BMJ Open

The impact of decentralising colposcopy services from a busy tertiary hospital to a primary care clinic in inner-city Johannesburg, South Africa

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2018-024726
Article Type:	Research
Date Submitted by the Author:	15-Jun-2018
Complete List of Authors:	Maimela, Gloria; University of the Witwatersrand, Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Nene, Xolisile; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Mvundla, Nontuthuko; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Sawry, Shobna; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Smith, Trudy; University of the Witwatersrand , Wits Donald Gordon Medical Centre, Faculty of Health Sciences Rees, Helen; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Kachingwe, Elizabeth; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Chersich, Matthew; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences
Keywords:	Colposcopy < GYNAECOLOGY, Community gynaecology < GYNAECOLOGY, Gynaecological oncology < GYNAECOLOGY, Minimally invasive surgery < GYNAECOLOGY

Title: The impact of decentralising colposcopy services from a busy tertiary hospital to a primary care clinic in inner-city Johannesburg, South Africa

Authors: G. Maimela*[1], X. Nene*[1], N. Mvundla[1], S. Sawry[1], T. Smith[2], H. Rees[1], E.Kachingwe[1], M. Chersich[1]

Affiliations:

1. Wits Reproductive Health and HIV Institute, Faculty of Health Science, University of the Witwatersrand, South Africa
2. Department of Obstetrics and Gynaecology, School of Clinical Medicine, Charlotte Maxeke Johannesburg Academic Hospital, Faculty of Health Science, University of the Witwatersrand, South Africa

Corresponding author: Gloria Maimela, GMaimela@wrhi.ac.za, Wits Reproductive Health and HIV Institute, Faculty of Health Sciences, University of the Witwatersrand, South Africa

Abstract (max 300 words)

Objective: To assess whether decentralising colposcopy services to a primary care facility in inner-city Johannesburg, South Africa raises access to colposcopy.

Design: Before-after study comparing two years before and two after decentralisation, using clinical records, and laboratory data on cervical cytology and histology.

Primary outcome: The proportion of all women attending HCHC with an abnormal Pap smear who had a colposcopy post-decentralisation.

Setting: Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) has provided colposcopy services for several decades. The Hillbrow Community Health Centre (HCHC), located about 3km away, began colposcopy services in 2014.

Participants: Women, aged above 18 years, who had a colposcopy for diagnosis and treatment of precancerous cervical lesions following a Pap smear, from 2012-2016 at CMJAH or HCHC.

Results: Pre-decentralisation at CMJAH, 910 women had colposcopy (2012-2014). Post-decentralisation (2014-2016), 721 had colposcopy at CMJAH and 399 at HCHC, the decentralised facility. The number who had a Pap smear at HCHC and then a colposcopy rose three-fold post-decentralisation (114 versus 350). Post-decentralisation, 43 women at HCHC were referred from to CMJAH for colposcopy, compared to 114 pre-decentralisation. Post-decentralisation, 47.3% of women at CMJAH waited >6 months for colposcopy, while 35.5% did at HCHC ($p<0.001$). Across all three groups, 26.9-30.3% of women had CIN III lesions or carcinoma on colposcopy. The proportion of invalid specimens was similar at CMJAH and HCHC (1.8-2.8%). Of 401 women who had an abnormal Pap smear at HCHC post-decentralisation, 267 had colposcopy (66.6%).

Conclusion: Decentralisation can decrease the time to colposcopy and reduce the workload of tertiary hospitals. Overall, more women accessed services. Colposcopy coverage at HCHC is higher than other sites, but could be further improved. Decentralisation did not appear to affect the quality of services and this model could be extended to similar settings in South Africa and elsewhere.

Key words: South Africa, colposcopy, cervical cancer, primary health care, decentralisation

Article Summary

Strengths and limitations of this study

- Data were collected for the purposes of patient care, and not specifically for research, potentially reducing data quality.
- The limited data collected meant that the study could not fully investigate several important questions, such as reasons for delays in colposcopy, and whether these delays relate to limited human resources for performing colposcopy or deficiencies in laboratory capacity, for example.
- Given that the study only covered the first two years after decentralisation, we are unable to ascertain the intervention's sustainability in the long-run.
- The study strengths include a relatively large number of women in all study groups, allowing us to detect differences between the time periods

Introduction

Though cervical cancer is a largely preventable disease, it is the second most common cancer among women aged 15 to 44 years in the world (1). In South Africa, it is the commonest cancer in that age group, and mortality rates are high (2, 3). About 3% of women in South Africa harbour cervical human papilloma virus (HPV)-16/18, which is responsible for the majority of cases of cervical cancer in the country (3). Rates of cervical cancer in South Africa can partly be attributed to the high HIV prevalence rate (4). Women with HIV infection have a seven fold higher rate of persistence of high-risk HPV compared to HIV uninfected women (5), heightening their risk for incident and progressive precancerous lesions. While antiretroviral therapy reduces the risk of cervical cancer and its precursors, the risk remains much higher than for HIV-negative women (6).

Cervical screening is used for the early identification and treatment of pre-cancerous lesions of the cervix. Screening methods include HPV screening, visual inspection with acetic acid, or cytology through Papanikolaou (Pap) smear, with referral of atypical findings for colposcopy to establish a definitive diagnosis. During colposcopy, the view of the cervix is magnified and, where required, a biopsy is taken or a large loop excision of the transformation zone (Lletz) is conducted. WHO recommends that women who are older than 30 years have repeat cervical cancer screening every 3-5 years, and more frequently if HIV infected (7) .

A range of health systems and patient factors influence access to colposcopy. System barriers include a limited number of colposcopy services, which are mostly centralised within tertiary-level facilities, with long waiting times for patients and few opportunities for non-specialist health workers to develop requisite skills (8). There are limited numbers of specialist gynaecologists within the public sector, and the high demands on these doctors for emergency and curative obstetric and gynaecology services may reduce the time available for diagnostic or preventive interventions, such as colposcopy. Another key factor is the complexity of providing Pap and other results to patients and then scheduling colposcopy appointments across the disjointed systems that often exist between a tertiary hospital and primary care centres (9-11). Patient-related factors linked with low uptake of colposcopy include low education levels, being single, fear of HIV testing and disclosure, a low CD4 count in HIV-infected women and transport costs for the additional visits (10, 12,

13). Patient demand for colposcopy is also undermined by a general fear of cancer, and lack of awareness or knowledge about cervical cancer (9, 14). Poor patient-provider interactions restrict access, whilst a longstanding relationship with a primary clinician can optimise uptake (14).

In South Africa, patients who require colposcopy are generally referred to a tertiary-level facility where the procedure is rendered by specialist gynaecology oncologists and trainee gynaecologists under supervision. While there may be benefits to decentralising colposcopy services to lower levels of care, these need to be balanced by the advantages of centralization of cancer services, such as concentrating clinical expertise, with a higher quality of care, and the rationalisation of expensive specialist equipment. Thus, in this before- and after-study, we assessed whether access to colposcopy would be raised by decentralising colposcopy services from a tertiary-level hospital to a primary care facility in inner-city Johannesburg, South Africa.

Methods

Study participants and setting

Women, aged 18 years and older, who accessed colposcopy services at either Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) or Hillbrow Community Health Centre (HCHC) between October 2012 and September 2016 were included in the study. Both facilities are in sub-district F of the Johannesburg Health District (JHD).

The Colposcopy clinic at CMJAH is part of the Gynaecology-Oncology Department at CMJAH, which has two colposcopy machines operated by specialist gynaecology-oncologists. Women attending a facility in JHD who have an abnormal Pap smear are referred to the facility, where they are provided with an appointment date for colposcopy.

Hillbrow Community Health Centre (HCHC) is situated in the densely populated inner-city area of Hillbrow, about 3km from CMJAH. HCHC provides primary level care, including a 24 hour casualty and a midwife obstetrics unit. The facility is run predominantly by nursing staff, with support from non-specialist medical doctors.

Implementation of decentralised services

In 2013, a review of patient files at HCHC found that a large proportion of women attending the HIV clinic had high-risk lesions on Pap smear (15). Moreover, there were some reports from patients and health workers at HCHC of prolonged waiting times for colposcopy services at CMJAH. The Wits Reproductive Health and HIV Institute (Wits RHI) thus set about establishing colposcopy services at the facility. A private sector company donated a colposcopy machine. Two district medical officers were trained by specialist gynaecology oncologists at CMJAH to provide the service. CMJAH staff provided ongoing support and established referral processes between the two facilities. The services, which began in October 2014, were provided twice a week by the medical officers, with assistance from the nurse who takes Pap smears at the facility. Patients attending HCHC and some surrounding clinics were given an appointment for colposcopy if they had an abnormal Pap smear result, defined as: high-grade squamous intraepithelial lesion (HSIL), atypical squamous cell and HSIL cannot be excluded (ASC-H), or squamous cell carcinoma (SCC) (16). A few patients with Pap smear results other than those defined as abnormal smears were also referred for colposcopy. Patients with complex lesions, such as abnormal cervical anatomy or a high suspicion of cancer on Pap smear were referred to CMJAH, as were those with a failed colposcopy. Colposcopy procedures included visual inspection only, or visual inspection together with either a Lletz or biopsy. After colposcopy, patients were given a date to return for results, where decisions on further tests and clinical management were made. Histology specimens from both sites were processed at the National Health Laboratory Service (NHLS).

Data sources and collection

For the purpose of this evaluation, women who accessed colposcopy services at CMJAH and HCHC were divided into three groups, according to when and where colposcopy took place: 1) pre-decentralisation at CMJAH between October 2012 and September 2014; 2) post-decentralisation at CMJAH between October 2014 and September 2016; and 3) post-decentralisation at HCHC between October 2014 and September 2016.

At CMJAH, we extracted data from paper-based records at the colposcopy clinic, including on patients' age, HIV status, antiretroviral treatment, date of Pap smear, Pap smear result, date of colposcopy, colposcopy procedure performed and histology results. Data were entered into a REDCap electronic database (REDcap Software, Version 4.14.5, Vanderbilt University) (17). At HCHC, demographic and clinical data on women who accessed

colposcopy services were entered into an MS Excel spreadsheet after each patient visit. Data were also obtained from the NHLS on Pap smear cytology for women attending HCHC who had a Pap smear and for the whole JHD.

Study variables and statistical analysis

Patient characteristics and colposcopy procedures were compared between HCHC and CMJAH post-decentralisation, and within CMJAH before and after decentralisation. Time to colposcopy was calculated as the number of months from date of Pap smear to colposcopy and was categorised as optimal (under 3 months), acceptable (3-6 months) and delayed (greater than 6 months). Histology results were classified as normal (includes benign endocervical polyp, atrophic ectocervical mucosa, koilocytotosis and metaplasia), Cervical Intraepithelial Neoplasia (CIN) I, CIN II, CIN III, carcinoma, other (includes infections such as cervicitis, inflammation and dysplasia) and invalid specimens (includes absent results). The coverage of colposcopy services at HCHC, the primary outcome, was estimated by calculating the proportion of all women at HCHC with an abnormal Pap smear who had a colposcopy.

Data were presented as proportions, medians and inter-quartile ranges, and differences between groups were assessed using a chi-square test or a Wilcoxon rank-sum test, as appropriate. All data were analysed using STATA version 13.0.

Ethical considerations

Ethical approval was obtained from Human Research Ethics Committee of the University of the Witwatersrand (Certificate number: M151184). Permission for use of the CMJAH data was granted by the hospital's Chief Executive Officer and the head of the Department of Obstetrics and Gynaecology at CMJAH. The NHLS Academic Affairs and Research Office gave permission for use of their data.

Patient Involvement

The study utilised data that had already been collected as part of routine patient care, and thus patients were not directly involved in the study. The findings will be used to further optimise their care and extend the intervention to other sites. We aim to include patients in those activities.

Results

Of all Pap smears done in the JHD in the two years after decentralisation (114,983), 1.9% were done at HCHC (2227; Table 2). Of these, 18.0% had abnormal cytology and required colposcopy (n=401), compared to only 8.2% of other women in JHD as a whole (n=1826; p<0.001).

In total, 910 women accessed colposcopy at CMJAH between October 2012 and September 2014. In the subsequent two years, 1120 women had a colposcopy: 399 at HCHC (35.6%) and 721 at CMJAH (64.4%; Table 1 and Figure 1a). The estimated colposcopy coverage among women who had a Pap smear at HCHC was 66.6% (267/401; 95%CI=61.7-71.2%).

The median age women at CMJAH was 37.1 years pre-decentralisation and 39.4 years post-decentralisation (p<0.001), and was 37.5 years at HCHC. In the post-decentralisation period, more women at CMJAH were older than 45 years than women at HCHC (30.6% versus 21.9%; p=0.002). At CMJAH, more women had a known HIV status pre-decentralisation than post-decentralisation (71.4% versus 59.5%, p<0.001). All women at HCHC had a documented HIV status. Around 85% of women with a known HIV status were HIV positive in all three groups. The proportion of positive women receiving ART rose in the second period at CMJAH from 78.7% to 87.6% (p<0.001), and almost all positive women were on ART at HCHC (99.7%; p<0.001).

In both periods, the large majority of women who had a colposcopy at CMJAH had had a Pap smear elsewhere, while three quarters of women who had a colposcopy at HCHC also had their Pap smear at the facility. The percentage of women at CMJAH who had had a Pap smear at HCHC halved post-decentralisation (p<0.001) and the absolute number decreased from 113 to 43. Post-decentralisation, the number of women who had a Pap smear at HCHC and then a colposcopy at either facility rose three-fold (from 113 to 350). At HCHC, post-decentralisation, 24.2% of women who had a colposcopy at HCHC, had a Negative for intraepithelial lesion or malignancy NILM or LSIL result on their Pap smear, compared with 18.5% in CMJAH in the same time period (p=0.02). Overall, across all three time periods, 17 women had a suspected carcinoma on Pap smear (0.8%).

Almost half of the women at CMJAH had a delay in receiving colposcopy (>6 months between Pap smear and colposcopy) post-decentralisation, compared to about a third pre-

decentralisation (47.3% versus 36.2%, p<0.001; Figure 1b). At HCHC, 21.7% of women had a colposcopy within three months of a Pap smear being taken (versus 11.8% at CMJAH pre- and 15.4% post-decentralisation, p<0.001).

At CMJAH, in both periods, nearly 60% of women had a biopsy at colposcopy (58.2%), while the same proportion had a Lletz at HCHC (58.2%). Women at HCHC were 3.6 fold more likely to have visual inspection only during colposcopy than women at CMJAH (95%CI odds ratio [OR]=2.3-5.4). Three women who had a colposcopy at HCHC were referred to CMJAH due to an unsuccessful procedure.

Women at HCHC were 3.5 fold more likely to have a normal result on histology than women at CMJAH (95%CI OR=2.1-5.7). Post-decentralisation, 29.0% of women at CMJAH and 26.3% at HCHC had CIN III lesions (p=0.37; Figure 1c). Post-decentralisation, 11 women had a diagnosis of carcinoma on histology (1.1%), compared to 3 before decentralisation (0.4%; p=0.06). The proportion of invalid specimens was similar across the three groups, ranging from 1.8 to 2.8%.

Discussion

In this study we determined whether decentralisation to primary care level improved access to colposcopy services by reviewing the number of women attending the service before and after decentralisation, and the coverage of colposcopy among women at HCHC. We found that the cumulative number of colposcopies across the two facilities rose following decentralisation, and after only two years, HCHC was responsible for a third of all colposcopies in the sub-district, even though it performs a negligible number of Pap smears relative to other sites. Overall, following decentralisation, three fold more women who had a Pap smear at HCHC had a colposcopy, and at CMJAH, the proportion of women from HCHC also reduced almost threefold. The marked increase in number of women from HCHC who had a colposcopy indicates that prior to decentralisation there may have been a large unmet need for the service, which was now being addressed, at least in part. The coverage reached 66.6%, considerably higher than figures in other settings.

Decentralisation of colposcopy services to primary level care has several potential benefits. Firstly, with adequate training, tasks that had been performed by highly specialised staff can

be shifted to lower health worker cadres, allowing specialists to focus on more complex cases (18). Also, decentralisation may alleviate patient barriers to access, by bringing services closer to them – in settings they are familiar with – and reducing their transport and other costs (9, 18). Decentralisation has long been central to the provision of HIV services in this setting through, for example, task shifting, providing antiretroviral treatment in primary health care and the dispensing of drugs from local pharmacies, rather than clinics (19).

Decentralisation of colposcopy can take several forms, including telecolposcopy from distant sites, outreach portable colposcopy, shifting of services to nurse practitioners or medical officers, and decentralisation to lower level facilities, as in this study (20). In other settings, shifting services to lower care levels was found to be cost-effective, acceptable to patients and to increase rates of attendance for colposcopy (12, 20, 21). In the Western Cape, South Africa, for example, colposcopy services were decentralised to a district hospital and provided by a gynaecologist (18). This raised uptake of the service and reduced time to procedure. Also, a study in the United Kingdom found that colposcopy could be performed by nurse practitioners, but they were restricted to only examining cases of post-coital bleeding (22). In high-income countries, services have been successfully decentralised to community health centres and portable outreach programmes in Alaska, the United States, and parts of Canada and Australia, targeting immigrant, Inuit and other vulnerable women (12, 13, 21, 23, 24).

Women attending HCHC colposcopy were at lower risk than those at CMJAH, as shown by their younger age and lower grades of abnormalities on Pap smear and histology. This may suggest that, as the programme had envisaged, higher-risk patients are being referred to CMJAH. Overall, services at HCHC appear to be performing well, with all women tested for HIV and almost all those positive were receiving ART. In addition, colposcopy services were now integrated into their care, which was previously off-site, complex to access and marked by lengthy delays. HIV-positive women made up the large majority of patients in all groups, reflecting the higher levels of risk for cervical cancer in this population. Clearly it remains a priority to integrate screening for cervical cancer within all clinics providing antiretroviral treatment.

The similar number of invalid histology samples and the isolated cases of failed colposcopy suggests that the quality of colposcopy services at HCHC may have been comparable to

CMJAH. Unlike at CMJAH, however, Lletz was the commonest procedure at HCHC, in keeping with evidence that Lletz is better suited to lower level facilities and staff (7). With decentralisation, it is critical to ensure that staff are adequately trained and service quality is closely monitored. The hesitancy to decentralise colposcopy to date, may reflect underlying concerns that cases of cancer may go undetected by lower-level staff. In some settings, lower-level health workers undergo a process of certification and have to perform a certain number of colposcopies per year to remain registered. While this approach may hold advantages, onerous processes around certification and recertification may lead to staff discontinuing colposcopy (22).

The decline in number of colposcopies at CMJAH is concerning, and may reflect factors other than a reduction in demand that accompanies decentralisation. Fewer women at the site had a known HIV status and waiting times for colposcopy lengthened. Thus, though decentralisation can reduce the patient burden at referral centres, this does not necessarily translate into improved services at that site. Other patient and systems factors may play a larger influence, for example, coinciding with the period after decentralisation, CMJAH lost a number of senior specialists.

Delays in colposcopy vary considerably between settings, from an average of 39 days from referral to colposcopy in one study in KwaZulu Natal, South Africa (8), to around 5-6 months in both our study and another in the Western Cape (18). It is concerning that time from Pap smear to colposcopy is greater than six months for half the women at CMJAH, and a third at HCHC. Reducing these delays is clearly a priority at both sites. We were unable, however, to discern reasons for these delays, which could be caused by delays in providing the results of Pap smears to patients, patient delays in making or attending appointments, or shortages of specialist staff. We could also not investigate which group of patients required referral to higher levels of care, and future studies might attempt to define criteria for referral. Moreover, given the relatively short period of the review, we are unable to assess sustainability of the services in the long-run, a pressing question. Lastly, the study evaluated the use of colposcopy following cytological screening with Pap smears and these findings may not be generalizable to screening with HPV testing, which is increasingly being used in many countries (25). HPV testing has a considerably higher sensitivity for detecting

precursor lesions of cervical cancer compared to cytology, and thus may alter the number of patients requiring colposcopy and types of lesions identified (26, 27).

Conclusion

In conclusion, decentralisation of colposcopy services can improve access to colposcopy, resulting in faster diagnoses of precancerous lesions of the cervix, more lesions being treated with Lletz and a reduction in the burden of patients in tertiary hospitals. Most importantly, increasing the number of colposcopies and treatments of precancerous lesions could reduce the incidence of cervical cancer. This is particularly important among HIV-positive women who now live longer with ART, and the treatment of their co-morbidities is rapidly gaining in importance. Though coverage of colposcopy reached two thirds at HCHC, it is important to identify interventions to raise coverage levels. Decentralisation is unlikely to affect the quality of services if medical officers are appropriately trained, supervised and supported by clear up-referral guidelines. The approach presented here could be extended to other primary- or secondary-level facilities in South Africa, and perhaps encompass the use of portable colposcopes or telecolposcopy, under close supervision. If done correctly and at scale, decentralisation of colposcopy services, could shore up cervical cancer prevention and finally decrease the public health burden and mortality due to the cancer.

Acknowledgements

We would like to acknowledge the following persons who contributed to this study:

H. Manyonga, Z. Dumakude, A. Moholola, N. Wattrus, L. Mbuyisa, I. Sishi, N. Twala, S. Sidabuka, E. Briedenhann, L. Mavuya, K. Moshaba, S. Mzobe, S. Carmona (NHLS), L. Chauke (Department of Obstetrics and Gynaecology, CMJAH).

Funding

This study has been made possible through funding from USAID-PEPFAR, grant number: AID-A-12-67400021. We would also like to acknowledge the following organizations for donating a colposcopy machine to Hillbrow CHC: Vodacom, Altech and Altron.

Competing Interests

All authors listed in this study do not have competing interests to declare.

Data sharing statement

There's no additional unpublished data from the study.

Author Contributions

Manuscript title: Decentralising colposcopy services raises access to treatment of abnormal cervical smears: a pilot in an inner-city clinic in Johannesburg, South Africa

All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated sufficiently in the work to take public responsibility for the content, including participation in the concept, design, analysis, writing, or revision of the manuscript. Furthermore, each author certifies that this material or similar material has not been and will not be submitted to or published in any other publication before its appearance in the Hong Kong Journal of Occupational Therapy.

Authorship contributions Please indicate the specific contributions made by each author (list the authors' initials followed by their surnames, e.g., Y.L. Cheung). The name of each author must appear at least once in each of the three categories below.

Category 1

Conception and design of study: G. Maimela*1, X. Nene*1, S. Sawry, N. Mvundla, M. Chersich

Acquisition of data: G. Maimela, X. Nene, N. Mvundla,

Analysis and/or interpretation of data: G. Maimela, X. Nene, S. Sawry, E. Kachingwe, M. Chersich, H. Rees; T. Smith.

Category 2

Drafting the manuscript: G. Maimela, X. Nene, N. Mvundla, S. Sawry, E. Kachingwe, M. Chersich.

Revising the manuscript critically for important intellectual content: M. Chersich, H. Rees, T. Smith

Category 3

Approval of the version of the manuscript to be published (*the names of all authors must be listed):*

G. Maimela*1, X. Nene*1, N. Mvundla1, S. Sawry1, T. Smith2, H. Rees1, E.Kachingwe1, M. Chersich1

Acknowledgements: *All persons who have made substantial contributions to the work reported in the manuscript (e.g., technical help, writing and editing assistance, general support), but who do not meet the criteria for authorship, are named in the Acknowledgements and have given us their written permission to be named. If we have not included an Acknowledgements, then that indicates that we have not received substantial contributions from non-authors.*

H. Manyonga, Z. Dumakude, A. Moholola, N. Wattrus, L. Mbuyisa, I. Sishi, N. Twala, S. Sidabuka, E. Briedenhann, L. Mavuya, K. Moshaba, S. Mzobe, S. Carmona (NHLS), L. Chauke (Department of Obstetrics and Gynaecology, CMJAH).

This statement is signed by all the authors (a photocopy of this form may be used if there are more than 10 authors):

References

1. Bruni L, Barrionuevo-Rosas L, Albero G, Serrano B, Mena M, Gómez D, et al. ICO/IARC Information Centre on HPV and Cancer (HPV Information Centre). Human Papillomavirus and Related Diseases in the World. Summary Report 27 July 2017.
2. Batra P, Kuhn L, Denny L. Utilisation and outcomes of cervical cancer prevention services among HIV-infected women in Cape Town. SAMJ: South African Medical Journal. 2010;100:39-44.
3. ICO/IARC Information Centre on HPV and Cancer. South Africa Human Papillomavirus and Related Cancers, Fact Sheet 2017. 2017.
4. Shisana O, Rehle T, Simbayi LC, Zuma K, Jooste S, Zungu N, et al. South African National HIV Prevalence, Incidence and Behaviour Survey, 2012. Cape Town: HSRC Press; 2014.
5. Adler D, Wallace M, Bennie T, Abar B, Sadeghi R, Meiring T, et al. High risk human papillomavirus persistence among HIV-infected young women in South Africa. International journal of infectious diseases : IJID : official publication of the International Society for Infectious Diseases. 2015;33:219-21.
6. Guiguet M, Boue F, Cadranel J, Lang JM, Rosenthal E, Costagliola D, et al. Effect of immunodeficiency, HIV viral load, and antiretroviral therapy on the risk of individual malignancies (FHDH-ANRS CO4): a prospective cohort study. Lancet Oncol. 2009;10(12):1152-9.
7. WHO. WHO guidelines for screening and treatment of precancerous lesions for cervical cancer prevention. 2013.
8. Katz IT, Butler LM, Crankshaw TL, Wright AA, Bramhill K, Leone DA, et al. Cervical Abnormalities in South African Women Living With HIV With High Screening and Referral Rates. J Glob Oncol. 2016;2(6):375-80.
9. Dawood S. Barriers and Facilitators to Colposcopy Attendance. Following an Abnormal Pap Smear: Patient and Provider Perspectives. Cape Town: University of Cape Town; 2014.

10. Momberg M, Botha MH, Van der Merwe FH, Moodley J. Women's experiences with cervical cancer screening in a colposcopy referral clinic in Cape Town, South Africa: a qualitative analysis. BMJ open. 2017;7(2):e013914.
11. Hoque M, Hoque E, Kader SB. Evaluation of cervical cancer screening program at a rural community of South Africa. East African journal of public health. 2008;5(2):111-6.
12. Martin B, Smith W, Orr P, Guijon F. Investigation and management of cervical intraepithelial neoplasia in Canadian Inuit: enhancing access to care. Arctic Med Res. 1995;54 Suppl 1:117-21.
13. Payne S, Jarrett N, Jeffs D. The impact of travel on cancer patients' experiences of treatment: a literature review. Eur J Cancer Care (Engl). 2000;9(4):197-203.
14. Baranoski AS, Stier EA. Factors associated with time to colposcopy after abnormal Pap testing in HIV-infected women. Journal of women's health (2002). 2012;21(4):418-24.
15. Stadler J, Chikandiwe A, Mayaud P, Rees H, Imrie J, Delany-Moretlwe S. Biographies of HIV and Cervical Cancer: Understanding Treatment-Seeking Amongst HIV Positive Women in Inner City Johannesburg. IAS conference, Durba, South Africa, Oral presentation. 2016.
16. Botha MH. Guidelines for cervical cancer screening in South Africa. Southern African Journal of Gynaecological Oncology 2017;9(1):8-12.
17. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009;42(2):377-81.
18. Blanckenberg ND, Oettle CA, Conradie HH, Krige FK. Impact of introduction of a colposcopy service in a rural South African sub-district on uptake of colposcopy. South African Journal of Obstetrics and Gynaecology. 2013;19(3).
19. Callaghan M, Ford N, Schneider H. A systematic review of task- shifting for HIV treatment and care in Africa. Human resources for health. 2010;8:8.
20. Bishai DM, Ferris DG, Litaker MS. What is the least costly strategy to evaluate cervical abnormalities in rural women? Comparing telemedicine, local practitioners, and expert physicians. Med Decis Making. 2003;23(6):463-70.
21. Ogilvie GS, Shaw EA, Lusk SP, Zazulak J, Kaczorowski JA. Access to colposcopy services for high-risk Canadian women: can we do better? Can J Public Health. 2004;95(5):346-51.
22. Sonnex C. Providing a genitourinary medicine colposcopy service. Sexually transmitted infections. 2014;90(1):8-10.
23. Gifford MS, Stone IK. Quality, access, and clinical issues in a nurse practitioner colposcopy outreach program. The Nurse practitioner. 1993;18(10):25-9, 33-6.
24. Hartz LE. Quality of care by nurse practitioners delivering colposcopy services. J Am Acad Nurse Pract. 1995;7(1):23-7.
25. Public Health England. NHS Cervical Screening Programme: Colposcopy and Programme Management. NHSCSP Publication number 20. Third Edition. 2016.
26. Dijkstra MG, Snijders PJ, Arbyn M, Rijkaart DC, Berkhof J, Meijer CJ. Cervical cancer screening: on the way to a shift from cytology to full molecular screening. Ann Oncol. 2014;25(5):927-35.
27. Wright TC, Jr., Stoler MH, Behrens CM, Sharma A, Sharma K, Apple R. Interlaboratory variation in the performance of liquid-based cytology: insights from the ATHENA trial. Int J Cancer. 2014;134(8):1835-43.

Table 1: Patient characteristics and colposcopy outcomes at a community clinic, and a tertiary-level facility before and after decentralisation

	Variables	Before versus after decentralisation at CMJAH			HCHC versus CMJAH after decentralisation	
		A) Pre-decentralisation (2012-2014) N=910	B) Post-decentralisation (2014-2016) N=721	P (A versus B)	C) Hillbrow CHC (2014–2016) N=399	P (B versus C)
Characteristics	Age groups in years					
	<20	7 (0.8)	6 (0.8)		0 (0)	
	20–34	351 (39.8)	209 (30.2)		150 (37.6)	
	35–44	342 (38.8)	266 (38.4)		156 (39.1)	
	45–59	161 (18.3)	187 (27.0)		79 (19.8)	
	>60	20 (2.3)	25 (3.6)	0.001	7 (1.8)	0.003
	HIV status known	650 (71.4)	429 (59.5)	<0.001	399 (100)	<0.001
	HIV status[^]					
	Negative	105 (16.2)	59 (13.8)		62 (15.5)	
	Positive	545 (83.9)	370 (86.3)	0.28	337 (84.5)	0.47
	On ART[%]	428/544 (78.7)	324/370 (87.6)	<0.001	336/337 (99.7)	<0.001
Cervical cancer	Facility where Pap smear done					
	CMJAH	115 (12.8)	124 (17.5)		0 (0.0)	
	HCHC	114 (12.7)	43 (6.1)		307 (76.9)	
	Other clinic or hospital	671 (74.6)	540 (76.4)	<0.001	92 (23.1)	<0.001

	Pap smear results					
	NILM	6 (0.7)	8 (1.1)		17 (4.3)	
	LSIL	141 (15.5)	125 (17.4)		79 (20.0)	
	ASCUS	19 (2.1)	34 (4.7)		4 (1.0)	
	HSIL	678 (74.7)	478 (66.4)		263 (66.4)	
	ASC-H	63 (6.9)	65 (9.0)		27 (6.8)	
	Carcinoma	1 (0.1)	10 (1.4)	<0.001	6 (1.5)	<0.001
	Pap smear risk categories					
	NILM, LSIL or ACSUS	166 (18.3)	167 (23.2)		100 (25.3)	
	HSIL, ASC-H or carcinoma	742 (81.7)	553 (76.8)	0.015	296 (74.8)	0.44
Cervical cancer diagnosis	Procedure during colposcopy					
	Visual inspection only	37 (4.1)	37 (5.2)		63 (15.9)	
	Lletz	337 (37.2)	258 (35.9)		231 (58.2)	
	Biopsy	526 (58.0)	420 (58.4)		90 (22.7)	
	Other	7 (0.8)	4 (0.6)	0.69	13 (3.3)	<0.001
	Histology result[&]					
	Normal	27 (3.1)	30 (4.4)		45 (13.8)	
	CIN I	254 (29.3)	200 (29.3)		84 (25.7)	
	CIN II	298 (34.3)	209 (30.7)		99 (30.3)	
	CIN III	236 (27.2)	198 (29.0)		86 (26.3)	
	Carcinoma	3 (0.4)	9 (1.3)		2 (0.6)	
	Other[*]	34 (3.9)	19 (2.8)		2 (0.6)	
	Invalid specimen	16 (1.8)	17 (2.5)	0.10	9 (2.8)	<0.001

χ^2 test for categorical variables or Wilcoxon Rank-sum test for continuous variables. [^]Of those with a known HIV status. [%]Of those HIV positive. [&]Of those with a histology specimen taken at biopsy, Lletz or other procedure. Charlotte Maxeke Johannesburg Academic Hospital (CMJAH). Hillbrow Community Health Centre (HCHC). [*]Other includes infections such as cervicitis, inflammation and dysplasia

Table 2: Cytology results in the City of Johannesburg in 2014-2016

Variable n (%)	Johannesburg health district* (n=114,983)	Hillbrow Community Health Centre (n=2227)	*P*
Pap smear results			
NILM	74,969 (65.2)	852 (38.3)	
LSIL	23,212 (20.2)	790 (35.5)	
ASCUS	7391 (6.4)	184 (8.3)	
HSIL	7808 (6.8)	364 (16.3)	
ASC-H	1221 (1.1)	28 (1.3)	
Carcinoma	382 (0.3)	9 (0.4)	<0.001
Number requiring colposcopy			
No (NILM, LSIL or ASCUS)	105,572 (91.8)	9411 (82.0)	<0.001
Yes (HSIL, ASC-H or carcinoma)	1826 (8.2)	401 (18.0)	

Data from the National Health Laboratory Service. Excludes invalid or missing specimens, and other Pap smear results (n=2446). *District total excludes HCHC

Table 1: Patient characteristics and colposcopy outcomes at a community clinic, and a tertiary-level facility before and after decentralisation

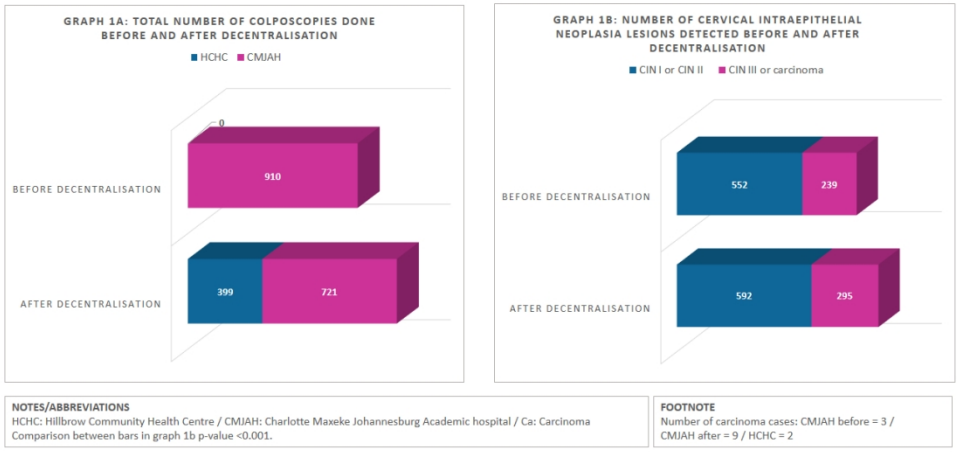
	Variables	Before versus after decentralisation at CMJAH			HCHC versus CMJAH after decentralisation	
		A) Pre-decentralisation (2012-2014) N=910	B) Post-decentralisation (2014-2016) N=721	P (A versus B)	C) Hillbrow CHC (2014–2016) N=399	P (B versus C)
Characteristics	**Age groups in years**					
	<20	7 (0.8)	6 (0.8)		0 (0)	
	20–34	351 (39.8)	209 (30.2)		150 (37.6)	
	35–44	342 (38.8)	266 (38.4)		156 (39.1)	
	45–59	161 (18.3)	187 (27.0)		79 (19.8)	
	>60	20 (2.3)	25 (3.6)	0.001	7 (1.8)	0.003
	HIV status known	650 (71.4)	429 (59.5)	<0.001	399 (100)	<0.001
	HIV status[^]					
	Negative	105 (16.2)	59 (13.8)		62 (15.5)	
	Positive	545 (83.9)	370 (86.3)	0.28	337 (84.5)	0.47
	On ART[%]	428/544 (78.7)	324/370 (87.6)	<0.001	336/337 (99.7)	<0.001
Cervical cancer Screening	**Facility where Pap smear done**					
	CMJAH	115 (12.8)	124 (17.5)		0 (0.0)	
	HCHC	114 (12.7)	43 (6.1)		307 (76.9)	
	Other clinic or hospital	671 (74.6)	540 (76.4)	<0.001	92 (23.1)	<0.001
	Pap smear results					
	NILM	6 (0.7)	8 (1.1)		17 (4.3)	
	LSIL	141 (15.5)	125 (17.4)		79 (20.0)	
	ASCUS	19 (2.1)	34 (4.7)		4 (1.0)	
	HSIL	678 (74.7)	478 (66.4)		263 (66.4)	
	ASC-H	63 (6.9)	65 (9.0)		27 (6.8)	
	Carcinoma	1 (0.1)	10 (1.4)	<0.001	6 (1.5)	<0.001
	Pap smear risk categories					
	NILM, LSIL or ACSUS	166 (18.3)	167 (23.2)		100 (25.3)	
	HSIL, ASC-H or carcinoma	742 (81.7)	553 (76.8)	0.015	296 (74.8)	0.44
Cervical cancer diagnosis	**Procedure during colposcopy**					
	Visual inspection only	37 (4.1)	37 (5.2)		63 (15.9)	
	Lletz	337 (37.2)	258 (35.9)		231 (58.2)	
	Biopsy	526 (58.0)	420 (58.4)		90 (22.7)	
	Other	7 (0.8)	4 (0.6)	0.69	13 (3.3)	<0.001
	Histology result[&]					
	Normal	27 (3.1)	30 (4.4)		45 (13.8)	
	CIN I	254 (29.3)	200 (29.3)		84 (25.7)	
	CIN II	298 (34.3)	209 (30.7)		99 (30.3)	
	CIN III	236 (27.2)	198 (29.0)		86 (26.3)	
	Carcinoma	3 (0.4)	9 (1.3)		2 (0.6)	
	Other[*]	34 (3.9)	19 (2.8)		2 (0.6)	
	Invalid specimen	16 (1.8)	17 (2.5)	0.10	9 (2.8)	<0.001

χ^2 test for categorical variables or Wilcoxon Rank-sum test for continuous variables. [^]Of those with a known HIV status. [%]Of those HIV positive. [&]Of those with a histology specimen taken at biopsy, Lletz or other procedure. Charlotte Maxeke Johannesburg Academic Hospital (CMJAH). Hillbrow Community Health Centre (HCHC). [*]Other includes infections such as cervicitis, inflammation and dysplasia

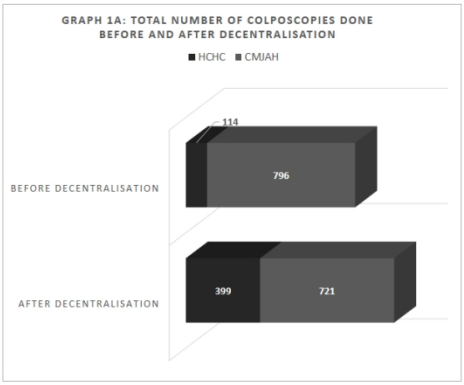
Table 2: Cytology results in the City of Johannesburg in 2014-2016

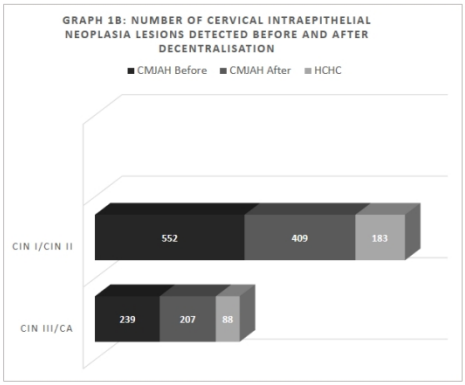
Variable n (%)	Johannesburg health district* (n=114,983)	Hillbrow Community Health Centre (n=2227)	*P*
Pap smear results			
NILM	74,969 (65.2)	852 (38.3)	
LSIL	23,212 (20.2)	790 (35.5)	
ASCUS	7391 (6.4)	184 (8.3)	
HSIL	7808 (6.8)	364 (16.3)	
ASC-H	1221 (1.1)	28 (1.3)	
Carcinoma	382 (0.3)	9 (0.4)	<0.001
Number requiring colposcopy			
No (NILM, LSIL or ASCUS)	105,572 (91.8)	9411 (82.0)	<0.001
Yes (HSIL, ASC-H or carcinoma)	1826 (8.2)	401 (18.0)	

Data from the National Health Laboratory Service. Excludes invalid or missing specimens, and other Pap smear results (n=2446). *District total excludes HCHC



355x266mm (96 x 96 DPI)





NOTES/ABBREVIATIONS
HCHC: Hillbrow Community Health Centre / CMJAH: Charlotte Maxeke Johannesburg Academic hospital / Ca: Carcinoma
Comparison between bars in graph 1b p-value <0.001.

FOOTNOTE
Number of carcinoma cases: CMJAH before = 3 / CMJAH after = 9 / HCHC = 2

355x266mm (96 x 96 DPI)

BMJ Open

The impact of decentralising colposcopy services from tertiary- to primary-level care in inner-city Johannesburg, South Africa: a before and after study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2018-024726.R1
Article Type:	Research
Date Submitted by the Author:	02-Nov-2018
Complete List of Authors:	Maimela, Gloria; University of the Witwatersrand, Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Nene, Xolisile; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Mvundla, Nontuthuko; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Sawry, Shobna; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Smith, Trudy; University of the Witwatersrand , Wits Donald Gordon Medical Centre, Faculty of Health Sciences Rees, Helen; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Kachingwe, Elizabeth; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Chersich, Matthew; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences
Primary Subject Heading:	Public health
Secondary Subject Heading:	Diagnostics, Obstetrics and gynaecology, Oncology, Reproductive medicine
Keywords:	Colposcopy < GYNAECOLOGY, Community gynaecology < GYNAECOLOGY, Gynaecological oncology < GYNAECOLOGY, Minimally invasive surgery < GYNAECOLOGY, PRIMARY CARE, Decentralised Care

Title: The impact of decentralising colposcopy services from tertiary- to primary-level care in inner-city Johannesburg, South Africa: a before and after study

Authors: G. Maimela*[1], X. Nene*[1], N. Mvundla[1], S. Sawry[1], T. Smith[2], H. Rees[1], E.Kachingwe[1], M. Chersich[1]

Affiliations:

1. Wits Reproductive Health and HIV Institute, Faculty of Health Sciences, University of the Witwatersrand, South Africa
2. Department of Obstetrics and Gynaecology, School of Clinical Medicine, Charlotte Maxeke Johannesburg Academic Hospital, Faculty of Health Sciences, University of the Witwatersrand, South Africa

Corresponding author: Gloria Maimela, GMaimela@wrhi.ac.za, Wits Reproductive Health and HIV Institute, Faculty of Health Sciences, University of the Witwatersrand, South Africa.

ABSTRACT

Objective: To assess whether decentralising colposcopy services to a primary care facility in inner-city Johannesburg, South Africa raises access to colposcopy.

Design: Before-after study comparing two years before and two after decentralisation, using clinical records, and laboratory data on cervical cytology and histology.

Primary outcome: The proportion of all women attending Hillbrow Community Health Centre (HCHC) with an abnormal Pap smear who had a colposcopy post-decentralisation.

Setting: Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) has provided colposcopy services for several decades. HCHC, located about 3km away, began colposcopy services in 2014.

Participants: Women, aged above 18 years, who had a colposcopy for diagnosis and treatment of precancerous cervical lesions following a Pap smear, from 2012-2016 at CMJAH or HCHC.

Results: Pre-decentralisation at CMJAH, 910 women had colposcopy (2012-2014). Post-decentralisation (2014-2016), 721 had colposcopy at CMJAH and 399 at HCHC, the decentralised facility. The number who had a Pap smear at

HCHC and then a colposcopy rose three-fold post-decentralisation (114 versus 350). Post-decentralisation, 43 women at HCHC were referred from CMJAH for colposcopy, compared to 114 pre-decentralisation. Post-decentralisation, 47.3% of women at CMJAH waited >6 months for colposcopy, while 35.5% did at HCHC (p<0.001). Across all three groups, 26.9-30.3% of women had CIN III lesions or carcinoma on colposcopy. The proportion of invalid specimens was similar at CMJAH and HCHC (1.8-2.8%). Of 401 women who had an abnormal Pap smear at HCHC post-decentralisation, 267 had colposcopy (66.6%).

Conclusion: Decentralisation can decrease the time to colposcopy and reduce the workload of tertiary hospitals. Overall, more women accessed services. Colposcopy coverage at HCHC is higher than other sites, but could be further improved. Decentralisation did not appear to affect the quality of services and this model could be extended to similar settings in South Africa and elsewhere.

Key words: South Africa, colposcopy, cervical cancer, primary health care, decentralisation

STRENGTHS AND LIMITATIONS OF THIS STUDY

- Data were collected for the purposes of patient care, and not specifically for research, potentially reducing data quality.
- The limited data available meant that the study could not fully investigate several important questions, such as reasons for delays in colposcopy or a detailed assessment of the quality of decentralised services. Additionally, the absence of baseline data at the primary care site does not allow us to directly compare changes in access among women at the primary care site over time.
- As the study only included a single primary care centre, we are unable to fully assess the potential impact of a broader decentralisation strategy. The findings of this study may thus not be generalizable to a larger initiative that, for example, adopted a hub and spoke approach encompassing several primary care centres.
- Given that the study only covered the first two years after decentralisation, we are unable to ascertain the intervention's long-term sustainability.
- The study strengths include a relatively large number of women in all study groups, allowing us to detect differences between the time periods

INTRODUCTION

Cervical cancer is a largely preventable disease and WHO has recently launched an initiative aimed at eliminating the condition.[1] At present, cervical cancer is the second most common cancer among women aged 15 to 44 years in the world.[2] In South Africa, it is the commonest cancer in that age group, and mortality rates are high.[3, 4] About 3% of women in South Africa harbour cervical human papilloma virus (HPV)-16/18, which is responsible for the majority of cases of cervical cancer in the country.[4] Rates of cervical cancer in South Africa can partly be attributed to the high level of HIV.[5] Women with HIV infection have a seven-fold higher rate of persistence of high-risk HPV compared to HIV uninfected women,[6] heightening their risk for incident and progressive precancerous lesions. While antiretroviral therapy reduces the risk of cervical cancer and its precursors, the risk remains much higher than for HIV-negative women.[7]

In South Africa, the policy for cervical cancer screening was introduced in 2001 and updated in 2017.[8] The policy recommends that low-risk women have three Pap smears in a lifetime at the ages of 30, 40 and 50 years, while women with HIV-infection are to be screened every three years, regardless of age. Screening is predominately based on cytology using Papanikolaou (Pap) smears, although there are plans to introduce liquid-based cytology which

offers the potential to do HPV screening. Women with atypical findings on cytology are referred for colposcopy to establish a definitive diagnosis. During colposcopy, the view of the cervix is magnified and, where required, a biopsy is taken or a large loop excision of the transformation zone (Lletz) is conducted.[9]

A range of health systems and patient factors influence access to colposcopy. System barriers include a limited number of colposcopy services, which are mostly centralised within tertiary-level facilities, with long waiting times for patients and few opportunities for non-specialist health workers to develop requisite skills.[10] There are limited numbers of specialist gynaecologists within the public sector, and the high demands on these doctors for emergency and curative obstetric and gynaecology services may reduce their time available for diagnostic or preventive interventions, such as colposcopy. Another key factor is the complexity of providing Pap and other results to patients and then scheduling colposcopy appointments across the disjointed systems that often exist between a tertiary hospital and primary care centres.[11-13] Patient-related factors linked with low uptake of colposcopy include low education levels, being single, fear of HIV testing and disclosure, a low CD4 count in HIV-infected women and transport costs for the additional visits.[12, 14, 15] Patient demand for colposcopy is also undermined by a

general fear of cancer, and lack of awareness or knowledge about cervical cancer.[11, 16] Poor patient-provider interactions restrict access, whilst a longstanding relationship with a primary clinician can optimise uptake.[16]

In South Africa, colposcopy procedures are generally done at tertiary-level facilities, by specialist gynaecology oncologists and trainee gynaecologists under supervision. While there may be benefits to decentralising colposcopy services to lower levels of care, these need to be balanced by the advantages of centralization of cancer services, such as concentrating clinical expertise, with a higher quality of care, and the rationalisation of expensive specialist equipment. Thus, in this before- and after-study, we aimed to determine if access to colposcopy increased following the decentralisation of colposcopy services from a tertiary-level hospital to a primary care facility in inner-city Johannesburg, South Africa. We compare the total number of colposcopies done and the coverage of colposcopy services in the primary-level facility after decentralisation. We also compare the two sites, specifically, the patient profile and cervical cancer risks, colposcopy procedures, quality of the services and histology outcomes.

METHODS

Study participants and setting

Women, aged 18 years and older, who accessed colposcopy services at either Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) or Hillbrow Community Health Centre (HCHC) between October 2012 and September 2016 were included in the study. Both facilities are in sub-district F of the Johannesburg Health District (JHD).

The colposcopy clinic at CMJAH is part of the Gynaecology-Oncology Department at CMJAH, which has two colposcopy machines. Women attending a facility in JHD who have an abnormal Pap smear are referred to the facility, where they are provided with an appointment date for colposcopy.

Hillbrow Community Health Centre (HCHC) is situated in the densely populated inner-city area of Hillbrow, about 3km from CMJAH.[17] HCHC provides primary level care, including a 24 hour casualty and a midwife obstetrics unit. The facility is run predominantly by nursing staff, with support from non-specialist medical doctors.

Implementation of decentralised services

In 2013, a review of patient files at HCHC found that a large proportion of women attending the HIV clinic had high-risk lesions on Pap smear.[18] Moreover, there were reports from patients and health workers at HCHC of prolonged waiting times for colposcopy services at CMJAH. The Wits

Reproductive Health and HIV Institute (Wits RHI) thus set about establishing decentralised colposcopy services at HCHC. A private sector company donated a colposcopy machine. Two district medical officers were trained by specialist gynaecology oncologists at CMJAH to provide the service. CMJAH staff provided ongoing support and established referral processes between the two facilities. Monthly meetings were held between staff at the two facilities, where concerns and difficult cases could be discussed.

The services, which began in October 2014, were provided twice a week by the medical officers, with assistance from the nurse who takes Pap smears at the facility. Patients attending HCHC and some referred from surrounding clinics were given an appointment for colposcopy if they had an abnormal Pap smear result, defined as: high-grade squamous intraepithelial lesion (HSIL), atypical squamous cell and HSIL cannot be excluded (ASC-H), or squamous cell carcinoma (SCC).[19] A few patients with Pap smear results other than those defined as abnormal smears were also referred for colposcopy. Patients with complex lesions, such as abnormal cervical anatomy or a high suspicion of cancer on Pap smear were referred to CMJAH, as were those with a failed colposcopy. Colposcopy procedures included colposcopic assessment only, or colposcopic assessment together with either a Lletz or biopsy. Histology specimens were processed at the National Health Laboratory Service (NHLS).

Data sources and collection

For the purpose of this evaluation, women who accessed colposcopy services at CMJAH and HCHC were divided into three groups: 1) pre-decentralisation at CMJAH between October 2012 and September 2014; 2) post-decentralisation at CMJAH between October 2014 and September 2016; and 3) post-decentralisation at HCHC between October 2014 and September 2016.

At CMJAH, we extracted data from paper-based records at the colposcopy clinic, including on patients' age, HIV status, antiretroviral treatment, date of Pap smear, Pap smear result, date of colposcopy, colposcopy procedure performed and histology results. Data were entered into a REDCap electronic database (REDcap Software, Version 4.14.5, Vanderbilt University).[20]. At HCHC, demographic and clinical data on women who accessed colposcopy services were entered into an MS Excel spreadsheet after each patient visit. Data were obtained from the NHLS on Pap smear cytology for women attending HCHC who had a Pap smear and for the whole of JHD.

Study variables and statistical analysis

Patient characteristics and colposcopy procedures were compared between the three groups. Time to colposcopy was calculated as the number of months from date of Pap smear to colposcopy and was categorised as optimal (under

3 months), acceptable (3-6 months) and delayed (greater than 6 months). Histology results were classified as normal (includes benign endocervical polyp, atrophic ectocervical mucosa, koilocytotosis and metaplasia), Cervical Intraepithelial Neoplasia (CIN) I, CIN II, CIN III, carcinoma, other (includes infections such as cervicitis, inflammation and dysplasia) and invalid specimens (includes absent results). We used the proportion of invalid specimens and number of failed colposcopies as proxy markers of the quality of services. The coverage of colposcopy services at HCHC, the primary outcome, was estimated by calculating the proportion of all women at HCHC with an abnormal Pap smear who had a colposcopy. Differences between the three study groups were assessed using a chi-square test or a Wilcoxon rank-sum test, as appropriate. All data were analysed using STATA version 13.0.

Ethical considerations

Ethical approval was obtained from Human Research Ethics Committee of the University of the Witwatersrand (Certificate number: M151184). Permission for use of the CMJAH data was granted by the hospital's Chief Executive Officer, and the head of the Department of Obstetrics and Gynaecology at CMJAH. The NHLS Academic Affairs and Research Office gave permission for use of their data.

Patient involvement

The study utilised data that had already been collected as part of routine patient care, and thus patients were not directly involved in the study. We did, however, attempt to contact patients who had abnormal lesions on histology and had not attended follow-up visits.

RESULTS

Access to colposcopy and timeliness of services

In total, 910 women accessed colposcopy at CMJAH between October 2012 and September 2014. In the subsequent two years, 1120 women had a colposcopy: 399 at HCHC (35.6%) and 721 at CMJAH (64.4%; Table 1 and Figure 1).

One quarter of women who had a colposcopy at HCHC had had their Pap smear at another facility. The percentage of women at CMJAH who had had a Pap smear at HCHC halved post-decentralisation ($p<0.001$) and the absolute number decreased from 113 to 43. The number of women who had a Pap smear at HCHC and then a colposcopy at either facility was three-fold higher post-decentralisation than pre-decentralisation (from 113 to 350) (Table 1).

Table 1: Patient characteristics and colposcopy outcomes at a community clinic, and a tertiary-level facility before and after decentralisation

Variables	Before versus after decentralisation at CMJAH	HCHC versus CMJAH after decentralisation

		A) Pre-decentralisation (2012-2014) N=910	B) Post-decentralisation (2014-2016) N=721	P (A vs B)	C) Hillbrow CHC (2014–2016) N=399	P (B vs C)
Characteristics	**Age groups in years**					
	<20	7 (0.8)	6 (0.8)		0 (0)	
	20–34	351 (39.8)	209 (30.2)		150 (37.6)	
	35–44	342 (38.8)	266 (38.4)		156 (39.1)	
	45–59	161 (18.3)	187 (27.0)		79 (19.8)	
	>60	20 (2.3)	25 (3.6)	0.001	7 (1.8)	0.003
	HIV status known	650 (71.4)	429 (59.5)	<0.001	399 (100)	<0.001
	HIV status^					
	Negative	105 (16.2)	59 (13.8)		62 (15.5)	
	Positive	545 (83.9)	370 (86.3)	0.28	337 (84.5)	0.47
	On ART%	428/544 (78.7)	324/370 (87.6)	<0.001	336/337 (99.7)	<0.001
Cervical cancer Screening	**Facility where Pap smear done**					
	CMJAH	115 (12.8)	124 (17.5)		0 (0.0)	
	HCHC	114 (12.7)	43 (6.1)		307 (76.9)	
	Other clinic or hospital	671 (74.6)	540 (76.4)	<0.001	92 (23.1)	<0.001
	Pap smear results					
	NILM	6 (0.7)	8 (1.1)		17 (4.3)	
	LSIL	141 (15.5)	125 (17.4)		79 (20.0)	
	ASCUS	19 (2.1)	34 (4.7)		4 (1.0)	
	HSIL	678 (74.7)	478 (66.4)		263 (66.4)	
	ASC-H	63 (6.9)	65 (9.0)		27 (6.8)	
	Carcinoma	1 (0.1)	10 (1.4)	<0.001	6 (1.5)	<0.001
	Pap smear risk categories					
	NILM, LSIL or ACSUS	166 (18.3)	167 (23.2)		100 (25.3)	
	HSIL, ASC-H or carcinoma	742 (81.7)	553 (76.8)	0.015	296 (74.8)	0.44

Cervical cancer diagnosis	**Procedure during colposcopy**					
	Visual inspection only	37 (4.1)	37 (5.2)		63 (15.9)	
	Lletz	337 (37.2)	258 (35.9)		231 (58.2)	
	Biopsy	526 (58.0)	420 (58.4)		90 (22.7)	
	Other	7 (0.8)	4 (0.6)	0.69	13 (3.3)	<0.001
	Histology result[&]					
	Normal	27 (3.1)	30 (4.4)		45 (13.8)	
	CIN I	254 (29.3)	200 (29.3)		84 (25.7)	
	CIN II	298 (34.3)	209 (30.7)		99 (30.3)	
	CIN III	236 (27.2)	198 (29.0)		86 (26.3)	
	Carcinoma	3 (0.4)	9 (1.3)		2 (0.6)	
	Other[*]	34 (3.9)	19 (2.8)		2 (0.6)	
	Invalid specimen	16 (1.8)	17 (2.5)	0.10	9 (2.8)	<0.001

χ^2 test for categorical variables or Wilcoxon Rank-sum test for continuous variables. [^]Of those with a known HIV status. [%]Of those HIV positive. [&]Of those with a histology specimen taken at biopsy, Lletz or other procedure. Charlotte Maxeke Johannesburg Academic Hospital (CMJAH). Hillbrow Community Health Centre (HCHC). [*]Other includes infections such as cervicitis, inflammation and dysplasia

Almost half of the women at CMJAH had a delay in receiving colposcopy (>6 months between Pap smear and colposcopy) post-decentralisation, compared to about a third pre-decentralisation (47.3% versus 36.2%, p<0.001; Figure 1: Graph 1A). At HCHC, 21.7% of women had a colposcopy within three months of a Pap smear being taken (versus 11.8% at CMJAH pre- and 15.4% post-decentralisation, p<0.001).

Of all Pap smears done in the JHD in the two years after decentralisation (114,983), 1.9% were done at HCHC (2227). Overall, 18.0% Pap smears done at HCHC had abnormal cytology and required colposcopy (n=401), compared to only 8.2% of other women in JHD as a whole (n=1826; p<0.001) (Table 2).

The estimated colposcopy coverage among women who had an abnormal Pap smear at HCHC was 66.6% (267/401; 95%CI=61.7-71.2%).

Table 2: Cytology results in the City of Johannesburg in 2014-2016

Variable n (%)	Johannesburg health district* (n=114,983)	Hillbrow Community Health Centre (n=2227)	*P*
Pap smear results			
NILM	74,969 (65.2)	852 (38.3)	
LSIL	23,212 (20.2)	790 (35.5)	
ASCUS	7391 (6.4)	184 (8.3)	
HSIL	7808 (6.8)	364 (16.3)	
ASC-H	1221 (1.1)	28 (1.3)	
Carcinoma	382 (0.3)	9 (0.4)	<0.001
Number requiring colposcopy			
No (NILM, LSIL or ASCUS)	105,572 (91.8)	9411 (82.0)	
Yes (HSIL, ASC-H or carcinoma)	1826 (8.2)	401 (18.0)	<0.001

Data from the National Health Laboratory Service. Excludes invalid or missing specimens, and other Pap smear results (n=2446).

*District total excludes HCHC

Characteristics of women in the three groups

The proportion of women older than 45 years pre-decentralisation at CMJAH was 20.5%, post-decentralisation at CMJAH 30.6% and at HCHC 21.9% (p<0.001). At CMJAH, more women had a known HIV status pre-decentralisation than post-decentralisation (71.4% versus 59.5%, p<0.001). All women at HCHC had a documented HIV status. Around 85% of women with a

known HIV status were HIV positive in all three groups. The proportion of positive women receiving ART rose in the second period at CMJAH from 78.7% to 87.6% (p<0.001), and almost all positive women were on ART at HCHC (99.7%; p<0.001). (Table 1)

Description of colposcopy procedures and histology findings

At CMJAH, in both periods, nearly 60% of women had a biopsy at colposcopy (58.2%), while the same proportion had a Lletz at HCHC (58.2%). Three women who had a colposcopy at HCHC were referred to CMJAH due to an unsuccessful procedure.

Women at HCHC were 3.5 fold more likely to have a normal result on histology than women at CMJAH (95% CI OR=2.1-5.7). Post-decentralisation, 29.0% of women at CMJAH and 26.3% at HCHC had CIN III lesions (p=0.37; Figure 1: Graph1B). Post-decentralisation, 11 women had a diagnosis of carcinoma on histology (1.1%), compared to 3 before decentralisation (0.4%; p=0.06). The proportion of invalid specimens was similar across the three groups, ranging from 1.8 to 2.8%.

DISCUSSION

In this study we determined whether decentralisation to primary care level improved access to colposcopy services by reviewing the number of women

attending the service before and after decentralisation, and the coverage of colposcopy among women at HCHC. We found that the cumulative number of colposcopies across the two facilities rose following decentralisation, and after only two years, HCHC was responsible for a third of all colposcopies in the sub-district, even though it performs a negligible number of Pap smears relative to other sites. Overall, following decentralisation, three fold more women who had a Pap smear at HCHC had a colposcopy, and at CMJAH, the proportion of women from HCHC reduced almost threefold. The marked increase in number of women from HCHC who had a colposcopy indicates that prior to decentralisation there may have been a large unmet need for the service, which was now being addressed, at least in part. The coverage reached 66.6%, considerably higher than figures in other settings.

Decentralisation of colposcopy services to primary level care has several potential benefits. Firstly, with adequate training, tasks that had been performed by highly specialised staff can be shifted to lower health worker cadres, allowing specialists to focus on more complex cases.[21] Also, decentralisation may alleviate patient barriers to access, by bringing services closer to them – in settings they are familiar with – and reducing their transport and other costs.[11, 21] Decentralisation has long been central to the provision of HIV services in this setting through, for example, task shifting, providing

antiretroviral treatment in primary care services and the dispensing of drugs from local pharmacies, rather than clinics.[22] Integration with HIV and ART services is beneficial to women as it reduces opportunity costs associated with multiple visits to the clinic and lowers the risk of loss to follow up.

Decentralisation of colposcopy can take several forms, including telecolposcopy from distant sites, outreach portable colposcopy, shifting of services to nurse practitioners or medical officers, and decentralisation to lower level facilities, as in this study.[23] In other settings, shifting services to lower care levels was found to be cost-effective, acceptable to patients and to increase rates of attendance for colposcopy.[14, 23, 24] In the Western Cape, South Africa, for example, colposcopy services were decentralised to a district hospital and provided by a gynaecologist.[21] This raised uptake of the service and reduced time to procedure. In high-income countries, services have been successfully decentralised to community health centres and portable outreach programmes in Alaska, the United States, and parts of Canada and Australia, targeting immigrant, Inuit and other vulnerable women.[14, 15, 24-26] The National Health Service in United Kingdom has gone a step further and colposcopy is often performed by nurse practitioners once they have completed certification procedures.[27]

Women attending HCHC colposcopy were at lower risk than those at CMJAH, as shown by their lower grades of abnormalities on Pap smear and histology. Women at HCHC were also younger than those at CMJAH, important as risk for cervical cancer rises considerably with age (the mean age at diagnosis of cervical cancer is 52.3 in South Africa).[28] These findings may suggest that, as the programme had envisaged, higher-risk patients are being referred to CMJAH. Overall, services at HCHC appear to be performing well, with all women tested for HIV and almost all those positive were receiving ART. In addition, colposcopy services were now integrated into their care, which was previously off-site, complex to access and marked by lengthy delays. HIV-positive women made up the large majority of patients in all groups, reflecting the higher levels of risk for cervical cancer in this population. Clearly it remains a priority to integrate screening for cervical cancer within all clinics providing antiretroviral treatment.

The similar number of invalid histology samples and the isolated cases of failed colposcopy suggests that the quality of colposcopy services at HCHC may have been comparable to CMJAH. Unlike at CMJAH, however, Lletz was the commonest procedure at HCHC, in keeping with evidence that Lletz is better suited to lower level facilities and staff.[9] With decentralisation, it is critical to ensure that staff are adequately trained and service quality is closely

monitored. The hesitancy to decentralise colposcopy to date, may reflect underlying concerns that cases of cancer may go undetected by lower-level staff. In some settings, lower-level health workers undergo a process of certification and have to perform a certain number of colposcopies per year to remain registered.[27] While this approach may hold advantages, onerous processes around certification and recertification may lead to staff discontinuing colposcopy.[29]

The decline in number of colposcopies at CMJAH is concerning, and may reflect factors other than a reduction in demand that accompanies decentralisation. Fewer women at the site had a known HIV status and waiting times for colposcopy lengthened. Thus, though decentralisation can reduce the patient burden at referral centres, this does not necessarily translate into improved services at that site. Other factors may play a larger influence, for example, coinciding with the period after decentralisation, CMJAH lost a number of senior specialists.

Delays in colposcopy vary considerably between settings, from an average of 39 days from referral to colposcopy in one study in KwaZulu Natal, South Africa,[10] to around 5-6 months in both our study and another in the Western Cape.[21] It is concerning that time from Pap smear to colposcopy is greater than six months for half the women at CMJAH, and a third at HCHC. Reducing

these delays is clearly a priority at both sites. We were unable, however, to discern reasons for these delays, which could be caused by delays in providing the results of Pap smears to patients, patient delays in making or attending appointments, or shortages of specialist staff. We could also not investigate which group of patients required referral to higher levels of care, and future studies might attempt to define criteria for referral. Moreover, given the relatively short period of the review, we are unable to assess sustainability of the services in the long-run, a pressing question. Lastly, the study evaluated the use of colposcopy following cytological screening with Pap smears and these findings may not be generalizable to screening with HPV testing, which is increasingly being used in many countries.[30] HPV testing has a considerably higher sensitivity for detecting precursor lesions of cervical cancer compared to cytology, and thus may alter the number of patients requiring colposcopy and types of lesions identified.[31, 32]

CONCLUSION

In conclusion, decentralisation of colposcopy services can improve access to colposcopy, resulting in faster diagnoses of precancerous lesions of the cervix, more lesions being treated with Lletz and a reduction in the burden of patients in tertiary hospitals. Most importantly, increasing the number of colposcopies

and treatments of precancerous lesions could reduce the incidence of cervical cancer. This is particularly important among HIV-positive women who now live longer with ART, and the treatment of their co-morbidities is rapidly gaining in importance. Though coverage of colposcopy reached two thirds at HCHC, it is important to identify interventions to further raise coverage levels. Decentralisation is unlikely to affect the quality of services if medical officers are appropriately trained, supervised and supported by clear referral guidelines. The approach presented here could be extended to other primary- or secondary-level facilities in South Africa, and perhaps encompass the use of portable colposcopes or telecolposcopy, under close supervision. If done correctly and at scale, decentralisation of colposcopy services, could shore up cervical cancer prevention and finally decrease the public health burden and mortality due to the cancer.

ACKNOWLEDGEMENTS

We would like to acknowledge the following persons who contributed to this study:

H. Manyonga, Z. Dumakude, A. Mohololа, N. Wattrus, L. Mbuyisa, I. Sishi, N. Twala, S. Sidabuka, E. Briedenhann, L. Mavuya, K. Moshaba, S. Mzobe, S.

Carmona (NHLS), L. Chauke (Department of Obstetrics and Gynaecology, CMJAH).

FUNDING

This study has been made possible through funding from USAID-PEPFAR, grant number: AID-A-12-67400021. We would also like to acknowledge the following organizations for donating a colposcopy machine to Hillbrow CHC: Vodacom, Altech and Altron.

COMPETING INTERESTS

All authors listed in this study do not have competing interests to declare.

DATA SHARING STATEMENT

There's no additional unpublished data from the study.

AUTHOR CONTRIBUTIONS

Manuscript title: Decentralising colposcopy services raises access to treatment of abnormal cervical smears: a pilot in an inner-city clinic in Johannesburg, South Africa

Category 1

Conception and design of study: G. Maimela*1, X. Nene*1, S. Sawry, N. Mvundla, M. Chersich

Acquisition of data: G. Maimela, X. Nene, N. Mvundla,

Analysis and/or interpretation of data: G. Maimela, X. Nene, S. Sawry, E. Kachingwe, M. Chersich, H. Rees; T. Smith.

Category 2

Drafting the manuscript: G. Maimela, X. Nene, N. Mvundla, S. Sawry, E. Kachingwe, M. Chersich.

Revising the manuscript critically for important intellectual content: M. Chersich, H. Rees, T. Smith

Category 3

Approval of the version of the manuscript to be published:

G. Maimela*1, X. Nene*1, N. Mvundla1, S. Sawry1, T. Smith2, H. Rees1, E.Kachingwe1, M. Chersich1

Acknowledgements: *All persons who have made substantial contributions to the work reported in the manuscript (e.g., technical help, writing and editing assistance, general support), but who do not meet the criteria for authorship, are named in the Acknowledgements and have given us their written permission to be named. If we have not included an Acknowledgements, then that indicates that we have not received substantial contributions from non-authors.*

H. Manyonga, Z. Dumakude, A. Mohololа, N. Wattrus, L. Mbuyisa, I. Sishi, N. Twala, S. Sidabuka, E. Briedenhann, L. Mavuya, K. Moshaba, S. Mzobe, S. Carmona (NHLS), L. Chauke (Department of Obstetrics and Gynaecology, CMJAH).

This statement is signed by all the authors (a photocopy of this form may be used if there are more than 10 authors):

REFERENCES

1. WHO. Cervical Cancer: An NCD We Can Overcome: Call to Action. 2018. http://www.who.int/reproductivehealth/DG_Call-to-Action.pdf

2. Bruni L, Barrionuevo-Rosas L, Albero G, Serrano B, Mena M, Gómez D, et al. ICO/IARC Information Centre on HPV and Cancer (HPV Information Centre). Human Papillomavirus and Related Diseases in the World. Summary Report 27 July 2017. http://www.hpvcentre.net/statistics/reports/XWX.pdf

3. Batra P, Kuhn L, Denny L. Utilisation and outcomes of cervical cancer prevention services among HIV-infected women in Cape Town. SAMJ: South African Medical Journal. 2010;100:39-44.

4. ICO/IARC Information Centre on HPV and Cancer. South Africa Human Papillomavirus and Related Cancers, Fact Sheet 2017. 2017. http://www.hpvcentre.net/statistics/reports/ZAF_FS.pdf

5. Shisana O, Rehle T, Simbayi LC, Zuma K, Jooste S, Zungu N, et al. South African National HIV Prevalence, Incidence and Behaviour Survey, 2012. Cape Town: HSRC Press: 2014.

6. Adler D, Wallace M, Bennie T, Abar B, Sadeghi R, Meiring T, et al. High risk human papillomavirus persistence among HIV-infected young women in South Africa. International journal of infectious diseases : IJID : official publication of the International Society for Infectious Diseases. 2015;33:219-21. Epub 2015/02/24.

7. Guiguet M, Boue F, Cadranel J, Lang JM, Rosenthal E, Costagliola D, et al. Effect of immunodeficiency, HIV viral load, and antiretroviral therapy on the risk of individual malignancies (FHDH-ANRS CO4): a prospective cohort study. Lancet Oncol. 2009;10(12):1152-9. Epub 2009/10/13.

8. National Department of Health South Africa. Cervical Cancer Prevention and Control Policy. 2017.

9. WHO. WHO guidelines for screening and treatment of precancerous lesions for cervical cancer prevention. 2013. http://apps.who.int/iris/bitstream/handle/10665/94830/9789241548694_eng.pdf;jsessionid=F65ED4960A15E4D16BB15F6E57F71518?sequence=1

10. Katz IT, Butler LM, Crankshaw TL, Wright AA, Bramhill K, Leone DA, et al. Cervical Abnormalities in South African Women Living With HIV With High Screening and Referral Rates. J Glob Oncol. 2016;2(6):375-80.

11. Dawood S. Barriers and Facilitators to Colposcopy Attendance. Following an Abnormal Pap Smear: Patient and Provider Perspectives. Cape Town: University of Cape Town; 2014.

12. Momberg M, Botha MH, Van der Merwe FH, Moodley J. Women's experiences with cervical cancer screening in a colposcopy referral clinic in Cape Town, South Africa: a qualitative analysis. BMJ open. 2017;7(2):e013914. Epub 2017/02/19.

13. Hoque M, Hoque E, Kader SB. Evaluation of cervical cancer screening program at a rural community of South Africa. East African journal of public health. 2008;5(2):111-6. Epub 2008/11/26.

14. Martin B, Smith W, Orr P, Guijon F. Investigation and management of cervical intraepithelial neoplasia in Canadian Inuit: enhancing access to care. Arctic Med Res. 1995;54 Suppl 1:117-21.

15. Payne S, Jarrett N, Jeffs D. The impact of travel on cancer patients' experiences of treatment: a literature review. Eur J Cancer Care (Engl). 2000;9(4):197-203.

16. Baranoski AS, Stier EA. Factors associated with time to colposcopy after abnormal Pap testing in HIV-infected women. Journal of women's health (2002). 2012;21(4):418-24. Epub 2011/12/07.

17. Rees H, Delany-Moretlwe S, Scorgie F, Luchters S, Chersich MF. At the Heart of the Problem: Health in Johannesburg's Inner-City. BMC Public Health. 2017;17(Suppl 3):554.

18. Stadler J, Chikandiwe A, Mayaud P, Rees H, Imrie J, Delany-Moretlwe S. Biographies of HIV and Cervical Cancer: Understanding Treatment-Seeking Amongst HIV Positive Women in Inner City Johannesburg. IAS conference, Durba, South Africa, Oral presentation. 2016.

19. Botha MH. Guidelines for cervical cancer screening in South Africa. Southern African Journal of Gynaecological Oncology 2017;9(1):8-12.

20. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009;42(2):377-81. Epub 2008/10/22.

21. Blanckenberg ND, Oettle CA, Conradie HH, Krige FK. Impact of introduction of a colposcopy service in a rural South African sub-district on uptake of colposcopy. South African Journal of Obstetrics and Gynaecology. 2013;19(3).

22. Callaghan M, Ford N, Schneider H. A systematic review of task- shifting for HIV treatment and care in Africa. Human resources for health. 2010;8:8. Epub 2010/04/02.

23. Bishai DM, Ferris DG, Litaker MS. What is the least costly strategy to evaluate cervical abnormalities in rural women? Comparing telemedicine, local practitioners, and expert physicians. Med Decis Making. 2003;23(6):463-70.

24. Ogilvie GS, Shaw EA, Lusk SP, Zazulak J, Kaczorowski JA. Access to colposcopy services for high-risk Canadian women: can we do better? Can J Public Health. 2004;95(5):346-51.

25. Gifford MS, Stone IK. Quality, access, and clinical issues in a nurse practitioner colposcopy outreach program. The Nurse practitioner. 1993;18(10):25-9, 33-6. Epub 1993/10/01.

26. Hartz LE. Quality of care by nurse practitioners delivering colposcopy services. J Am Acad Nurse Pract. 1995;7(1):23-7.

27. Public Health England, National Health Service. NHS Cervical Screening Programme Colposcopy and Programme Management. NHSCSP Publication number 20. Third edition. 2016. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/515817/NHSCSP_colposcopy_management.pdf

28. Olorunfemi G, Ndlovu N, Masukume G, Chikandiwa A, Pisa PT, Singh E. Temporal trends in the epidemiology of cervical cancer in South Africa (1994-2012). Int J Cancer. 2018;143(9):2238-49.

29. Sonnex C. Providing a genitourinary medicine colposcopy service. Sexually transmitted infections. 2014;90(1):8-10. Epub 2013/07/31.

30. Public Health England. NHS Cervical Screening Programme: Colposcopy and Programme Management. NHSCSP Publication number 20. Third Edition. 2016. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/515817/NHSCSP_colposcopy_management.pdf

31. Dijkstra MG, Snijders PJ, Arbyn M, Rijkaart DC, Berkhof J, Meijer CJ. Cervical cancer screening: on the way to a shift from cytology to full molecular screening. Ann Oncol. 2014;25(5):927-35. Epub 2014/01/22.

32. Wright TC, Jr., Stoler MH, Behrens CM, Sharma A, Sharma K, Apple R. Interlaboratory variation in the performance of liquid-based cytology: insights from the ATHENA trial. Int J Cancer. 2014;134(8):1835-43. Epub 2013/10/15.

FIGURE LEGENDS

Figure 1:

Graph 1A: Total number of colposcopies done before and after decentralisation

Graph 1B: Number of cervical intraepithelial neoplasia lesions detected before and after decentralisation

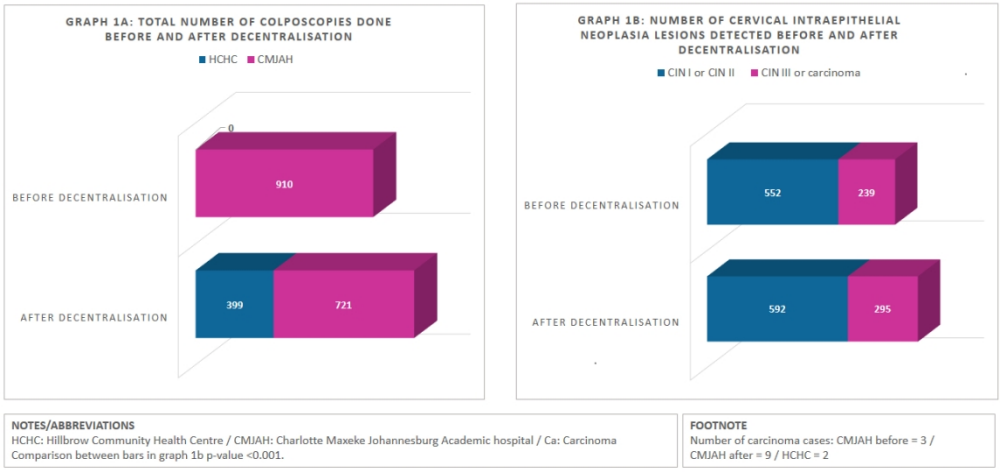


Figure 1:
Graph 1A: Total number of colposcopies done before and after decentralisation
Graph 1B: Number of cervical intraepithelial neoplasia lesions detected before and after decentralisation

271x128mm (120 x 120 DPI)

BMJ Open

The impact of decentralising colposcopy services from tertiary- to primary-level care in inner-city Johannesburg, South Africa: a before and after study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2018-024726.R2
Article Type:	Research
Date Submitted by the Author:	14-Jan-2019
Complete List of Authors:	Maimela, Gloria; University of the Witwatersrand, Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Nene, Xolisile; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Mvundla, Nontuthuko; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Sawry, Shobna; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Smith, Trudy; University of the Witwatersrand , Wits Donald Gordon Medical Centre, Faculty of Health Sciences Rees, Helen; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Kachingwe, Elizabeth; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Chersich, Matthew; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences
Primary Subject Heading:	Public health
Secondary Subject Heading:	Diagnostics, Obstetrics and gynaecology, Oncology, Reproductive medicine
Keywords:	Colposcopy < GYNAECOLOGY, Community gynaecology < GYNAECOLOGY, Gynaecological oncology < GYNAECOLOGY, Minimally invasive surgery < GYNAECOLOGY, PRIMARY CARE, Decentralised Care

Title: The impact of decentralising colposcopy services from tertiary- to primary-level care in inner-city Johannesburg, South Africa: a before and after study

Authors: G. Maimela*[1], X. Nene*[1], N. Mvundla[1], S. Sawry[1], T. Smith[2], H. Rees[1], E.Kachingwe[1], M. Chersich[1]

Affiliations:

1. Wits Reproductive Health and HIV Institute, Faculty of Health Sciences, University of the Witwatersrand, South Africa
2. Department of Obstetrics and Gynaecology, School of Clinical Medicine, Charlotte Maxeke Johannesburg Academic Hospital, Faculty of Health Sciences, University of the Witwatersrand, South Africa

Corresponding author: Gloria Maimela, GMaimela@wrhi.ac.za, Wits Reproductive Health and HIV Institute, Faculty of Health Sciences, University of the Witwatersrand, South Africa

ABSTRACT

Objective: To assess whether decentralising colposcopy services to a primary care facility in inner-city Johannesburg, South Africa raises access to colposcopy.

Design: Before-after study comparing two years before and two after decentralisation, using clinical records, and laboratory data on cervical cytology and histology.

Primary outcome: The proportion of all women attending Hillbrow Community Health Centre (HCHC) with an abnormal Pap smear who had a colposcopy post-decentralisation.

Setting: Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) has provided colposcopy services for several decades. HCHC, located about 3km away, began colposcopy services in 2014.

Participants: Women, aged above 18 years, who had a colposcopy for diagnosis and treatment of precancerous cervical lesions following a Pap smear, from 2012-2016 at CMJAH or HCHC.

Results: Pre-decentralisation at CMJAH, 910 women had colposcopy (2012-2014). Post-decentralisation (2014-2016), 721 had colposcopy at CMJAH and 399 at HCHC, the decentralised facility. The number who had a Pap smear at

HCHC and then a colposcopy rose three-fold post-decentralisation (114 versus 350). Post-decentralisation, 43 women at HCHC were referred from CMJAH for colposcopy, compared to 114 pre-decentralisation. Post-decentralisation, 47.3% of women at CMJAH waited >6 months for colposcopy, while 35.5% did at HCHC (p<0.001). Across all three groups, 26.9-30.3% of women had CIN III lesions or carcinoma on colposcopy. The proportion of invalid specimens was similar at CMJAH and HCHC (1.8-2.8%). Of 401 women who had an abnormal Pap smear at HCHC post-decentralisation, 267 had colposcopy (66.6%).

Conclusion: Decentralisation can decrease the time to colposcopy and reduce the workload of tertiary hospitals. Overall, more women accessed services. Colposcopy coverage at HCHC is higher than other sites, but could be further improved. Decentralisation did not appear to undermine the quality of services and this model could be extended to similar settings in South Africa and elsewhere.

Key words: South Africa, colposcopy, cervical cancer, primary health care, decentralisation

ARTICLE SUMMARY

Strengths and limitations of this study

- Data were collected for the purposes of patient care, and not specifically for research, potentially reducing data quality.
- The limited data available meant that the study could not fully investigate several important questions, such as reasons for delays in colposcopy or a detailed assessment of the quality of decentralised services. Additionally, the absence of baseline data at the primary care site does not allow us to directly compare changes in access among women at the primary care site over time.
- As the study only included a single primary care centre, we are unable to fully assess the potential impact of a broader decentralisation strategy. The findings of this study may thus not be generalizable to a larger initiative that, for example, adopted a hub and spoke approach encompassing several primary care centres.
- Given that the study only covered the first two years after decentralisation, we are unable to ascertain the intervention's long-term sustainability.
- The study strengths include a relatively large number of women in all study groups, allowing us to detect differences between the time periods. Additionally, the hub and spoke approach has been used for several other health services that similarly require an integrated tiered health care and laboratory system, such as TB care and colorectal cancer screening. The

successful application of this approach elsewhere supports the generalizability of the study findings and assertions about the validity of the results reported.

INTRODUCTION

Cervical cancer is a largely preventable disease and WHO has recently launched an initiative aimed at eliminating the condition.[1] At present, cervical cancer is the second most common cancer among women aged 15 to 44 years in the world.[2] In South Africa, it is the commonest cancer in that age group, and mortality rates are high.[3, 4] About 3% of women in South Africa harbour cervical human papilloma virus (HPV)-16/18, which is responsible for the majority of cases of cervical cancer in the country.[4] Rates of cervical cancer in South Africa can partly be attributed to the high level of HIV.[5] Women with HIV infection have a seven-fold higher rate of persistence of high-risk HPV compared to HIV uninfected women,[6] heightening their risk for incident and progressive precancerous lesions. While antiretroviral therapy reduces the risk of cervical cancer and its precursors, the risk remains much higher than for HIV-negative women.[7]

In South Africa, the policy for cervical cancer screening was introduced in 2001 and updated in 2017.[8] The policy recommends that low-risk women have three Pap smears in a lifetime at the ages of 30, 40 and 50 years, while women with HIV-infection are to be screened every three years, regardless of age. About 60% of women aged 30 to 49 years have had cervical cancer screening.[9] Screening is predominately based on cytology using Papanikolaou (Pap) smears, although there are plans to introduce liquid-based cytology which offers the potential to do HPV screening. Women with atypical findings on cytology are referred for colposcopy to establish a definitive diagnosis. During colposcopy, the view of the cervix is magnified and, where required, a biopsy is taken or a large loop excision of the transformation zone (Lletz) is conducted.[10]

The gap between screening for cervical cancer and treatment of high-risk lesions is believed to be very high in South Africa.[11] Although there are few published data to support this assertion, the fact that the number of cervical cancer cases remains high despite the large number of cervical cancer screening procedures suggest this is the case. A range of health systems and patient factors influence access to colposcopy. System barriers include a limited number of colposcopy services, which are mostly centralised within tertiary-level facilities, with long waiting times for patients and few

opportunities for non-specialist health workers to develop requisite skills.[12] There are limited numbers of specialist gynaecologists within the public sector, and the high demands on these doctors for emergency and curative obstetric and gynaecology services may reduce their time available for diagnostic or preventive interventions, such as colposcopy. Another key factor is the complexity of providing Pap and other results to patients and then scheduling colposcopy appointments across the disjointed systems that often exist between a tertiary hospital and primary care centres.[13-15] Patient-related factors linked with low uptake of colposcopy include low education levels, being single, fear of HIV testing and disclosure, a low CD4 count in HIV-infected women and transport costs for the additional visits.[14, 16, 17] Patient demand for colposcopy is also undermined by a general fear of cancer, and lack of awareness or knowledge about cervical cancer.[13, 18] Poor patient-provider interactions restrict access, whilst a longstanding relationship with a primary clinician can optimise uptake.[18]

In South Africa, colposcopy procedures are generally done at tertiary-level facility, by specialist gynaecology oncologists and trainee gynaecologists under supervision. While there may be benefits to decentralising colposcopy services to lower levels of care, these need to be balanced by the advantages of centralization of cancer services, such as concentrating clinical expertise,

with a higher quality of care, and the rationalisation of expensive specialist equipment. Thus, in this before- and after-study, we aimed to determine if access to colposcopy increased following the decentralisation of colposcopy services from a tertiary-level hospital to a primary care facility in inner-city Johannesburg, South Africa. We compare the total number of colposcopies done and the coverage of colposcopy services in the primary-level facility after decentralisation. We also compare the two sites, specifically, the patient profile and cervical cancer risks, colposcopy procedures, quality of the services and histology outcomes.

METHODS

Study participants and setting

Women, aged 18 years and older, who accessed colposcopy services at either Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) or Hillbrow Community Health Centre (HCHC) between October 2012 and September 2016 were included in the study. Both facilities are in sub-district F of the Johannesburg Health District (JHD).

The colposcopy clinic at CMJAH is part of the Gynaecology-Oncology Department at CMJAH, which has two colposcopy machines. Women attending a facility in JHD who have an abnormal Pap smear are referred to the facility, where they are provided with an appointment date for colposcopy.

Hillbrow Community Health Centre (HCHC) is situated in the densely populated inner-city area of Hillbrow, about 3km from CMJAH.[19] HCHC provides primary level care, including a 24 hour casualty and a midwife obstetrics unit. The facility is run predominantly by nursing staff, with support from non-specialist medical doctors.

Implementation of decentralised services

In 2013, a review of patient files at HCHC found that a large proportion of women attending the HIV clinic had high-risk lesions on Pap smear.[20] Moreover, there were reports from patients and health workers at HCHC of prolonged waiting times for colposcopy services at CMJAH. The Wits Reproductive Health and HIV Institute (Wits RHI) thus set about establishing decentralised colposcopy services at HCHC. A private sector company donated a colposcopy machine. Two district medical officers were trained by specialist gynaecology oncologists at CMJAH to provide the service. CMJAH staff provided ongoing support and established referral processes between the two facilities. Monthly meetings were held between staff at the two facilities, where concerns and difficult cases could be discussed.

The services, which began in October 2014, were provided twice a week by the medical officers, with assistance from the nurse who takes Pap smears at the facility. Patients attending HCHC and some referred from surrounding

clinics were given an appointment for colposcopy if they had an abnormal Pap smear result, defined as: high-grade squamous intraepithelial lesion (HSIL), atypical squamous cell and HSIL cannot be excluded (ASC-H), or squamous cell carcinoma (SCC).[21] A few patients with Pap smear results other than those defined as abnormal smears were also referred for colposcopy. Patients with complex lesions, such as abnormal cervical anatomy or a high suspicion of cancer on Pap smear were referred to CMJAH, as were those with a failed colposcopy. Colposcopy procedures included colposcopic assessment only, or colposcopic assessment together with either a Lletz or biopsy. Histology specimens were processed at the National Health Laboratory Service (NHLS).

Data sources and collection

For the purpose of this evaluation, women who accessed colposcopy services at CMJAH and HCHC were divided into three groups: 1) pre-decentralisation at CMJAH between October 2012 and September 2014; 2) post-decentralisation at CMJAH between October 2014 and September 2016; and 3) post-decentralisation at HCHC between October 2014 and September 2016.

At CMJAH, we extracted data from paper-based records at the colposcopy clinic, including on patients' age, HIV status, antiretroviral treatment, date of Pap smear, Pap smear result, date of colposcopy, colposcopy procedure

performed and histology results. Data were entered into a REDCap electronic database (REDcap Software, Version 4.14.5, Vanderbilt University).[22] At HCHC, demographic and clinical data on women who accessed colposcopy services were entered into an MS Excel spreadsheet after each patient visit. Data were obtained from the NHLS on Pap smear cytology for women attending HCHC who had a Pap smear and for the whole of JHD.

Study variables and statistical analysis

Access to colposcopy was measured by the total number of colposcopies done across the two facilities and the colposcopy coverage at HCHC, the primary study outcome. Coverage was estimated by calculating the proportion of all women at HCHC with an abnormal Pap smear who had a colposcopy. Time to colposcopy was calculated as the number of months from date of Pap smear to colposcopy and was categorised as optimal (under 3 months), acceptable (3-6 months) and delayed (greater than 6 months). We also examined changes in referral patterns of women who had an abnormal Pap smear at HCHC.

Patient characteristics were compared between the three groups, as well as level of integration of HIV services (provision of HIV testing and antiretroviral treatment).

We also compared the types of colposcopy procedures performed in the different periods and histology findings. Histology results were classified as normal (includes benign endocervical polyp, atrophic ectocervical mucosa, koilocytotosis and metaplasia), Cervical Intraepithelial Neoplasia (CIN) I, CIN II, CIN III, carcinoma, other (includes infections such as cervicitis, inflammation and dysplasia) and invalid specimens (includes absent results). Quality of services was evaluated using proxy markers, specifically the proportion of invalid specimens and number of unsuccessful colposcopy procedures. Differences between the three study groups were assessed using a chi-square test or a Wilcoxon rank-sum test, as appropriate. All data were analysed using STATA version 13.0.

Ethical considerations

Ethical approval was obtained from Human Research Ethics Committee of the University of the Witwatersrand (Certificate number: M151184). Permission for use of the CMJAH data was granted by the hospital's Chief Executive Officer, and the head of the Department of Obstetrics and Gynaecology at CMJAH. The NHLS Academic Affairs and Research Office gave permission for use of their data.

Patient involvement

The study utilised data that had already been collected as part of routine patient care, and thus patients were not directly involved in the study. We did, however, attempt to contact patients who had abnormal lesions on histology and had not attended follow-up visits.

RESULTS

Access to colposcopy and timeliness of services

In total, 910 women accessed colposcopy at CMJAH between October 2012 and September 2014. In the subsequent two years, 1120 women had a colposcopy: 399 at HCHC (35.6%) and 721 at CMJAH (64.4%; Table 1 and Figure 1).

Table 1: Patient characteristics and colposcopy outcomes at a community clinic, and a tertiary-level facility before and after decentralisation

Variables		Before versus after decentralisation at CMJAH			HCHC versus CMJAH after decentralisation	
		A) Pre-decentralisation (2012-2014) N=910	B) Post-decentralisation (2014-2016) N=721	P (A vs B)	C) Hillbrow CHC (2014–2016) N=399	P (B vs C)
Characteristics	Age groups in years					
	<20	7 (0.8)	6 (0.8)		0 (0)	
	20–34	351 (39.8)	209 (30.2)		150 (37.6)	
	35–44	342 (38.8)	266 (38.4)		156 (39.1)	
	45–59	161 (18.3)	187 (27.0)		79 (19.8)	
	>60	20 (2.3)	25 (3.6)	0.001	7 (1.8)	0.003
	HIV status known	650 (71.4)	429 (59.5)	<0.001	399 (100)	<0.001

	HIV status^					
	Negative	105 (16.2)	59 (13.8)		62 (15.5)	
	Positive	545 (83.9)	370 (86.3)	0.28	337 (84.5)	0.47
	On ART%	428/544 (78.7)	324/370 (87.6)	<0.001	336/337 (99.7)	<0.001
Cervical cancer Screening	**Facility where Pap smear done**					
	CMJAH	115 (12.8)	124 (17.5)		0 (0.0)	
	HCHC	114 (12.7)	43 (6.1)		307 (76.9)	
	Other clinic or hospital	671 (74.6)	540 (76.4)	<0.001	92 (23.1)	<0.001
	Pap smear results					
	NILM	6 (0.7)	8 (1.1)		17 (4.3)	
	LSIL	141 (15.5)	125 (17.4)		79 (20.0)	
	ASCUS	19 (2.1)	34 (4.7)		4 (1.0)	
	HSIL	678 (74.7)	478 (66.4)		263 (66.4)	
	ASC-H	63 (6.9)	65 (9.0)		27 (6.8)	
	Carcinoma	1 (0.1)	10 (1.4)	<0.001	6 (1.5)	<0.001
	Pap smear risk categories					
	NILM, LSIL or ACSUS	166 (18.3)	167 (23.2)		100 (25.3)	
	HSIL, ASC-H or carcinoma	742 (81.7)	553 (76.8)	0.015	296 (74.8)	0.44
Cervical cancer diagnosis	**Procedure during colposcopy**					
	Visual inspection only	37 (4.1)	37 (5.2)		63 (15.9)	
	Lletz	337 (37.2)	258 (35.9)		231 (58.2)	
	Biopsy	526 (58.0)	420 (58.4)		90 (22.7)	
	Other	7 (0.8)	4 (0.6)	0.69	13 (3.3)	<0.001
	Histology result&					
	Normal	27 (3.1)	30 (4.4)		45 (13.8)	
	CIN I	254 (29.3)	200 (29.3)		84 (25.7)	
	CIN II	298 (34.3)	209 (30.7)		99 (30.3)	
	CIN III	236 (27.2)	198 (29.0)		86 (26.3)	
	Carcinoma	3 (0.4)	9 (1.3)		2 (0.6)	
	Other*	34 (3.9)	19 (2.8)		2 (0.6)	
	Invalid specimen	16 (1.8)	17 (2.5)	0.10	9 (2.8)	<0.001

χ^2 test for categorical variables or Wilcoxon Rank-sum test for continuous variables. ^Of those with a known HIV status. %Of those HIV positive. &Of those with a histology specimen taken at biopsy, Lletz or other procedure. Charlotte Maxeke

Johannesburg Academic Hospital (CMJAH). Hillbrow Community Health Centre (HCHC). *Other includes infections such as cervicitis, inflammation and dysplasia

Of all Pap smears done in the JHD in the two years after decentralisation (114,983), 1.9% were done at HCHC (2227; Table 2). Overall, 18.0% of Pap smears done at HCHC had abnormal cytology and required colposcopy (n=401), compared to only 8.2% of other women in JHD as a whole (n=1826; p<0.001). The estimated colposcopy coverage among women who had an abnormal Pap smear at HCHC was 66.6% (267/401; 95%CI=61.7-71.2%). The number of women who had a Pap smear at HCHC and then a colposcopy at either facility was three-fold higher post-decentralisation than pre-decentralisation (from 113 to 350) (Table 1).

Table 2: Cytology results in the City of Johannesburg in 2014-2016

Variable n (%)	Johannesburg health district* (n=114,983)	Hillbrow Community Health Centre (n=2227)	*P*
Pap smear results			
NILM	74,969 (65.2)	852 (38.3)	
LSIL	23,212 (20.2)	790 (35.5)	
ASCUS	7391 (6.4)	184 (8.3)	
HSIL	7808 (6.8)	364 (16.3)	
ASC-H	1221 (1.1)	28 (1.3)	
Carcinoma	382 (0.3)	9 (0.4)	<0.001
Number requiring colposcopy			
No (NILM, LSIL or ASCUS)	105,572 (91.8)	9411 (82.0)	

Yes (HSIL, ASC-H or carcinoma)	1826 (8.2)	401 (18.0)	<0.001

Data from the National Health Laboratory Service. Excludes invalid or missing specimens, and other Pap smear results (n=2446).

*District total excludes HCHC

Almost half of the women at CMJAH had a delay in receiving colposcopy (>6 months between Pap smear and colposcopy) post-decentralisation, compared to about a third pre-decentralisation (47.3% versus 36.2%, p<0.001; Figure 1: Graph 1A). At HCHC, 21.7% of women had a colposcopy within three months of a Pap smear being taken (versus 11.8% at CMJAH pre- and 15.4% post-decentralisation, p<0.001).

The absolute number of women at CMJAH who had had a Pap smear at HCHC decreased from 113 to 43 in the second period. One quarter of women who had a colposcopy at HCHC had had their Pap smear at another facility.

Characteristics of women in the three groups and HIV service integration

The proportion of women older than 45 years pre-decentralisation at CMJAH was 20.6%, post-decentralisation at CMJAH 30.6% and at HCHC 21.9% (p<0.001). At CMJAH, more women had a known HIV status pre-decentralisation than post-decentralisation (71.4% versus 59.5%, p<0.001). All women at HCHC had a documented HIV status. Around 85% of women with a known HIV status were HIV positive in all three groups. The proportion of

positive women receiving ART rose in the second period at CMJAH from 78.7% to 87.6% (p<0.001), and almost all positive women were on ART at HCHC (99.7%; p<0.001) (Table 1).

Description of colposcopy procedures, histology findings and colposcopy quality

At CMJAH, in both periods, nearly 60% of women had a biopsy at colposcopy (58.2%), while the same proportion had a Lletz at HCHC (58.2%). Three women who had a colposcopy at HCHC were referred to CMJAH due to an unsuccessful procedure.

Women at HCHC were 3.5 fold more likely to have a normal result on histology than women at CMJAH (95%CI OR=2.1-5.7). Post-decentralisation, 29.0% of women at CMJAH and 26.3% at HCHC had CIN III lesions (p=0.37; Figure 1; Graph1B). Post-decentralisation, 11 women had a diagnosis of carcinoma on histology (1.1%), compared to 3 before decentralisation (0.4%; p=0.06). The proportion of invalid specimens was similar across the three groups, ranging from 1.8 to 2.8% (Table 1).

DISCUSSION

In this study we determined whether decentralisation to primary care level improved access to colposcopy services by reviewing the number of women attending the service before and after decentralisation, and the coverage of colposcopy among women at HCHC. We found that the cumulative number of colposcopies across the two facilities rose following decentralisation, and after only two years, HCHC was responsible for a third of all colposcopies in the sub-district, even though it performs a negligible number of Pap smears relative to other sites. Overall, following decentralisation, three fold more women who had a Pap smear at HCHC had a colposcopy, and equally, at CMJAH, the proportion of women referred from HCHC reduced almost threefold. The marked increase in number of women from HCHC who had a colposcopy indicates that prior to decentralisation there may have been a large unmet need for the service, which was now being addressed, at least in part. The coverage reached 66.6%, considerably higher than figures in other settings.

Decentralisation of colposcopy services to primary level care has several potential benefits. Firstly, with adequate training, tasks that had been performed by highly specialised staff can be shifted to lower health worker cadres, allowing specialists to focus on more complex cases.[23] Additionally,

decentralisation may alleviate patient barriers to access, by bringing services closer to them – in settings they are familiar with – and reducing their transport and other costs.[13, 23] Decentralisation has long been central to the provision of HIV services in this setting through, for example, task shifting, providing antiretroviral treatment in primary care services and the dispensing of drugs from local pharmacies, rather than clinics.[24]

Decentralisation of colposcopy can take several forms, including telecolposcopy from distant sites, outreach portable colposcopy, shifting of services to nurse practitioners or medical officers, and decentralisation to lower level facilities, as in this study.[25] In other settings, shifting services to lower care levels was found to be cost-effective, acceptable to patients and to increase rates of attendance for colposcopy.[16, 25, 26] In the Western Cape, South Africa, for example, colposcopy services were decentralised to a district hospital and provided by a gynaecologist.[23] This raised uptake of the service and reduced time to procedure. In high-income countries, services have been successfully decentralised to community health centres and portable outreach programmes in Alaska, the United States, and parts of Canada and Australia, targeting immigrant, Inuit and other vulnerable women.[16, 17, 26-28] The National Health Service in United Kingdom has gone a step further and

colposcopy is often performed by nurse practitioners once they have completed certification procedures.[29]

Women attending HCHC colposcopy were at lower risk than those at CMJAH, as shown by their lower grades of abnormalities on Pap smear and histology. Women at HCHC were also younger than those at CMJAH, important as risk for cervical cancer is higher in rises considerably with age (the mean age at diagnosis of cervical cancer is 52.3 in South Africa).[30] These findings may suggest that, as the programme had envisaged, higher-risk patients are being referred to CMJAH. Overall, services at HCHC appear to be performing well, with all women tested for HIV and almost all those positive were receiving ART. In addition, colposcopy services were now integrated into their care, which was previously off-site, complex to access and marked by lengthy delays. HIV-positive women made up the large majority of patients in all groups, reflecting the higher levels of risk for cervical cancer in this population. Clearly it remains a priority to integrate screening for cervical cancer within all clinics providing antiretroviral treatment. Equally, ART and services such as screening and treatment for sexually transmitted infections could be integrated within colposcopy clinics, reducing the opportunity costs associated with multiple visits to the clinic and lowering the risk of loss to follow up.

The similar number of invalid histology samples and the isolated cases of failed colposcopy suggests that the quality of colposcopy services at HCHC may have been comparable to CMJAH. Unlike at CMJAH, however, Lletz was the commonest procedure at HCHC, in keeping with evidence that Lletz is better suited to lower level facilities and staff.[10] With decentralisation, it is critical to ensure that staff are adequately trained and service quality is closely monitored. The hesitancy to decentralise colposcopy to date, may reflect underlying concerns that cases of cancer may go undetected by lower-level staff. In some settings, lower-level health workers undergo a process of certification and have to perform a certain number of colposcopies per year to remain registered.[29] While this approach may hold advantages, onerous processes around certification and recertification may lead to staff discontinuing colposcopy.[31]

The decline in number of colposcopies at CMJAH is concerning, and may reflect factors other than a reduction in demand that accompanies decentralisation. Fewer women at the site had a known HIV status and waiting times for colposcopy lengthened. Thus, though decentralisation can reduce the patient burden at referral centres, this does not necessarily translate into improved services at that site. Other factors may play a larger influence, for

example, coinciding with the period after decentralisation, CMJAH lost a number of senior specialists.

Delays in colposcopy vary considerably between settings, from an average of 39 days from referral to colposcopy in one study in KwaZulu Natal, South Africa,[12] to around 5-6 months in both our study and another in the Western Cape.[23] It is concerning that time from Pap smear to colposcopy is greater than six months for half the women at CMJAH, and a third at HCHC. Reducing these delays is clearly a priority at both sites. We were unable, however, to discern reasons for these delays, which could be caused by delays in providing the results of Pap smears to patients, patient delays in making or attending appointments, or shortages of specialist staff. We could also not investigate which group of patients required referral to higher levels of care, and future studies might attempt to define criteria for referral. Moreover, given the relatively short period of the review, we are unable to assess sustainability of the services in the long-run, a pressing question. Lastly, the study evaluated the use of colposcopy following cytological screening with Pap smears and these findings may not be generalizable to screening with HPV testing.[29] HPV testing has a considerably higher sensitivity for detecting precursor lesions of cervical cancer compared to cytology, and thus may alter

the number of patients requiring colposcopy and types of lesions identified.[32, 33]

CONCLUSION

In conclusion, decentralisation of colposcopy services can improve access to colposcopy, resulting in faster diagnoses of precancerous lesions of the cervix, more lesions being treated with Lletz and a reduction in the burden of patients in tertiary hospitals. Most importantly, increasing the number of colposcopies and treatments of precancerous lesions could reduce the incidence of cervical cancer. This is particularly important among HIV-positive women who now live longer with ART, and the treatment of their co-morbidities is rapidly gaining in importance. Though coverage of colposcopy reached two thirds at HCHC, it is important to identify interventions to further raise coverage levels. Decentralisation is unlikely to affect the quality of services if medical officers are appropriately trained, supervised and supported by clear referral guidelines. The approach presented here could be extended to other primary- or secondary-level facilities in South Africa, and perhaps encompass the use of portable colposcopes or telecolposcopy, under close supervision. If done correctly and at scale, decentralisation of colposcopy services, could shore up cervical cancer prevention and finally decrease the public health burden and mortality due to the cancer.

ACKNOWLEDGEMENTS

We would like to acknowledge the following persons who contributed to this study:

H. Manyonga, Z. Dumakude, A. Mohololа, N. Wattrus, L. Mbuyisa, I. Sishi, N. Twala, S. Sidabuka, E. Briedenhann, L. Mavuya, K. Moshaba, S. Mzobe, S. Carmona (NHLS), L. Chauke (Department of Obstetrics and Gynaecology, CMJAH).

FUNDING

This study has been made possible through funding from USAID-PEPFAR, grant number: AID-A-12-67400021. We would also like to acknowledge the following organizations for donating a colposcopy machine to Hillbrow CHC: Vodacom, Altech and Altron.

COMPETING INTERESTS

All authors listed in this study do not have competing interests to declare.

DATA SHARING STATEMENT

There's no additional unpublished data from the study.

AUTHOR CONTRIBUTIONS

Manuscript title: The impact of decentralising colposcopy services from tertiary- to primary-level care in inner-city Johannesburg, South Africa: a before and after study

Category 1

Conception and design of study: G. Maimela*1, X. Nene*1, S. Sawry, N. Mvundla, M. Chersich

Acquisition of data: G. Maimela, X. Nene, N. Mvundla,

Analysis and/or interpretation of data: G. Maimela, X. Nene, S. Sawry, E. Kachingwe, M. Chersich, H. Rees; T. Smith.

Category 2

Drafting the manuscript: G. Maimela, X. Nene, N. Mvundla, S. Sawry, E. Kachingwe, M. Chersich.

Revising the manuscript critically for important intellectual content: M. Chersich, H. Rees, T. Smith

Category 3

Approval of the version of the manuscript to be published*:*

G. Maimela*1, X. Nene*1, N. Mvundla1, S. Sawry1, T. Smith2, H. Rees1, E.Kachingwe1, M. Chersich1

ACKNOWLEDGEMENTS: *All persons who have made substantial contributions to the work reported in the manuscript (e.g., technical help, writing and editing assistance, general support), but who do not meet the criteria for authorship, are named in the Acknowledgements and have given us their written permission to be named. If we have not included an Acknowledgements, then that indicates that we have not received substantial contributions from non-authors.*

H. Manyonga, Z. Dumakude, A. Mohololа, N. Wattrus, L. Mbuyisa, I. Sishi, N. Twala, S. Sidabuka, E. Briedenhann, L. Mavuya, K. Moshaba, S. Mzobe, S. Carmona (NHLS), L. Chauke (Department of Obstetrics and Gynaecology, CMJAH).

This statement is signed by all the authors (a photocopy of this form may be used if there are more than 10 authors):

REFERENCES

1. WHO. Cervical Cancer: An NCD We Can Overcome: Call to Action. 2018. http://www.who.int/reproductivehealth/DG_Call-to-Action.pdf.

2. Bruni L, Barrionuevo-Rosas L, Albero G, Serrano B, Mena M, Gómez D, et al. ICO/IARC Information Centre on HPV and Cancer (HPV Information Centre). Human Papillomavirus and Related Diseases in the World. . Summary Report 27 July 2017. http://www.hpvcentre.net/statistics/reports/XWX.pdf.

3. Batra P, Kuhn L, Denny L. Utilisation and outcomes of cervical cancer prevention services among HIV-infected women in Cape Town. SAMJ: South African Medical Journal. 2010;100:39-44.

4. ICO/IARC Information Centre on HPV and Cancer. South Africa Human Papillomavirus and Related Cancers, Fact Sheet 2017. 2017. http://www.hpvcentre.net/statistics/reports/ZAF_FS.pdf.

5. Shisana O, Rehle T, Simbayi LC, Zuma K, Jooste S, Zungu N, et al. South African National HIV Prevalence, Incidence and Behaviour Survey, 2012. Cape Town: HSRC Press; 2014.

6. Adler D, Wallace M, Bennie T, Abar B, Sadeghi R, Meiring T, et al. High risk human papillomavirus persistence among HIV-infected young women in South Africa. International journal of infectious diseases : IJID : official publication of the International Society for Infectious Diseases. 2015;33:219-21.

7. Guiguet M, Boue F, Cadranel J, Lang JM, Rosenthal E, Costagliola D, et al. Effect of immunodeficiency, HIV viral load, and antiretroviral therapy on the risk of individual malignancies (FHDH-ANRS CO4): a prospective cohort study. Lancet Oncol. 2009;10(12):1152-9.

8. National Department of Health South Africa. Cervical Cancer Prevention and Control Policy. 2017.

9. Day C, Gray A, Ndlovu N. South African Health Review 2018. Durban: Health Systems Trust. 2018.

10. WHO. WHO guidelines for screening and treatment of precancerous lesions for cervical cancer prevention. http://apps.who.int/iris/bitstream/handle/10665/94830/9789241548694_eng.pdf;jsessionid=F65ED4960A15E4D16BB15F6E57F71518?sequence=1; 2013.

11. Denny L, Kuhn L. Cervical cancer prevention and early detection from a South African perspective. Chapter 18. South African Health Review Published by Health Systems Trust. 2017.

12. Katz IT, Butler LM, Crankshaw TL, Wright AA, Bramhill K, Leone DA, et al. Cervical Abnormalities in South African Women Living With HIV With High Screening and Referral Rates. J Glob Oncol. 2016;2(6):375-80.

13. Dawood S. Barriers and Facilitators to Colposcopy Attendance. Following an Abnormal Pap Smear: Patient and Provider Perspectives. Cape Town: University of Cape Town; 2014.

14. Momberg M, Botha MH, Van der Merwe FH, Moodley J. Women's experiences with cervical cancer screening in a colposcopy referral clinic in Cape Town, South Africa: a qualitative analysis. BMJ open. 2017;7(2):e013914.

15. Hoque M, Hoque E, Kader SB. Evaluation of cervical cancer screening program at a rural community of South Africa. East African journal of public health. 2008;5(2):111-6.

16. Martin B, Smith W, Orr P, Guijon F. Investigation and management of cervical intraepithelial neoplasia in Canadian Inuit: enhancing access to care. Arctic Med Res. 1995;54 Suppl 1:117-21.

17. Payne S, Jarrett N, Jeffs D. The impact of travel on cancer patients' experiences of treatment: a literature review. Eur J Cancer Care (Engl). 2000;9(4):197-203.

18. Baranoski AS, Stier EA. Factors associated with time to colposcopy after abnormal Pap testing in HIV-infected women. Journal of women's health (2002). 2012;21(4):418-24.

19. Rees H, Delany-Moretlwe S, Scorgie F, Luchters S, Chersich MF. At the Heart of the Problem: Health in Johannesburg's Inner-City. BMC Public Health. 2017;17(Suppl 3):554.

20. Stadler J, Chikandiwe A, Mayaud P, Rees H, Imrie J, Delany-Moretlwe S. Biographies of HIV and Cervical Cancer: Understanding Treatment-Seeking Amongst HIV Positive Women in Inner City Johannesburg. IAS conference, Durba, South Africa, Oral presentation. 2016.

21. Botha MH. Guidelines for cervical cancer screening in South Africa. Southern African Journal of Gynaecological Oncology 2017;9(1):8-12.

22. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009;42(2):377-81.

23. Blanckenberg ND, Oettle CA, Conradie HH, Krige FK. Impact of introduction of a colposcopy service in a rural South African sub-district on uptake of colposcopy. South African Journal of Obstetrics and Gynaecology. 2013;19(3).

24. Callaghan M, Ford N, Schneider H. A systematic review of task- shifting for HIV treatment and care in Africa. Human resources for health. 2010;8:8.

25. Bishai DM, Ferris DG, Litaker MS. What is the least costly strategy to evaluate cervical abnormalities in rural women? Comparing telemedicine, local practitioners, and expert physicians. Med Decis Making. 2003;23(6):463-70.

26. Ogilvie GS, Shaw EA, Lusk SP, Zazulak J, Kaczorowski JA. Access to colposcopy services for high-risk Canadian women: can we do better? Can J Public Health. 2004;95(5):346-51.

27. Gifford MS, Stone IK. Quality, access, and clinical issues in a nurse practitioner colposcopy outreach program. The Nurse practitioner. 1993;18(10):25-9, 33-6.

28. Hartz LE. Quality of care by nurse practitioners delivering colposcopy services. J Am Acad Nurse Pract. 1995;7(1):23-7.

29. Public Health England, National Health Service. NHS Cervical Screening Programme Colposcopy and Programme Management. NHSCSP Publication number 20. Third edition. 2016. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/515817/NHSCSP_colposcopy_management.pdf.

30. Olorunfemi G, Ndlovu N, Masukume G, Chikandiwa A, Pisa PT, Singh E. Temporal trends in the epidemiology of cervical cancer in South Africa (1994-2012). Int J Cancer. 2018;143(9):2238-49.

31. Sonnex C. Providing a genitourinary medicine colposcopy service. Sexually transmitted infections. 2014;90(1):8-10.

32. Dijkstra MG, Snijders PJ, Arbyn M, Rijkaart DC, Berkhof J, Meijer CJ. Cervical cancer screening: on the way to a shift from cytology to full molecular screening. Ann Oncol. 2014;25(5):927-35.

33. Wright TC, Jr., Stoler MH, Behrens CM, Sharma A, Sharma K, Apple R. Interlaboratory variation in the performance of liquid-based cytology: insights from the ATHENA trial. Int J Cancer. 2014;134(8):1835-43.

FIGURE LEGENDS

Figure 1:

Graph 1A: Total number of colposcopies done before and after decentralisation

Graph 1B: Number of cervical intraepithelial neoplasia lesions detected before and after decentralisation

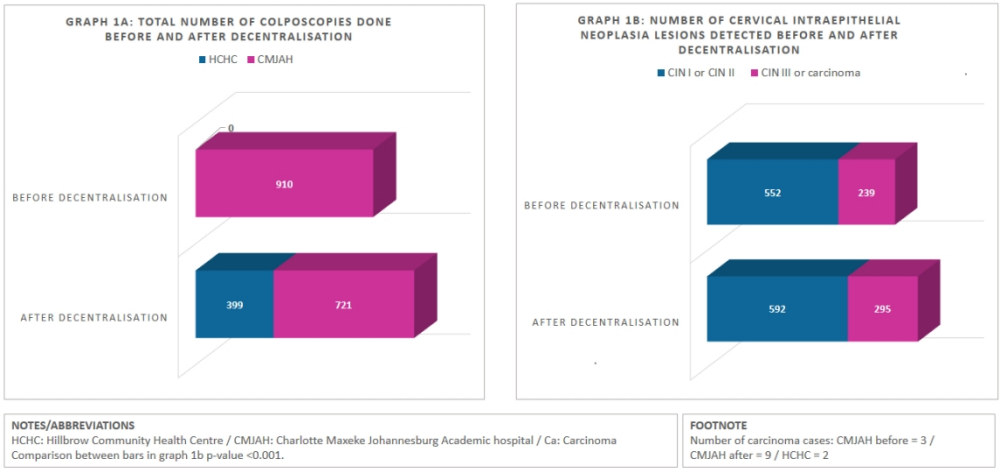


Figure 1:
Graph 1A: Total number of colposcopies done before and after decentralisation
Graph 1B: Number of cervical intraepithelial neoplasia lesions detected before and after decentralisation

271x128mm (120 x 120 DPI)

BMJ Open

The impact of decentralising colposcopy services from tertiary- to primary-level care in inner-city Johannesburg, South Africa: a before and after study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2018-024726.R3
Article Type:	Research
Date Submitted by the Author:	19-Feb-2019
Complete List of Authors:	Maimela, Gloria; University of the Witwatersrand, Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Nene, Xolisile; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Mvundla, Nontuthuko; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Sawry, Shobna; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Smith, Trudy; University of the Witwatersrand , Wits Donald Gordon Medical Centre, Faculty of Health Sciences Rees, Helen; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Kachingwe, Elizabeth; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences Chersich, Matthew; University of the Witwatersrand , Wits Reproductive Health and HIV Institute, Faculty of Health Sciences
Primary Subject Heading:	Public health
Secondary Subject Heading:	Diagnostics, Obstetrics and gynaecology, Oncology, Reproductive medicine
Keywords:	Colposcopy < GYNAECOLOGY, Community gynaecology < GYNAECOLOGY, Gynaecological oncology < GYNAECOLOGY, Minimally invasive surgery < GYNAECOLOGY, PRIMARY CARE, Decentralised Care

Title: The impact of decentralising colposcopy services from tertiary- to primary-level care in inner-city Johannesburg, South Africa: a before and after study

Authors: G. Maimela*[1], X. Nene*[1], N. Mvundla[1], S. Sawry[1], T. Smith[2], H. Rees[1], E.Kachingwe[1], M. Chersich[1]

Affiliations:

1. Wits Reproductive Health and HIV Institute, Faculty of Health Sciences, University of the Witwatersrand, South Africa
2. Department of Obstetrics and Gynaecology, School of Clinical Medicine, Charlotte Maxeke Johannesburg Academic Hospital, Faculty of Health Sciences, University of the Witwatersrand, South Africa

Corresponding author: Gloria Maimela, GMaimela@wrhi.ac.za, Wits Reproductive Health and HIV Institute, Faculty of Health Sciences, University of the Witwatersrand, South Africa

ABSTRACT

Objective: To assess whether decentralising colposcopy services to a primary care facility in inner-city Johannesburg, South Africa raises access to colposcopy.

Design: Before-after study comparing two years before and two after decentralisation, using clinical records, and laboratory data on cervical cytology and histology.

Primary outcome: The proportion of all women attending Hillbrow Community Health Centre (HCHC) with an abnormal Pap smear who had a colposcopy post-decentralisation.

Setting: Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) has provided colposcopy services for several decades. HCHC, located about 3km away, began colposcopy services in 2014.

Participants: Women, aged above 18 years, who had a colposcopy for diagnosis and treatment of precancerous cervical lesions following a Pap smear, from 2012-2016 at CMJAH or HCHC.

Results: Pre-decentralisation at CMJAH, 910 women had colposcopy (2012-2014). Post-decentralisation (2014-2016), 721 had colposcopy at CMJAH and 399 at HCHC, the decentralised facility. The number who had a Pap smear at

HCHC and then a colposcopy rose three-fold post-decentralisation (114 versus 350). Post-decentralisation, 43 women at HCHC were referred from CMJAH for colposcopy, compared to 114 pre-decentralisation. Post-decentralisation, 47.3% of women at CMJAH waited >6 months for colposcopy, while 35.5% did at HCHC (p<0.001). Across all three groups, 26.9-30.3% of women had CIN III lesions or carcinoma on colposcopy. The proportion of invalid specimens was similar at CMJAH and HCHC (1.8-2.8%). Of 401 women who had an abnormal Pap smear at HCHC post-decentralisation, 267 had colposcopy (66.6%).

Conclusion: Decentralisation can decrease the time to colposcopy and reduce the workload of tertiary hospitals. Overall, more women accessed services. Colposcopy coverage at HCHC is higher than other sites, but could be further improved. Decentralisation did not appear to undermine the quality of services and this model could be extended to similar settings in South Africa and elsewhere.

Key words: South Africa, colposcopy, cervical cancer, primary health care, decentralisation

ARTICLE SUMMARY

Strengths and limitations of this study

- The study included a relatively large number of women from high-volume facilities in all study groups, allowing us to detect differences between the time periods
- As the study assessed only one primary care centre in the first two years after decentralisation, we were unable ascertain the intervention's long-term sustainability, or to assess the impact of a broader decentralisation strategy, such as a hub and spoke approach encompassing several primary care centres
- A hub and spoke approach has been successfully applied to other similar health services that require an integrated, tiered health care and laboratory system (such as TB care and colorectal cancer screening), supporting the generalizability of the study findings to similar settings, and assertions about the validity of the results reported.
- The limited number of variables collected meant that the study could not investigate several important questions in detail, such as reasons for delays in colposcopy, the quality of decentralised services or comparisons of changes in access among women at the primary care site over time.
- Data were collected for the purposes of patient care, and not specifically for research, potentially reducing data quality.

INTRODUCTION

Cervical cancer is a largely preventable disease and WHO has recently launched an initiative aimed at eliminating the condition.[1] At present, cervical cancer is the second most common cancer among women aged 15 to 44 years in the world.[2] In South Africa, it is the commonest cancer in that age group, and mortality rates are high.[3, 4] About 3% of women in South Africa harbour cervical human papilloma virus (HPV)-16/18, which is responsible for the majority of cases of cervical cancer in the country.[4] Rates of cervical cancer in South Africa can partly be attributed to the high level of HIV.[5] Women with HIV infection have a seven-fold higher rate of persistence of high-risk HPV compared to HIV uninfected women,[6] heightening their risk for incident and progressive precancerous lesions. While antiretroviral therapy

reduces the risk of cervical cancer and its precursors, the risk remains much higher than for HIV-negative women.[7]

In South Africa, the policy for cervical cancer screening was introduced in 2001 and updated in 2017.[8] The policy recommends that low-risk women have three Pap smears in a lifetime at the ages of 30, 40 and 50 years, while women with HIV-infection are to be screened every three years, regardless of age. About 60% of women aged 30 to 49 years have had cervical cancer screening.[9] Screening is predominately based on cytology using Papanikolaou (Pap) smears, although there are plans to introduce liquid-based cytology which offers the potential to do HPV screening. Women with atypical findings on cytology are referred for colposcopy to establish a definitive diagnosis. During colposcopy, the view of the cervix is magnified and, where required, a biopsy is taken or a large loop excision of the transformation zone (Lletz) is conducted.[10]

The gap between screening for cervical cancer and treatment of high-risk lesions is believed to be very high in South Africa.[11] Although there are few published data to support this assertion, the fact that the number of cervical cancer cases remains high despite the large number of cervical cancer screening procedures suggest this is the case. A range of health systems and patient factors influence access to colposcopy. System barriers include a

limited number of colposcopy services, which are mostly centralised within tertiary-level facilities, with long waiting times for patients and few opportunities for non-specialist health workers to develop requisite skills.[12] There are limited numbers of specialist gynaecologists within the public sector, and the high demands on these doctors for emergency and curative obstetric and gynaecology services may reduce their time available for diagnostic or preventive interventions, such as colposcopy. Another key factor is the complexity of providing Pap and other results to patients and then scheduling colposcopy appointments across the disjointed systems that often exist between a tertiary hospital and primary care centres.[13-15] Patient-related factors linked with low uptake of colposcopy include low education levels, being single, fear of HIV testing and disclosure, a low CD4 count in HIV-infected women and transport costs for the additional visits.[14, 16, 17] Patient demand for colposcopy is also undermined by a general fear of cancer, and lack of awareness or knowledge about cervical cancer.[13, 18] Poor patient-provider interactions restrict access, whilst a longstanding relationship with a primary clinician can optimise uptake.[18]

In South Africa, colposcopy procedures are generally done at tertiary-level facility, by specialist gynaecology oncologists and trainee gynaecologists under supervision. While there may be benefits to decentralising colposcopy

services to lower levels of care, these need to be balanced by the advantages of centralization of cancer services, such as concentrating clinical expertise, with a higher quality of care, and the rationalisation of expensive specialist equipment. Thus, in this before- and after-study, we aimed to determine if access to colposcopy increased following the decentralisation of colposcopy services from a tertiary-level hospital to a primary care facility in inner-city Johannesburg, South Africa. We compare the total number of colposcopies done and the coverage of colposcopy services in the primary-level facility after decentralisation. We also compare the two sites, specifically, the patient profile and cervical cancer risks, colposcopy procedures, quality of the services and histology outcomes.

METHODS

Study participants and setting

Women, aged 18 years and older, who accessed colposcopy services at either Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) or Hillbrow Community Health Centre (HCHC) between October 2012 and September 2016 were included in the study. Both facilities are in sub-district F of the Johannesburg Health District (JHD).

The colposcopy clinic at CMJAH is part of the Gynaecology-Oncology Department at CMJAH, which has two colposcopy machines. Women

attending a facility in JHD who have an abnormal Pap smear are referred to the facility, where they are provided with an appointment date for colposcopy.

Hillbrow Community Health Centre (HCHC) is situated in the densely populated inner-city area of Hillbrow, about 3km from CMJAH.[19] HCHC provides primary level care, including a 24 hour casualty and a midwife obstetrics unit. The facility is run predominantly by nursing staff, with support from non-specialist medical doctors.

Implementation of decentralised services

In 2013, a review of patient files at HCHC found that a large proportion of women attending the HIV clinic had high-risk lesions on Pap smear.[20] Moreover, there were reports from patients and health workers at HCHC of prolonged waiting times for colposcopy services at CMJAH. The Wits Reproductive Health and HIV Institute (Wits RHI) thus set about establishing decentralised colposcopy services at HCHC. A private sector company donated a colposcopy machine. Two district medical officers were trained by specialist gynaecology oncologists at CMJAH to provide the service. CMJAH staff provided ongoing support and established referral processes between the two facilities. Monthly meetings were held between staff at the two facilities, where concerns and difficult cases could be discussed.

The services, which began in October 2014, were provided twice a week by the medical officers, with assistance from the nurse who takes Pap smears at the facility. Patients attending HCHC and some referred from surrounding clinics were given an appointment for colposcopy if they had an abnormal Pap smear result, defined as: high-grade squamous intraepithelial lesion (HSIL), atypical squamous cell and HSIL cannot be excluded (ASC-H), or squamous cell carcinoma (SCC).[21] A few patients with Pap smear results other than those defined as abnormal smears were also referred for colposcopy. Patients with complex lesions, such as abnormal cervical anatomy or a high suspicion of cancer on Pap smear were referred to CMJAH, as were those with a failed colposcopy. Colposcopy procedures included colposcopic assessment only, or colposcopic assessment together with either a Lletz or biopsy. Histology specimens were processed at the National Health Laboratory Service (NHLS).

Data sources and collection

For the purpose of this evaluation, women who accessed colposcopy services at CMJAH and HCHC were divided into three groups: 1) pre-decentralisation at CMJAH between October 2012 and September 2014; 2) post-decentralisation at CMJAH between October 2014 and September 2016; and 3) post-decentralisation at HCHC between October 2014 and September 2016.

At CMJAH, we extracted data from paper-based records at the colposcopy clinic, including on patients' age, HIV status, antiretroviral treatment, date of Pap smear, Pap smear result, date of colposcopy, colposcopy procedure performed and histology results. Data were entered into a REDCap electronic database (REDcap Software, Version 4.14.5, Vanderbilt University).[22] At HCHC, demographic and clinical data on women who accessed colposcopy services were entered into an MS Excel spreadsheet after each patient visit. Data were obtained from the NHLS on Pap smear cytology for women attending HCHC who had a Pap smear and for the whole of JHD.

Study variables and statistical analysis

Access to colposcopy was measured by the total number of colposcopies done across the two facilities and the colposcopy coverage at HCHC, the primary study outcome. Coverage was estimated by calculating the proportion of all women at HCHC with an abnormal Pap smear who had a colposcopy. Time to colposcopy was calculated as the number of months from date of Pap smear to colposcopy and was categorised as optimal (under 3 months), acceptable (3-6 months) and delayed (greater than 6 months). We also examined changes in referral patterns of women who had an abnormal Pap smear at HCHC.

Patient characteristics were compared between the three groups, as well as level of integration of HIV services (provision of HIV testing and antiretroviral treatment).

We also compared the types of colposcopy procedures performed in the different periods and histology findings. Histology results were classified as normal (includes benign endocervical polyp, atrophic ectocervical mucosa, koilocytotosis and metaplasia), Cervical Intraepithelial Neoplasia (CIN) I, CIN II, CIN III, carcinoma, other (includes infections such as cervicitis, inflammation and dysplasia) and invalid specimens (includes absent results). Quality of services was evaluated using proxy markers, specifically the proportion of invalid specimens and number of unsuccessful colposcopy procedures. Differences between the three study groups were assessed using a chi-square test or a Wilcoxon rank-sum test, as appropriate. All data were analysed using STATA version 13.0.

Ethical considerations

Ethical approval was obtained from Human Research Ethics Committee of the University of the Witwatersrand (Certificate number: M151184). Permission for use of the CMJAH data was granted by the hospital's Chief Executive Officer, and the head of the Department of Obstetrics and Gynaecology at CMJAH.

The NHLS Academic Affairs and Research Office gave permission for use of their data.

Patient involvement

The study utilised data that had already been collected as part of routine patient care, and thus patients were not directly involved in the study. We did, however, attempt to contact patients who had abnormal lesions on histology and had not attended follow-up visits.

RESULTS

Access to colposcopy and timeliness of services

In total, 910 women accessed colposcopy at CMJAH between October 2012 and September 2014. In the subsequent two years, 1120 women had a colposcopy: 399 at HCHC (35.6%) and 721 at CMJAH (64.4%; Table 1 and Figure 1).

Table 1: Patient characteristics and colposcopy outcomes at a community clinic, and a tertiary-level facility before and after decentralisation

Variables	Before versus after decentralisation at CMJAH			HCHC versus CMJAH after decentralisation	
	A) Pre-decentralisation (2012-2014) N=910	B) Post-decentralisation (2014-2016) N=721	P (A vs B)	C) Hillbrow CHC (2014–2016) N=399	P (B vs C)

Characteristics	**Age groups in years**					
	<20	7 (0.8)	6 (0.8)		0 (0)	
	20–34	351 (39.8)	209 (30.2)		150 (37.6)	
	35–44	342 (38.8)	266 (38.4)		156 (39.1)	
	45–59	161 (18.3)	187 (27.0)		79 (19.8)	
	>60	20 (2.3)	25 (3.6)	0.001	7 (1.8)	0.003
	HIV status known	650 (71.4)	429 (59.5)	<0.001	399 (100)	<0.001
	HIV status^					
	Negative	105 (16.2)	59 (13.8)		62 (15.5)	
	Positive	545 (83.9)	370 (86.3)	0.28	337 (84.5)	0.47
	On ART%	428/544 (78.7)	324/370 (87.6)	<0.001	336/337 (99.7)	<0.001
Cervical cancer Screening	**Facility where Pap smear done**					
	CMJAH	115 (12.8)	124 (17.5)		0 (0.0)	
	HCHC	114 (12.7)	43 (6.1)		307 (76.9)	
	Other clinic or hospital	671 (74.6)	540 (76.4)	<0.001	92 (23.1)	<0.001
	Pap smear results					
	NILM	6 (0.7)	8 (1.1)		17 (4.3)	
	LSIL	141 (15.5)	125 (17.4)		79 (20.0)	
	ASCUS	19 (2.1)	34 (4.7)		4 (1.0)	
	HSIL	678 (74.7)	478 (66.4)		263 (66.4)	
	ASC-H	63 (6.9)	65 (9.0)		27 (6.8)	
	Carcinoma	1 (0.1)	10 (1.4)	<0.001	6 (1.5)	<0.001
	Pap smear risk categories					
	NILM, LSIL or ACSUS	166 (18.3)	167 (23.2)		100 (25.3)	
	HSIL, ASC-H or carcinoma	742 (81.7)	553 (76.8)	0.015	296 (74.8)	0.44
Cervical cancer diagnosis	**Procedure during colposcopy**					
	Visual inspection only	37 (4.1)	37 (5.2)		63 (15.9)	
	Lletz	337 (37.2)	258 (35.9)		231 (58.2)	
	Biopsy	526 (58.0)	420 (58.4)		90 (22.7)	
	Other	7 (0.8)	4 (0.6)	0.69	13 (3.3)	<0.001

	Histology result[&]					
	Normal	27 (3.1)	30 (4.4)		45 (13.8)	
	CIN I	254 (29.3)	200 (29.3)		84 (25.7)	
	CIN II	298 (34.3)	209 (30.7)		99 (30.3)	
	CIN III	236 (27.2)	198 (29.0)		86 (26.3)	
	Carcinoma	3 (0.4)	9 (1.3)		2 (0.6)	
	Other[*]	34 (3.9)	19 (2.8)		2 (0.6)	
	Invalid specimen	16 (1.8)	17 (2.5)	0.10	9 (2.8)	<0.001

χ^2 test for categorical variables or Wilcoxon Rank-sum test for continuous variables. [^]Of those with a known HIV status. [%]Of those HIV positive. [&]Of those with a histology specimen taken at biopsy, Lletz or other procedure. Charlotte Maxeke Johannesburg Academic Hospital (CMJAH). Hillbrow Community Health Centre (HCHC). [*]Other includes infections such as cervicitis, inflammation and dysplasia

Of all Pap smears done in the JHD in the two years after decentralisation (114,983), 1.9% were done at HCHC (2227; Table 2). Overall, 18.0% of Pap smears done at HCHC had abnormal cytology and required colposcopy (n=401), compared to only 8.2% of other women in JHD as a whole (n=1826; p<0.001). The estimated colposcopy coverage among women who had an abnormal Pap smear at HCHC was 66.6% (267/401; 95%CI=61.7-71.2%). The number of women who had a Pap smear at HCHC and then a colposcopy at either facility was three-fold higher post-decentralisation than pre-decentralisation (from 113 to 350) (Table 1).

Table 2: Cytology results in the City of Johannesburg in 2014-2016

Variable n (%)	Johannesburg health district[*] (n=114,983)	Hillbrow Community Health Centre (n=2227)	*P*
Pap smear results			

NILM LSIL ASCUS HSIL ASC-H Carcinoma	74,969 (65.2) 23,212 (20.2) 7391 (6.4) 7808 (6.8) 1221 (1.1) 382 (0.3)	852 (38.3) 790 (35.5) 184 (8.3) 364 (16.3) 28 (1.3) 9 (0.4)	<0.001
Number requiring colposcopy No (NILM, LSIL or ASCUS) Yes (HSIL, ASC-H or carcinoma)	105,572 (91.8) 1826 (8.2)	9411 (82.0) 401 (18.0)	<0.001

Data from the National Health Laboratory Service. Excludes invalid or missing specimens, and other Pap smear results (n=2446).

*District total excludes HCHC

Almost half of the women at CMJAH had a delay in receiving colposcopy (>6 months between Pap smear and colposcopy) post-decentralisation, compared to about a third pre-decentralisation (47.3% versus 36.2%, p<0.001; Figure 1: Graph 1A). At HCHC, 21.7% of women had a colposcopy within three months of a Pap smear being taken (versus 11.8% at CMJAH pre- and 15.4% post-decentralisation, p<0.001).

The absolute number of women at CMJAH who had had a Pap smear at HCHC decreased from 113 to 43 in the second period. One quarter of women who had a colposcopy at HCHC had had their Pap smear at another facility.

Characteristics of women in the three groups and HIV service integration

The proportion of women older than 45 years pre-decentralisation at CMJAH was 20.6%, post-decentralisation at CMJAH 30.6% and at HCHC 21.9% (p<0.001). At CMJAH, more women had a known HIV status pre-decentralisation than post-decentralisation (71.4% versus 59.5%, p<0.001). All women at HCHC had a documented HIV status. Around 85% of women with a known HIV status were HIV positive in all three groups. The proportion of positive women receiving ART rose in the second period at CMJAH from 78.7% to 87.6% (p<0.001), and almost all positive women were on ART at HCHC (99.7%; p<0.001) (Table 1).

Description of colposcopy procedures, histology findings and colposcopy quality

At CMJAH, in both periods, nearly 60% of women had a biopsy at colposcopy (58.2%), while the same proportion had a Lletz at HCHC (58.2%). Three women who had a colposcopy at HCHC were referred to CMJAH due to an unsuccessful procedure.

Women at HCHC were 3.5 fold more likely to have a normal result on histology than women at CMJAH (95%CI OR=2.1-5.7). Post-decentralisation, 29.0% of women at CMJAH and 26.3% at HCHC had CIN III lesions (p=0.37; Figure 1; Graph1B). Post-decentralisation, 11 women had a diagnosis of carcinoma on histology (1.1%), compared to 3 before decentralisation (0.4%; p=0.06). The proportion of invalid specimens was similar across the three groups, ranging from 1.8 to 2.8% (Table 1).

DISCUSSION

In this study we determined whether decentralisation to primary care level improved access to colposcopy services by reviewing the number of women attending the service before and after decentralisation, and the coverage of colposcopy among women at HCHC. We found that the cumulative number of colposcopies across the two facilities rose following decentralisation, and after only two years, HCHC was responsible for a third of all colposcopies in the sub-district, even though it performs a negligible number of Pap smears relative to other sites. Overall, following decentralisation, three fold more women who had a Pap smear at HCHC had a colposcopy, and equally, at CMJAH, the proportion of women referred from HCHC reduced almost threefold. The marked increase in number of women from HCHC who had a colposcopy indicates that prior to decentralisation there may have been a

large unmet need for the service, which was now being addressed, at least in part. The coverage reached 66.6%, considerably higher than figures in other settings.

Decentralisation of colposcopy services to primary level care has several potential benefits. Firstly, with adequate training, tasks that had been performed by highly specialised staff can be shifted to lower health worker cadres, allowing specialists to focus on more complex cases.[23] Additionally, decentralisation may alleviate patient barriers to access, by bringing services closer to them – in settings they are familiar with – and reducing their transport and other costs.[13, 23] Decentralisation has long been central to the provision of HIV services in this setting through, for example, task shifting, providing antiretroviral treatment in primary care services and the dispensing of drugs from local pharmacies, rather than clinics.[24]

Decentralisation of colposcopy can take several forms, including telecolposcopy from distant sites, outreach portable colposcopy, shifting of services to nurse practitioners or medical officers, and decentralisation to lower level facilities, as in this study.[25] In other settings, shifting services to lower care levels was found to be cost-effective, acceptable to patients and to increase rates of attendance for colposcopy.[16, 25, 26] In the Western Cape, South Africa, for example, colposcopy services were decentralised to a district

hospital and provided by a gynaecologist.[23] This raised uptake of the service and reduced time to procedure. In high-income countries, services have been successfully decentralised to community health centres and portable outreach programmes in Alaska, the United States, and parts of Canada and Australia, targeting immigrant, Inuit and other vulnerable women.[16, 17, 26-28] The National Health Service in United Kingdom has gone a step further and colposcopy is often performed by nurse practitioners once they have completed certification procedures.[29]

Women attending HCHC colposcopy were at lower risk than those at CMJAH, as shown by their lower grades of abnormalities on Pap smear and histology. Women at HCHC were also younger than those at CMJAH, important as risk for cervical cancer is higher in rises considerably with age (the mean age at diagnosis of cervical cancer is 52.3 in South Africa).[30] These findings may suggest that, as the programme had envisaged, higher-risk patients are being referred to CMJAH. Overall, services at HCHC appear to be performing well, with all women tested for HIV and almost all those positive were receiving ART. In addition, colposcopy services were now integrated into their care, which was previously off-site, complex to access and marked by lengthy delays. HIV-positive women made up the large majority of patients in all groups, reflecting the higher levels of risk for cervical cancer in this population.

Clearly it remains a priority to integrate screening for cervical cancer within all clinics providing antiretroviral treatment. Equally, ART and services such as screening and treatment for sexually transmitted infections could be integrated within colposcopy clinics, reducing the opportunity costs associated with multiple visits to the clinic and lowering the risk of loss to follow up.

The similar number of invalid histology samples and the isolated cases of failed colposcopy suggests that the quality of colposcopy services at HCHC may have been comparable to CMJAH. Unlike at CMJAH, however, Lletz was the commonest procedure at HCHC, in keeping with evidence that Lletz is better suited to lower level facilities and staff.[10] With decentralisation, it is critical to ensure that staff are adequately trained and service quality is closely monitored. The hesitancy to decentralise colposcopy to date, may reflect underlying concerns that cases of cancer may go undetected by lower-level staff. In some settings, lower-level health workers undergo a process of certification and have to perform a certain number of colposcopies per year to remain registered.[29] While this approach may hold advantages, onerous processes around certification and recertification may lead to staff discontinuing colposcopy.[31]

The decline in number of colposcopies at CMJAH is concerning, and may reflect factors other than a reduction in demand that accompanies

decentralisation. Fewer women at the site had a known HIV status and waiting times for colposcopy lengthened. Thus, though decentralisation can reduce the patient burden at referral centres, this does not necessarily translate into improved services at that site. Other factors may play a larger influence, for example, coinciding with the period after decentralisation, CMJAH lost a number of senior specialists.

Delays in colposcopy vary considerably between settings, from an average of 39 days from referral to colposcopy in one study in KwaZulu Natal, South Africa,[12] to around 5-6 months in both our study and another in the Western Cape.[23] It is concerning that time from Pap smear to colposcopy is greater than six months for half the women at CMJAH, and a third at HCHC. Reducing these delays is clearly a priority at both sites. We were unable, however, to discern reasons for these delays, which could be caused by delays in providing the results of Pap smears to patients, patient delays in making or attending appointments, or shortages of specialist staff. We could also not investigate which group of patients required referral to higher levels of care, and future studies might attempt to define criteria for referral. Moreover, given the relatively short period of the review, we are unable to assess sustainability of the services in the long-run, a pressing question. Lastly, the study evaluated the use of colposcopy following cytological screening with Pap

smears and these findings may not be generalizable to screening with HPV testing.[29] HPV testing has a considerably higher sensitivity for detecting precursor lesions of cervical cancer compared to cytology, and thus may alter the number of patients requiring colposcopy and types of lesions identified.[32, 33]

CONCLUSION

In conclusion, decentralisation of colposcopy services can improve access to colposcopy, resulting in faster diagnoses of precancerous lesions of the cervix, more lesions being treated with Lletz and a reduction in the burden of patients in tertiary hospitals. Most importantly, increasing the number of colposcopies and treatments of precancerous lesions could reduce the incidence of cervical cancer. This is particularly important among HIV-positive women who now live longer with ART, and the treatment of their co-morbidities is rapidly gaining in importance. Though coverage of colposcopy reached two thirds at HCHC, it is important to identify interventions to further raise coverage levels. Decentralisation is unlikely to affect the quality of services if medical officers are appropriately trained, supervised and supported by clear referral guidelines. The approach presented here could be extended to other similar primary- or secondary-level facilities in South Africa, and perhaps encompass the use of portable colposcopes or telecolposcopy,

under close supervision. If done correctly and at scale, decentralisation of colposcopy services, could shore up cervical cancer prevention and finally decrease the public health burden and mortality due to the cancer.

ACKNOWLEDGEMENTS

We would like to acknowledge the following persons who contributed to this study:

H. Manyonga, Z. Dumakude, A. Mohololа, N. Wattrus, L. Mbuyisa, I. Sishi, N. Twala, S. Sidabuka, E. Briedenhann, L. Mavuya, K. Moshaba, S. Mzobe, S. Carmona (NHLS), L. Chauke (Department of Obstetrics and Gynaecology, CMJAH).

FUNDING

This study has been made possible through funding from USAID-PEPFAR, grant number: AID-A-12-67400021. We would also like to acknowledge the

following organizations for donating a colposcopy machine to Hillbrow CHC: Vodacom, Altech and Altron.

COMPETING INTERESTS

All authors listed in this study do not have competing interests to declare.

DATA SHARING STATEMENT

There's no additional unpublished data from the study.

AUTHOR CONTRIBUTIONS

Manuscript title: The impact of decentralising colposcopy services from tertiary- to primary-level care in inner-city Johannesburg, South Africa: a before and after study

Category 1

Conception and design of study: G. Maimela*1, X. Nene*1, S. Sawry, N. Mvundla, M. Chersich

Acquisition of data: G. Maimela, X. Nene, N. Mvundla,

Analysis and/or interpretation of data: G. Maimela, X. Nene, S. Sawry, E. Kachingwe, M. Chersich, H. Rees; T. Smith.

Category 2

Drafting the manuscript: G. Maimela, X. Nene, N. Mvundla, S. Sawry, E. Kachingwe, M. Chersich.

Revising the manuscript critically for important intellectual content: M. Chersich, H. Rees, T. Smith

Category 3

Approval of the version of the manuscript to be published*:*

G. Maimela*1, X. Nene*1, N. Mvundla1, S. Sawry1, T. Smith2, H. Rees1, E.Kachingwe1, M. Chersich1

ACKNOWLEDGEMENTS: *All persons who have made substantial contributions to the work reported in the manuscript (e.g., technical help, writing and editing assistance, general support), but who do not meet the criteria for authorship, are named in the Acknowledgements and have given us their written permission to be named. If we have not included an Acknowledgements, then that indicates that we have not received substantial contributions from non-authors.*

H. Manyonga, Z. Dumakude, A. Mohololа, N. Wattrus, L. Mbuyisa, I. Sishi, N. Twala, S. Sidabuka, E. Briedenhann, L. Mavuya, K. Moshaba, S. Mzobe, S. Carmona (NHLS), L. Chauke (Department of Obstetrics and Gynaecology, CMJAH).

This statement is signed by all the authors (a photocopy of this form may be used if there are more than 10 authors):

REFERENCES

1. WHO. Cervical Cancer: An NCD We Can Overcome: Call to Action. 2018. http://www.who.int/reproductivehealth/DG_Call-to-Action.pdf.

2. Bruni L, Barrionuevo-Rosas L, Albero G, Serrano B, Mena M, Gómez D, et al. ICO/IARC Information Centre on HPV and Cancer (HPV Information Centre). Human Papillomavirus and Related Diseases in the World. . Summary Report 27 July 2017. http://www.hpvcentre.net/statistics/reports/XWX.pdf.

3. Batra P, Kuhn L, Denny L. Utilisation and outcomes of cervical cancer prevention services among HIV-infected women in Cape Town. SAMJ: South African Medical Journal. 2010;100:39-44.

4. ICO/IARC Information Centre on HPV and Cancer. South Africa Human Papillomavirus and Related Cancers, Fact Sheet 2017. 2017. http://www.hpvcentre.net/statistics/reports/ZAF_FS.pdf.

5. Shisana O, Rehle T, Simbayi LC, Zuma K, Jooste S, Zungu N, et al. South African National HIV Prevalence, Incidence and Behaviour Survey, 2012. Cape Town: HSRC Press; 2014.

6. Adler D, Wallace M, Bennie T, Abar B, Sadeghi R, Meiring T, et al. High risk human papillomavirus persistence among HIV-infected young women in South Africa. International journal of infectious diseases : IJID : official publication of the International Society for Infectious Diseases. 2015;33:219-21.

7. Guiguet M, Boue F, Cadranel J, Lang JM, Rosenthal E, Costagliola D, et al. Effect of immunodeficiency, HIV viral load, and antiretroviral therapy on the risk of individual malignancies (FHDH-ANRS CO4): a prospective cohort study. Lancet Oncol. 2009;10(12):1152-9.

8. National Department of Health South Africa. Cervical Cancer Prevention and Control Policy. 2017.

9. Day C, Gray A, Ndlovu N. South African Health Review 2018. Durban: Health Systems Trust. 2018.

10. WHO. WHO guidelines for screening and treatment of precancerous lesions for cervical cancer prevention.

http://apps.who.int/iris/bitstream/handle/10665/94830/9789241548694_eng.pdf;jsessionid=F65ED4960A15E4D16BB15F6E57F71518?sequence=1; 2013.

11. Denny L, Kuhn L. Cervical cancer prevention and early detection from a South African perspective. Chapter 18. South African Health Review Published by Health Systems Trust. 2017.

12. Katz IT, Butler LM, Crankshaw TL, Wright AA, Bramhill K, Leone DA, et al. Cervical Abnormalities in South African Women Living With HIV With High Screening and Referral Rates. J Glob Oncol. 2016;2(6):375-80.

13. Dawood S. Barriers and Facilitators to Colposcopy Attendance. Following an Abnormal Pap Smear: Patient and Provider Perspectives. Cape Town: University of Cape Town; 2014.

14. Momberg M, Botha MH, Van der Merwe FH, Moodley J. Women's experiences with cervical cancer screening in a colposcopy referral clinic in Cape Town, South Africa: a qualitative analysis. BMJ open. 2017;7(2):e013914.

15. Hoque M, Hoque E, Kader SB. Evaluation of cervical cancer screening program at a rural community of South Africa. East African journal of public health. 2008;5(2):111-6.

16. Martin B, Smith W, Orr P, Guijon F. Investigation and management of cervical intraepithelial neoplasia in Canadian Inuit: enhancing access to care. Arctic Med Res. 1995;54 Suppl 1:117-21.

17. Payne S, Jarrett N, Jeffs D. The impact of travel on cancer patients' experiences of treatment: a literature review. Eur J Cancer Care (Engl). 2000;9(4):197-203.

18. Baranoski AS, Stier EA. Factors associated with time to colposcopy after abnormal Pap testing in HIV-infected women. Journal of women's health (2002). 2012;21(4):418-24.

19. Rees H, Delany-Moretlwe S, Scorgie F, Luchters S, Chersich MF. At the Heart of the Problem: Health in Johannesburg's Inner-City. BMC Public Health. 2017;17(Suppl 3):554.

20. Stadler J, Chikandiwe A, Mayaud P, Rees H, Imrie J, Delany-Moretlwe S. Biographies of HIV and Cervical Cancer: Understanding Treatment-Seeking Amongst HIV Positive Women in Inner City Johannesburg. IAS conference, Durba, South Africa, Oral presentation. 2016.

21. Botha MH. Guidelines for cervical cancer screening in South Africa. Southern African Journal of Gynaecological Oncology 2017;9(1):8-12.

22. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009;42(2):377-81.

23. Blanckenberg ND, Oettle CA, Conradie HH, Krige FK. Impact of introduction of a colposcopy service in a rural South African sub-district on uptake of colposcopy. South African Journal of Obstetrics and Gynaecology. 2013;19(3).

24. Callaghan M, Ford N, Schneider H. A systematic review of task- shifting for HIV treatment and care in Africa. Human resources for health. 2010;8:8.

25. Bishai DM, Ferris DG, Litaker MS. What is the least costly strategy to evaluate cervical abnormalities in rural women? Comparing telemedicine, local practitioners, and expert physicians. Med Decis Making. 2003;23(6):463-70.

26. Ogilvie GS, Shaw EA, Lusk SP, Zazulak J, Kaczorowski JA. Access to colposcopy services for high-risk Canadian women: can we do better? Can J Public Health. 2004;95(5):346-51.

27. Gifford MS, Stone IK. Quality, access, and clinical issues in a nurse practitioner colposcopy outreach program. The Nurse practitioner. 1993;18(10):25-9, 33-6.

28. Hartz LE. Quality of care by nurse practitioners delivering colposcopy services. J Am Acad Nurse Pract. 1995;7(1):23-7.

29. Public Health England, National Health Service. NHS Cervical Screening Programme Colposcopy and Programme Management. NHSCSP Publication number 20. Third edition. 2016.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/515817/NHSCSP_colposcopy_management.pdf.

30. Olorunfemi G, Ndlovu N, Masukume G, Chikandiwa A, Pisa PT, Singh E. Temporal trends in the epidemiology of cervical cancer in South Africa (1994-2012). Int J Cancer. 2018;143(9):2238-49.

31. Sonnex C. Providing a genitourinary medicine colposcopy service. Sexually transmitted infections. 2014;90(1):8-10.

32. Dijkstra MG, Snijders PJ, Arbyn M, Rijkaart DC, Berkhof J, Meijer CJ. Cervical cancer screening: on the way to a shift from cytology to full molecular screening. Ann Oncol. 2014;25(5):927-35.

33. Wright TC, Jr., Stoler MH, Behrens CM, Sharma A, Sharma K, Apple R. Interlaboratory variation in the performance of liquid-based cytology: insights from the ATHENA trial. Int J Cancer. 2014;134(8):1835-43.

FIGURE LEGENDS

Figure 1:

Graph 1A: Total number of colposcopies done before and after decentralisation

Graph 1B: Number of cervical intraepithelial neoplasia lesions detected before and after decentralisation

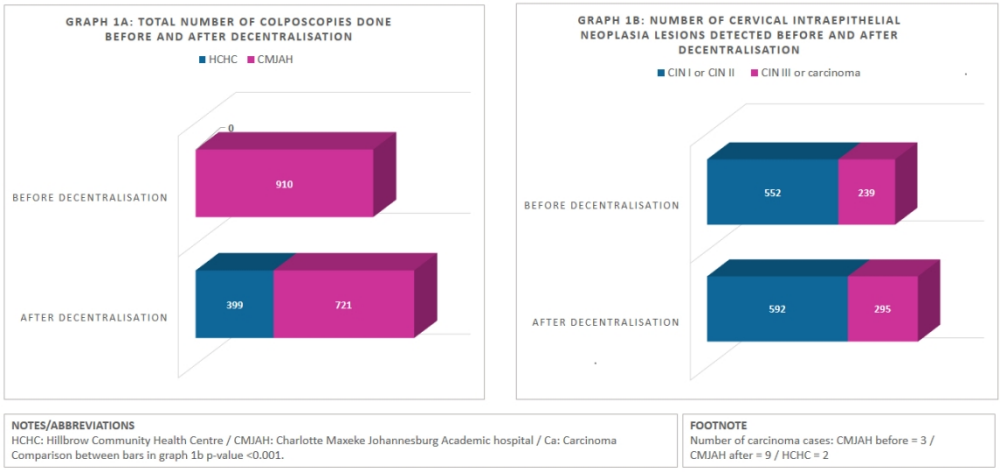


Figure 1:
Graph 1A: Total number of colposcopies done before and after decentralisation
Graph 1B: Number of cervical intraepithelial neoplasia lesions detected before and after decentralisation

271x128mm (120 x 120 DPI)