). Sufficient practice was provided for everyone to be assessed as competent according to guidelines agreed upon by participating institutions.[26] Four skilled colposcopists who provided intensive nurse supervision during the project received similar training.

Project sites

Three nurses provided services at their hospital (static services) or as two-person, itinerant teams that regularly visited 36 rural primary health centres in the hospital catchment area (mobile services).

Screening participant selection criteria

The project targeted women aged 30–45 years, since its focus was to identify and treat precancerous lesions.[16] Women with a total hysterectomy, history of cervical cancer, or more than 20 weeks pregnant (by clinical examination) were also excluded. Eligible women attending selected sites for any reason during recruitment were invited to participate. Ministry volunteers who routinely do health promotion activities in catchment villages provided information about the project by distributing brochures, by telling women about the services, and through loudspeaker announcements.

Sample size

A key question about cryotherapy use in low-resource settings is its safety when provided by non-physicians. Clinical experience with cryotherapy in developed countries has been associated with a low complication rate (<5%), which we anticipated would also be the case in Thailand. To ensure that we could detect a complication rate as low as 4% (with 2% precision), we estimated that 370 women needed treatment and 3700 women needed recruiting (assuming a 10% minimum test-positive rate).[4] To allow for mobile-specific versus static-specific estimates, the final targeted sample size was 740 treated and 7400 tested.

Clinical protocol

At the intake visit, interested women participated in a group education session. Subsequently, a clinical history (including demographic and reproductive health questions) was taken. Women were individually counselled again, and written informed consent was obtained before testing.

Project VIA categories and their relation to clinical findings

VIA category	Clinical findings
Test-positive	Raised and thickened white plaques
Test-negative	Smooth, pink, uniform, and featureless; ectopy, polyp, cervicitis, inflammation, Nabothian cysts
Cancer	Cauliflower-like growth or ulcer; fungating mass
Indeterminate	No distinct acetowhite lesion is visible, but some white area is apparent that could represent an abnormality Or, cervicitis or inflammatory changes are so severe that the cervix cannot be adequately assessed for acetowhite lesions

After being positioned on the examination table, abdominal and external genitalia examinations were done, a Graves speculum was inserted, and the cervix was brought into view. The nurse then assessed the cervix for the presence of gross lesions consistent with possible cancer. Next, a dilute (5%) acetic acid solution was applied liberally to the cervix. After waiting 1 min, the cervix was re-examined by flashlight or an examination light. Special attention was paid to ensuring that the entire squamocolumnar junction was visualised. Assessment findings were recorded with standardised VIA categories (panel).

Test-positive women with lesions meeting four criteria were deemed eligible for immediate cryotherapy: not suspicious for cancer; did not extend onto the vaginal wall; occupied less than 75% of the cervix; and extended less than 2 mm beyond the cryotherapy probe. To conform with Thai clinical guidelines, additional criteria for postponement of immediate treatment, referral, or both included: menses—current or expected within 7 days (treatment postponed until after menses); HIV—known positive status (follow-up provided by a referral physician); polyp—protruding into the cervical os (polyp removed by a referral physician, after which the patient was to return to the nurse for cryotherapy); fibroid—tumours more than 12 weeks' size (woman referred to a physician; if not a candidate for hysterectomy, she was to return to the nurse for cryotherapy).

Women assessed as indeterminate with one or more of the following risk factors were also offered treatment: sister or mother had cervical cancer; previous abnormal pap; early sexual onset; smoker; HIV positive; or previous history of a sexually transmitted disease.

Before treatment, the nurse explained the meaning of the test results, the treatment procedure, potential risks, benefits, side-effects, and advantages and disadvantages of immediate (versus postponed) treatment. Then, the woman made an informed choice about whether or not she wanted immediate treatment. Test-positive women with evidence of purulent cervicitis, otherwise eligible for immediate treatment, got one oral dose of two antibiotics before cryotherapy to reduce the risk of pelvic infection post-treatment.

Cryotherapy was provided with a standard double-freeze technique and a 19-mm probe with a shallow nipple (Wallach Scientific, CT, USA). Oral non-narcotic analgesics were offered to women with bothersome cramping after treatment. Before

leaving, treated women were given home self-care instructions and were told when to return for their next visit. Women were instructed to return immediately if they had any symptoms of a potential complication—eg, fever for more than 2 days. Finally, women were counselled to abstain from sexual intercourse for at least 4 weeks after treatment and were given 20 condoms to reduce the risk of infection, if intercourse could not be avoided.

The first follow-up visit (at 3 months) was to inquire about the woman's post-treatment experience—eg, when watery discharge ceased—and any post-treatment problems. Nurses did a pelvic examination only to investigate a specific complaint. A 1-year follow-up visit was for pelvic and speculum examinations to assess the general state of the cervix and a VIA test to determine whether any acetowhite lesion was present. Anyone who was VIA-positive at 1 year was referred to a physician for further assessment.

Outcome measures

Project indicators represented four basic themes: safety, acceptability, feasibility, and programme effort. Specific indicators measured were as follows.

Safety—(1) proportion having severe bleeding, shock, or any disorder needing admission during treatment; (2) proportion with post-cryotherapy complications; and (3) proportion returning for a problem visit.

Acceptability—(1) proportion satisfied with their initial visit decisions; (2) proportion whose partner supported their treatment decisions; and (3) proportion who successfully adhered to home-care instructions.

Feasibility—(1) recruitment rate; (2) cryotherapy rate; (3) proportion of cryotherapy procedures postponed versus provided immediately; and (4) time-trend correlation between VIA and family planning visits.

Programme effort—(1) VIA test-positive rate 1 year post-cryotherapy; (2) VIA coverage rate; and (3) correlation between provider and supervisor VIA assessment findings.

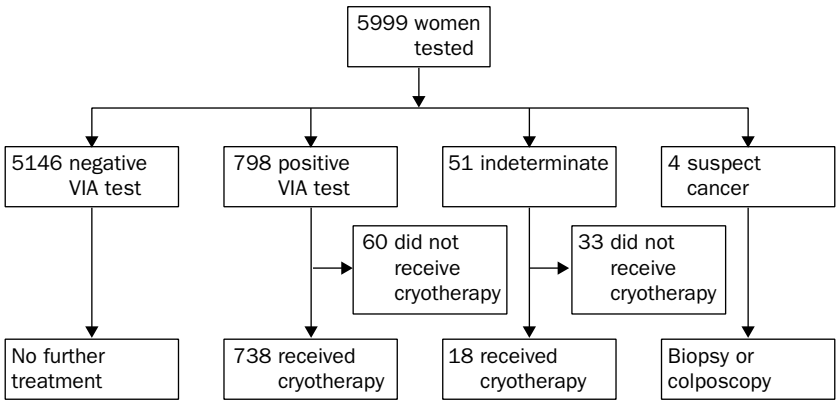


Figure 1: **Participant flow through project**
Flow of participants through the project protocol provides the numerators and denominators for project outcome measures. For some calculations, the denominators varied because of differences in completeness of the dataset.

	Number of women* (%)
Reported symptoms	
Bleeding not associated with menses	18/627 (2·9%)
Blood clots	3/627 (<1%)
Pain, cramping, or both, not associated with menses	85/626 (13·6%)
Other problems of cervix, vagina, pelvic area	12/626 (1·9%)
Change in menstrual blood	55/552 (10·0%)
Change in number of days of menses	41/552 (7·4%)
Change in menstrual cramping	64/552 (11·6%)

*Denominator equals the number of informative responses for that question.

Table 1: **Safety at first follow-up visit**

Role of the funding source

The sponsors of this study had no role in study design, data collection, data analysis, data interpretation, writing of the report, or in the decision to submit the report for publication.

Results

5999 women were VIA tested (figure 1); they were mean age 36·7 years (SD 4·35) and had 5·6 years of education (SD 2·74). 5837 (97·3%) were married or cohabiting with a partner. More than half (3516; 58·6%) received mobile services in a primary centre; the others received services at a district hospital. 798 (13·3%) were VIA positive. The test-positive rate did not differ significantly between static and mobile services (13·9% *vs* 12·9%, respectively; p=0·23). However, it did differ significantly by district (p<0·0001). 51 patients (0·9%) were classified as indeterminate and four (<1%) had suspect cancer.

738 (92·5%) women who were VIA positive, and 18 who were indeterminate, received cryotherapy (figure 1). Of the four suspect cancers, all were followed up with colposcopy or biopsy at the referral hospital; one cancer was confirmed (stage 2B, poorly differentiated squamous cell carcinoma). This finding yields a cancer rate of 16·7 per 100 000 women, similar to the age-adjusted cancer rate (18 per 100 000) for nearby Khon Kaen Province, as reported by the International Agency for Research on Cancer. The other women with suspect cancers had cervicitis.

Of those treated with cryotherapy, 629 (83·2%) returned for their scheduled first visit. No significant difference existed in mean age or education level (p=0·35 and p=0·95, respectively) between those returning and not returning. However, the proportion returning did differ significantly by district (p<0·0001) and between mobile and static sites (86·4% and 78·8%, respectively; p=0·01). A higher proportion (707; 93·5%) returned for their 1-year than their first follow-up visit.

With respect to safety of cryotherapy, of 290 women reporting some pain during the procedure, it was mild for 229 (79%), moderate for 53 (18·3%), and severe for eight (2·8%). An analgesic was provided after the procedure to 46 (6·2%) of 746 women. Immediately post-treatment, 307 (40·8%) reported pain, although 247 (80·4%) of these said it was mild. 11 women had mild bleeding during the procedure, which was managed by

	Number of women (%)
Attitude	
Satisfied with their decision to be tested	5648/5742 (98·5%)
Testing experience was better than expected	5133/5729 (89·6%)
Informed enough through counselling about probable experience	5699/5709 (99·8%)
Satisfied with their decision to get treated on the spot	745/752 (99·1%)
Cryotherapy experience was better than expected	688/752 (91·5%)
Informed enough about probable treatment experience	740/744 (99·5%)

Table 2: **Women's attitudes towards project services**

applying pressure; no surface medication (eg, Monsel's solution) was applied. No admissions and no outpatient clinical action, other than pressure, were needed immediately post-treatment.

33 (4·4%) of 756 women returned for an unscheduled (problem) visit. An outpatient procedure—a conservative proxy measure for minor complications—was done for 17 (51·5%) of those returning (2·2% of those treated). Very few women (n=7) complained about discharge or spotting. No major complications (admission, transfusion, or major surgery) were reported. One woman had suspect pelvic inflammatory disease but did not need admission or intravenous antibiotics. Systems were instituted to actively monitor whether women presented with cryotherapy-related problems elsewhere. Some problem visits might have gone unreported but, in view of the high project visibility, any important complication is unlikely to have gone unnoticed. 100 (16%) of the 624 women returning at the first follow-up visit post-treatment had a complaint (table 1), most typically pain or cramping (n=71).

With respect to acceptability of the single-visit approach, women reported being highly satisfied at the end of their initial visit (table 2). Almost all (5136/5146; 99·8%) women who had a negative VIA test said they would recommend it, and 737 (97·5%) of the 756 women treated indicated they would recommend both VIA and cryotherapy. At 3 months, 97·9% (616/629) had recommended VIA to others and 94·5% (594/629) said that treatment was equal to or better than expected.

	Number of women VIA tested in 7 months during 2000	Percentage coverage from project efforts*
District		
Kasetwisai	1227	12·2
Pathumrat	1320	25·9
Chaturpakpiman	1990	20·0
Phanomphrai	1462	14·7
Total four districts	5999	17·1
Total province	5999	1·5

*Estimated number of women age 30–45 years in all four districts in 2000=35 062 (1·1% annual growth rate). Estimated number of women age 30–45 in the whole province in 2000=140 191.

Table 3: **Coverage rates**

Rates of adherence to home-care requirements were impressively high. Although 454/628 (72·3%) reported having intercourse post-treatment, 312 (68·9%) of 453 initiated intercourse after 4 weeks. Of the remaining 140 (31·1%), 124 (88·6%) used condoms and almost all reported consistent condom use. Overall, only 16/627 (2·6%) had unprotected intercourse within 1 month post-treatment (4·3% [27/624] including those inconsistently using condoms).

Initially, 697 (92·2%) of those treated thought abstaining from intercourse for 4 weeks would not be a problem for their husband. Few (45/628; 7·2%) at first follow-up indicated having problems convincing their husband to postpone intercourse. Of those having intercourse (454), only 13 (2·9%) reported problems convincing their husband to use condoms. Many (596/628; 94·9%) at this visit reported husband satisfaction with their decision to get treated. Of those having intercourse within 1 month, 128 (92·8%) did so because of their husband. After a few weeks, the nurses reported feeling very confident about their testing and treatment skills and positive about VIA and the single-visit approach.

With respect to feasibility of the single-visit approach, about 75% (4499/5999) of the women were tested within the first 3 months, probably because of supplemental outreach village education and awareness efforts by Ministry staff. Once most of the targeted sample size had been achieved, these efforts were discontinued, and VIA recruitment in the latter months was promoted via provider or woman word of mouth.

610 test-positives and eight indeterminates were eligible for immediate treatment. Eligibility did not differ significantly between mobile and static users (p>0·99),

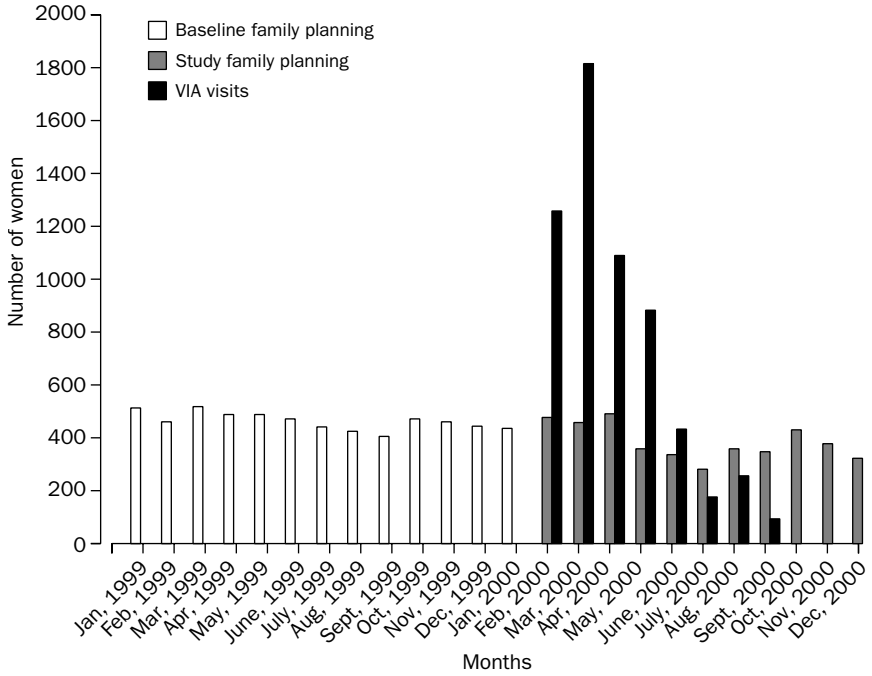


Figure 2: **Relation between family planning and VIA visits**
During project recruitment, average monthly number of women presenting to participating centres for routine family planning visits was not greatly affected.

	Percentage agreement (95% CI)	κ	p	Matched pairs
Result indicator				
VIA assessment category	92·94 (92·85–93·03)	0·8013	<0·0001	85
Case management decision	91·67 (91·59–91·75)	0·8017	<0·0001	72

Table 4: **Supervisory visit co-assessment**

nor by mean age or education level (p=0·83 and p=0·54, respectively). 115 test-positives were eligible for cryotherapy but at a later date (postponed). The main reason for postponement was menses. Few (n=10) postponements were for clinic problems (eg, no equipment or supplies). 14 test-positives were told to return for cryotherapy after seeing a referral physician, 42 and 13 women with a positive test were totally ineligible due to lesion size and gynaecological problems, respectively, and four test-positives were referred for reasons unrecorded. Overall, 79 women were referred (73 test-positives, four suspect cancers, and two indeterminates). Of those ultimately treated (n=756), 615 (81·3%) received cryotherapy immediately. 609 of 618 judged eligible by the nurse for immediate cryotherapy received it immediately.

To assess the project's possible effect on other hospital outpatient reproductive health services, time trends were compared (Pearson's correlation) between family planning visits in 1999 and 2000 and VIA visits during the project (figure 2). No significant linear correlation was noted between the two time trends (r=0·4; p=0·12).

The 1-year VIA test-negative rate was 94·3%. One woman had an indeterminate test and one had suspect cancer (later confirmed as adenocarcinoma in a polyp, stage 1A). No squamous cell cancers were identified at 1 year. During recruitment, 1·5% of eligible women in Roi-et Province were VIA tested. Coverage varied substantially by district (table 3).

Assessments done independently by supervisors and providers for the same woman during supervisory visits were highly correlated (table 4), suggesting nurses did VIA competently and followed clinical protocol appropriately.

Discussion

These results clearly show that a single-visit approach with VIA followed by immediate treatment with cryotherapy for those testing positive (or referral as indicated) is safe, acceptable, feasible, and with sustained effort, can achieve moderate population coverage. The project provides important safety information for policymakers in developing countries who are considering how best to initiate or strengthen fledgling cervical-cancer prevention programmes. Follow-up data indicate no clinically apparent pelvic inflammatory disease or stenosis as a result of cryotherapy. And, the overall minor complication rate (within a year post-treatment) associated with nurses doing cryotherapy without colposcopy was lower than anticipated (2·2%). It is unlikely that serious problems post-cryotherapy went unreported, because project staff routinely investigated problems at local facilities, and all women had a card indicating project participation.

This single-visit approach seemed to be acceptable not only to women but also to their partners and to project providers. Results from qualitative acceptability studies, to be published subsequently, will provide additional insight into how acceptable the project was, and aspects in need of attention.

This Thailand experience also shows that it is logistically feasible to refill carbon-dioxide tanks and transport cryotherapy units between sites for mobile services. The low number of working parts that could malfunction, and training in equipment care, contributed to the ability to maintain these units in the field. Treatment postponements for clinic-related reasons were few, concentrated early on when project logistics were being worked out. The average number of women tested and safely treated daily suggests a consistently high demand for services and an ability to safely manage the demand. Home-care adherence and scheduled return visit rates were high. This probably shows the quality of counselling about reasons for abstinence or condom use, that women were offered the opportunity to postpone treatment if needed to negotiate with their husband, and the high level of regard for the government medical system among rural Thai women.

Costs are a large part of the effort needed to sustain a prevention programme. Many screening and case management approaches for cervical neoplasia were computer modelled, in the context of rural Thailand, to predict incidence and mortality reductions and costs associated with each approach.[14] Comparing each approach with no organised screening (estimated at US$2 per woman), the most cost-effective approach was VIA, followed immediately by cryotherapy (or referral for lesions ineligible for immediate treatment), every 5 years for the age 35–55 year cohort. Mortality reductions over 25% were only predicted if at least 70% of targeted women were tested each screening cycle. In this project, coverage after 7 months was 17%. If project efforts (including funding) were sustained, over 70% coverage in the four districts could be achieved within 5 years. Project women, however, reported taking on average 14·5 min to reach the facility—meaning coverage rates reflect use of services by women living close. The effort needed to recruit women living in more remote areas remains to be determined. The current phase of the project focuses on this important question.

Because we aimed to test the single-visit approach as it would probably be implemented as part of a programme, no other measure of disease status other than VIA testing was obtained before treatment.[27] Therefore, actual treatment cure rates were not measurable. However, acetowhite lesions 1-year post-treatment provide an indication of the need for retreatment (and/or referral) and are something that can be feasibly monitored in regular programmes, as part of routine quality assurance. Importantly, in this project, the test-positive rate at 1 year was only 5·7%, with one adenocarcinoma (of low stage). Although cryotherapy was inappropriate if the adenocarcinoma was present but missed at initial testing, it could also be argued that a low stage, treatable cancer was discovered as part of the project (that would otherwise have very likely gone unreported or surfaced only at a much later stage). Since VIA's negative predictive value (primary testing) is consistently reported at 96% or greater,[7,9,10,12] the low project test-positive rate at 1 year should reassure policymakers that cancers were not misdiagnosed in the first place.

It is noteworthy that for most of those treated, the squamocolumnar junction was visible to the nurses at 1 year. A generally held opinion about disadvantages of cryotherapy is that after treatment, the junction recedes into the cervical canal, is no longer visible, and therefore cannot serve as a landmark for detecting precancers. In this project, in parous women, the junction initially seemed to be well out on the face of the exocervix, such that even after the cervix had healed post-cryotherapy, it remained visible, and repeat assessment by VIA was possible.

For over 30 years, Thailand has struggled to make a cervical-cancer prevention programme based on a test-and-refer approach (cytology-based screening and referral of positives for diagnostic testing, including biopsy, and treatment, when indicated) work successfully. Despite efforts to develop cytological services, national annual cytology coverage is low (5%). Also, treatment for rural women with precancer is available only in select hospitals. Although additional work exploring the programmatic potential of VIA combined with cryotherapy is warranted to answer questions related to coverage, cost, sustainability, quality assurance, and cryotherapy effectiveness in the hands of non-physicians, these results indicate that a single-visit approach based on VIA and cryotherapy done by rural nurses is safe, acceptable, and feasible. Consequently, especially in view of the mounting cost-effectiveness data supporting a single-visit approach,[14,28] it should be considered an alternative for areas in which the likelihood of successfully implementing a more traditional approach to cancer prevention is low.

Royal Thai College of Obstetricians and Gynaecologists (RTCOG) and the JHPIEGO Corporation Cervical Cancer Prevention Group
Writing committee—L Gaffikin, P D Blumenthal, M Emerson, K Limpaphayom.
Project design—P D Blumenthal, L Gaffikin, K Limpaphayom, P Lumbiganon, P Ringers.
Clinical training intervention—P D Blumenthal, P Lumbiganon, S Srisupundit.
Fieldwork—P Lumbiganon, K Limpahayom, S Warakamin, P Ringers, R Lewis, S Srisupundit, B Chumworathayee, S Kanavacharakul.
Data management and analysis—M Emerson, L Gaffikin, P Ringers, P D Blumenthal, P Lumbiganon, K Limpaphayom.

Conflict of interest statement
None declared.

Acknowledgments
Roi-et Province Ministry of Public Health nurses did the fieldwork under the direct supervision of clinical supervisors from Khon Kaen University Hospital (Bundit Chumworathayee, Sanguanchoke Luanratanakorn) and Khon Kaen Provincial Hospital (Sumontha Prasertpan, Suwaree Paojirasinchai). Supervision of data collection and data entry in the field was provided by Kesara Phuttong, with assistance from Sodsuay Kanavacharakul and Rabiab Poomban-khor. We thank the Roi-et Provincial Medical Directors, K Chaisiri and C Theerakanok for their assistance with this project and the district hospital directors and other facility staff who supported project implementation. Our gratitude to Khon Kaen University for providing backup clinical support and supervision and the Royal Thai College of Obstetricians and Gynaecologists for logistical and advocacy assistance. We also thank the Thai Ministry of Public Health for its support and encouragement. The village health volunteers deserve acknowledgment for their contribution to participant education and recruitment. We also thank the following JHPIEGO Corporation staff: Noel McIntosh for overall programme guidance; Sarah Slade for training and clinical input; Sapna Sharma for project coordination; Karen Mazziott for financial assistance, Saifuddin Ahmed for help with statistical analyses; Sonia Elabd for assisting with training materials and Mark Fritzler for equipment support. Finally, the team owes a debt of gratitude to the women and their families who participated in this project. This project was funded by a grant to the JHPIEGO Corporation from the Bill and Melinda Gates Foundation through the Alliance for Cervical Cancer Prevention and by the Ministry of Public Health of Thailand.

References

1 Reproductive Health Outlook. Cervical cancer prevention. http://www.rho.org/html/cxca.htm (accessed Jan 13, 2003).
2 UNFPA. Update 1998–1999 maternal mortality: a report on UNFPA support to reduce maternal mortality. http://www.unfpa.org/tpd/ mmupdate/index.htm (accessed Jan 18, 2002).
3 Sankaranarayanan R, Shymalakumary B, Wesley R, et al. Visual inspection as a screening test for cervical cancer control in developing countries. In: Franco E, Monsonego J, eds. New developments in cervical cancer screening and prevention. Oxford: Blackwell Science, 1997: 411–21.
4 Sankaranarayanan R, Budukh AM, Rajkumar R. Effective screening programmes for cervical cancer in low- and middle-income developing countries. *Bull World Health Organ* 2001; **79:** 954–62.
5 Gaffikin L, Blumenthal PD, Davis C, Brechin SJG. Workshop proceedings: alternatives for cervical cancer screening and treatment in low-resource settings. Baltimore: JHPIEGO Corporation, 1997.
6 Soler ME, Gaffikin L, Blumenthal PD. Cervical cancer screening in developing countries. *Prim Care Update Obstet Gynecol* 2000; **7:** 118–23.
7 University of Zimbabwe/JHPIEGO Cervical Cancer Project. Visual inspection with acetic acid for cervical cancer screening: test qualities in a primary-care setting. *Lancet* 1999; **353:** 869–73.
8 Sankaranarayanan R, Wesley R, Somanathan T, et al. Visual inspection of the uterine cervix after the application of acetic acid in the detection of cervical carcinoma and its precursors. *Cancer* 1998; **83:** 2150–56.
9 Sankaranarayanan R, Shyamalakumary B, Wesley R, Amma NS, Parkin MD, Nair MK. Visual inspection with acetic acid in the early detection of cervical cancer and precursors. *Int J Cancer* 1999; **80:** 161–63.
10 Belinson, JL, Pretorius RG, Zhang WH, Wu LY, Qiao YL, Elson P. Cervical cancer screening by simple visual inspection after acetic acid. *Obstet Gynecol* 2001; **98:** 441–44.
11 Cecchini S, Bonardi R, Maxxotta A, Grazzini G, Iossa A, Ciatto S. Testing cervicography and cervicoscopy as screening tests for cervical cancer. *Tumori* 1993; **79:** 22–25.
12 Megevand E, Denny L, Dehaeck K, Soeters R, Bloch B. Acetic acid visualization of cervix: an alternative to cytologic screening. *Obstet Gynecol* 1996; **88:** 383–86.
13 Londhe M, George SS, Seshadri L. Detection of CIN by naked eye visualization after application of acetic acid. *Indian J Cancer* 1997; **34:** 88–91
14 Mandelblatt JS, Lawrence WF, Gaffikin L, et al. The benefits and costs of alternative strategies for cervical cancer screening in less developed countries: a case study from Thailand. *J Natl Cancer Inst* 2002; **94:** 1–15.
15 Kitchener HC, Symonds P. Detection of cervical intraepithelial neoplasia in developing countries. *Lancet* 1999; **353:** 856–57.
16 Herdman C, Sherris J. Planning appropriate cervical cancer prevention programs. Seattle: PATH, 2000.
17 Abwao S, Greene P, Sanghvi H, Tsu V, Winkler J. Prevention and control of cervical cancer in the East and Southern Africa region. Proceedings of regional meeting held in Nairobi, Kenya; 1998, Mar 29–Apr 1; Nairobi, Kenya. Seattle: PATH, 1998.
18 Santos C, Galdos R, Alvarez M, et al. One-session management of cervical intraepithelial neoplasia: a solution for developing countries—a prospective, randomized trial of LEEP versus laser excisional conization. *Gynecol Oncol* 1996; **61:** 11–15.
19 Holschneider CH, Felix JC, Satmary W, Johnson MT, Sandweiss LM, Montz FJ. A single-visit cervical carcinoma prevention program offered at an inner city church: a pilot project. *Cancer* 1999; **86:** 2659–67.
20 Cullins VE, Wright TC, Beattie KJ, Pollack AE. Cervical cancer prevention using visual screening methods. *Reprod Health Matters* 1999; **1:** 134–43.
21 Mitchell MF, Tortolero-Luna G, Cook E, Whittaker L, Rhodes-Morris H, Silva E. A randomized clinical trial of cryotherapy, laser vaporization, and loop electrosurgical excision for treatment of squamous intraepithelial lesions of the cervix. *Obstet Gynecol* 1998; **92:** 737–44.
22 Nuovo J, Melnikow J, Willan AR, Chan BK. Treatment outcomes for squamous intraepithelial lesions. *Int J Gynaecol Obstet* 2000; **68:** 25–33.
23 Andersen ES, Husth M. Cryosurgery for cervical intraepithelial neoplasia: 10-year follow-up. *Gynecol Oncol* 1992; **45:** 240–42.
24 Cox JT. Management of cervical intraepithelial neoplasia. *Lancet* 1999; **353:** 857–59.

25 Morris DL, McLean CH, Bishop SL, et al. A comparison of the evaluation and treatment of cervical dysplasia by gynecologists and nurse practitioners. *Nurse Practitioner* 1996; **23:** 101–14.

26 Limpaphayom K, Ajello C, Lumbiganon P, Gaffikin L. The effectiveness of model-based training in accelerating IUD skill acquisition: a study of midwives in Thailand. *Br J Obstet Gynaecol* 1997; **23:** 3107–15.

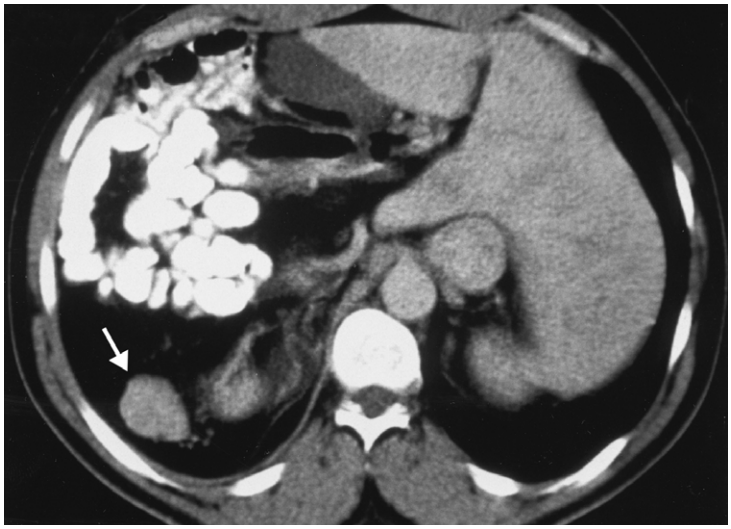
27 Blumenthal PD, Ringers P, McIntosh N, Gaffikin L. Innovative approaches to cervical cancer prevention. *Medscape Women's Health* 2001; **6:** 1. http://www.medscape.com/viewarticle/415125 (accessed Feb 3, 2003).

28 Goldie S, Kuhn L, Denny L, Pollack A, Wright TC Jr. Policy analysis of cervical cancer screening strategies in low-resource settings: clinical benefits and cost-effectiveness. *JAMA* 2001; **285:** 3107–15.

Clinical picture

Situs inversus and severe pulmonaryhypertension

Thorsten Schmidt, Vincent M Brandenburg, Stefan Krüger, Patrick Haage



A 31-year-old man presented with a 2-year history of progressive exertional dyspnoea and chest pain. He had severe pulmonary hypertension with a mean pulmonary artery pressure of 53 mm Hg. Magnetic resonance imaging (figure, left; T1-weighted 3D echo sequence with contrast), showed the dilated central pulmonary vessels and a persisting left caval vein (arrow) draining into a dilated coronary sinus. Spiral computed tomography (figure, right) showed the liver in midline position, a right-sided hypoplastic spleen (arrow) and the small bowel almost confined to the right abdomen. Abdominal angiography showed complex vascular malformations including bilateral aneurysms of the renal arteries, and an inferior mesenteric vein flowing into the superior mesenteric vein, which drained into the inferior vena cava. In combination with hypoplastic portal and hepatic veins, this anatomy caused a portosystemic shunt with elevated blood ammonia concentrations. This is a rare case with features of heterotaxy syndrome in a young adult, complicated by primary pulmonary hypertension.

Department of Diagnostic Radiology (T Schmidt MD, P Haage MD)**, Department of Nephrology** (V M Brandenburg MD)**, Department of Cardiology** (S Krüger MD)**, University of Technology, D-52057 Aachen, Germany**