Original Article

Visual Inspection with Acetic Acid (VIA) for Diagnosis of Cervical and Precancerous Lesion: A Study in TMSS Medical College and Rafatullah Community Hospital, Bogura

Pervin S[1]*, Razia S[2], Poly NN[3], Habiba U[4], Rashid UH[5], Sultana S[6]

1. Dr. Shohela Pervin, Assistant Professor, Department of Obstetrics and Gynaecology, TMSS Medical College, Bogura.
2. Dr. Sultana Razia, Professor, Department of Obstetrics and Gynaecology, TMSS Medical College, Bogura.
3. Dr. Nazmun Naher Poly, Assistant Professor, Department of Obstetrics and Gynaecology, TMSS Medical College, Bogura.
4. Dr. Ummaia Habiba, Registrar, Department of Obstetrics and Gynaecology, TMSS Medical College, Bogura.
5. Dr. Ummay Habiba Rashid, Registrar, Department of Obstetrics and Gynaecology, TMSS Medical College, Bogura.
6. Dr. Shamema Sultana, Medical Officer, Department of Obstetrics and Gynaecology, TMSS Medical College, Bogura.

***Corresponding Author**

Abstract

Background: Cervical cancer remains a leading cause of morbidity and mortality among women in low- and middle-income countries (LMICs), particularly in Bangladesh. Visual Inspection with Acetic Acid (VIA) has emerged as a cost-effective and feasible screening method for early detection of cervical lesions in resource-limited settings. This study evaluates VIA in detecting cervical cancer and precancerous lesions, with colposcopy directed Biopsy and histopathology as the gold standard in TMSS Medical College and Rafatullah Community Hospital.

Materials and Methods: This observational study was conducted from January 2022 to June 2023 in the Department of Obstetrics and Gynecology, TMSS Medical College and Rafatullah Community Hospital, Bogura, among 210 women presenting with multiple indications of cervical cancer. Data were collected and analyzed using SPSS version 25. Descriptive statistics were used to summarize demographic and clinical characteristics. Sensitivity, specificity, accuracy, positive predictive value (PPV), and negative predictive value (NPV) were calculated using standard diagnostic values, holding colposcopy directed Biopsy and histopathological diagnosis as the gold standard.

Results: Of the 210 participants, 74.76% (n=157) tested positive with VIA, and 25.24% (n=53) tested negative. Histopathological analysis showed that 30.48% had normal findings, 24.29% had atypia, 20.95% had CIN-1, and 11.43% had CIN-2. VIA demonstrated a sensitivity of 95.89%, specificity of 73.44%, accuracy of 89.05%, PPV of 89.17%, and NPV of 88.68%. While VIA showed high sensitivity, its moderate specificity indicated the potential for false positives.

Conclusion: VIA is a highly sensitive and practical screening tool for cervical cancer in low-resource settings like Bangladesh. However, its moderate specificity and the presence of false positives suggest the need for improved diagnostic protocols, potentially involving adjunctive tests. The integration of VIA into national screening programs could enhance early detection rates and contribute in reducing cervical cancer-related mortality in LMICs.

Keywords: Cervical cancer, VIA, Sensitivity, Specificity, Low-resource settings, Cervical lesions.

Introduction

Cervical cancer remains a significant global health burden, especially among women in low- and middle-income countries (LMICs). It is the fourth most common cancer affecting women worldwide, with an estimated 662,301 new cases and 348,874 deaths according to GLOBOCAN in 2022, making it a leading cause of cancer-related mortality among women globally. Of these deaths, nearly 90% occur in LMICs, highlighting the critical role of socioeconomic factors in disease progression and outcomes.[1] In Bangladesh and other South Asian countries, the situation is particularly dire, with cervical cancer being the second most common cancer among women. According to national cancer registry data, the incidence of cervical cancer in Bangladesh is alarmingly high, and mortality rates remain elevated due to inadequate screening and treatment facilities.[2] This has prompted a growing emphasis on the need for

affordable, accessible, and effective screening strategies that can help detect the disease at an earlier, more treatable stage. Early detection of cervical cancer plays a crucial role in reducing mortality rates, as timely intervention can prevent progression from precancerous lesions to invasive cancer. The World Health Organization (WHO) has consistently advocated for cervical cancer screening as a key public health strategy in LMICs, where the burden of disease is most pronounced. Current screening methods, such as the Papanicolaou (Pap) smear and human papillomavirus (HPV) DNA testing, have proven effective in high-resource settings. However, these methods often require sophisticated laboratory infrastructure, trained personnel, and are relatively expensive, making them less feasible in low-resource environments like Bangladesh.[3,4] The Pap smear, for instance, although widely regarded as the gold standard for cervical cancer screening, is associated with high costs, complex laboratory processes, and long waiting times for results, all of which limit its accessibility in rural and underserved regions.[5] In contrast, Visual Inspection with Acetic Acid (VIA) has emerged as a cost-effective, simple, and feasible alternative, particularly for LMICs. VIA involves applying dilute acetic acid to the cervix and visually inspecting the cervix for aceto white lesions that indicate precancerous changes. One of the key advantages of VIA is its ability to provide real-time results, enabling healthcare providers to make immediate decisions regarding treatment. This screen-and-treat approach is especially valuable in areas with high cervical cancer burdens, where follow-up visits may be difficult due to logistical and financial constraints.[6] Studies have shown that VIA can be effectively performed by trained healthcare workers, including midwives and nurses, in low-resource settings, making it an attractive option for mass screening programs in countries like Bangladesh.[7] Several studies have evaluated the sensitivity and specificity of VIA in detecting cervical intraepithelial neoplasia (CIN) and early-stage cervical cancer. A pooled analysis of studies conducted in India and Africa reported that VIA had a sensitivity of 79% and specificity of 85% for detecting CIN2+ lesions, making it a viable alternative to Pap smears and HPV testing in resource-limited settings.[8] Similarly, in a comparative study conducted in Bangladesh, VIA demonstrated a sensitivity of 90.2% and specificity of 88.1%, indicating its high diagnostic accuracy in detecting cervical neoplasia. However, the performance of VIA can vary depending on the training of healthcare providers, the availability of quality control mechanisms, and population demographics. The wide range of sensitivity (49-98%) and specificity (75-91%) reported in the literature underscores the importance of measuring these parameters in region-specific contexts.[10] In Bangladesh, where healthcare infrastructure is often fragmented and resources are limited, understanding the local diagnostic performance of VIA is essential for designing effective screening programs. Despite the global body of research supporting the use of VIA, there remains a gap in the literature specifically focusing on its diagnostic accuracy within the Bangladeshi healthcare system. While VIA has been widely studied in other LMICs, limited research exists on its region-specific sensitivity and specificity in South Asia, particularly in Bangladesh. This lack of data is problematic, as regional factors such as healthcare worker training, patient population characteristics, and access to follow-up care can significantly influence the performance of screening methods. Furthermore, public health strategies for cervical cancer prevention in Bangladesh have yet to fully integrate VIA into national screening programs, despite its proven efficacy in similar settings. As a result, there is an urgent need for localized studies that evaluate the effectiveness of VIA within the specific cultural, economic, and healthcare contexts of Bangladesh. The present study aims to address this gap by evaluating the sensitivity and specificity of VIA in diagnosing cervical cancer and precancerous lesions in a Bangladeshi population. By providing real-world data on the diagnostic performance of VIA in a low-resource setting, this research seeks to inform future cervical cancer prevention strategies in Bangladesh. Understanding the region-specific

efficacy of VIA is critical for developing national screening programs that are both cost-effective and capable of reducing the cervical cancer burden in underserved communities.

Materials and Methods

This observational study was conducted in the Department of Obstetrics and Gynaecology at TMSS Medical College and Rafatullah Community Hospital, Bogura, Bangladesh, over a period of 1.5 years, from January 2022 to June 2023. The study included a sample size of 210 patients, all of whom presented with more than one indication suggestive of cervical cancer. The inclusion criteria were based on the presence of multiple clinical symptoms indicative of cervical abnormalities, while exclusion criteria included patients with previously diagnosed cervical cancer or those exhibiting very severe indications of the disease.Data collection involved detailed clinical examinations, screening with Visual Inspection with Acetic Acid (VIA), and confirmation through colposcopy directed Biopsy and histopathological diagnosis, which served as the gold standard. The clinical symptoms prompting VIA screening included abnormal vaginal discharge, irregular menstruation, unhealthy cervix, and other gynecological signs of potential cervical lesions.Data were analyzed using SPSS version 25, and descriptive statistics were applied to summarize patient demographics, clinical characteristics, and symptom distributions. The diagnostic performance of VIA was assessed through sensitivity, specificity, accuracy, positive predictive value (PPV), and negative predictive value (NPV), which were calculated based on standard diagnostic values. Sensitivity and specificity were measured to evaluate VIA's ability to correctly identify both the presence and absence of cervical cancer, while accuracy, PPV, and NPV offered insights into the test's overall reliability in detecting cervical lesions. All calculations were performed with reference to the histopathological diagnosis to ensure precise comparisons.

Results

Table I: Distribution of baseline characteristics among the participants (N=210)

Baseline Characteristics	Number	Percentage (%)
Age		
≤30	53	25.24
31-40	82	39.05
41-50	53	25.24
51-60	16	7.62
>60	6	2.86
Education		
Primary	119	56.67
Secondary	69	32.86
Higher Secondary	12	5.71
Graduate	10	4.76
Socioeconomic Status		
Poor	109	51.90
Middle Class	76	36.19
Upper Class	25	11.90
Age at marriage		
Mean±SD	16.40±4.85	
Age at First Delivery		
Mean±SD	18.81±4.26	

The study included a total of 210 participants. The majority of the participants were aged between 31-40 years, representing 39.05% (n=82) of the sample, followed by participants in the age groups of ≤30 years (25.24%, n=53) and 41-50 years (25.24%, n=53). A smaller proportion of participants were aged 51-60 years (7.62%, n=16), with the lowest representation in the >60 age group (2.86%, n=6).Regarding educational attainment, more than half of the participants had completed only primary education (56.67%, n=119), while 32.86% (n=69) had attained secondary education. A smaller portion of participants had completed higher secondary education (5.71%, n=12), and only 4.76% (n=10) were graduates.In terms of socioeconomic status, 51.90% (n=109) of the participants were categorized as poor, 36.19% (n=76) were classified as middle class, and the remaining 11.90% (n=25) were from the upper class. The mean age at marriage was 16.40 years (SD ±4.85), while the mean age at first delivery was 18.81 years (SD ±4.26).

Table II: Distribution of symptoms and indications of cervical lesion among the participants (N=210)

Indication for VIA	Number	Percentage (%)
Irregular Menstruation	111	52.86
Unhealthy Cervix	105	50.00
Abnormal Vaginal Discharge	156	74.29
Cervical ectropion	27	12.86
Bleeding and Itching	42	20.00

The most common indication for undergoing Visual Inspection with Acetic Acid (VIA) screening among the participants was abnormal vaginal discharge, reported by 74.29% (n=156) of the participants. Irregular menstruation was also a frequently observed symptom, present in 52.86% (n=111) of participants, followed closely by unhealthy cervix, noted in 50.00% (n=105) of cases. Other less frequent indications included bleeding and itching, reported by 20.00% (n=42), and cervical ectropion, which was present in 12.86% (n=27) of the participants. Notably, multiple indications were often observed in the same individuals.

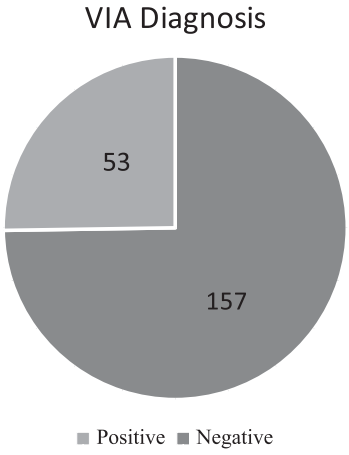

Figure 1: Distribution of VIA diagnosis among the participants (N=210)

Figure 1 shows the distribution of VIA diagnosis among the participants. Of the 210 participants, 74.76% (n=157) tested positive for cervical lesions via VIA screening, while the remaining 25.24% (n=53) had a negative VIA result, indicating no visible cervical abnormalities.

Table III: Distribution of histopathological diagnosis among the participants (N=210)

Histopathology results	Number	Percentage (%)
Normal	64	30.48
Sq. Metaplasia	4	1.90
HPV infection	2	0.95
Atypia	51	24.29
CIN-1	44	20.95
CIN-2	24	11.43
CIN-3	17	8.10
Early invasive Carcinoma	4	1.90

The histopathological findings of the participants are presented in Table III. Of the 210 participants, 30.48% (n=64) were diagnosed as normal with no cervical abnormalities. Atypia was the most frequently observed abnormal finding, present in 24.29% (n=51) of participants, followed by CIN-1 (Cervical Intraepithelial Neoplasia grade 1), observed in 20.95% (n=44). More advanced lesions were also identified, with CIN-2 diagnosed in 11.43% (n=24) and CIN-3 in 8.10% (n=17) of the cases. A smaller percentage of participants had findings of squamous metaplasia (1.90%, n=4), HPV infection (0.95%, n=2), or early invasive carcinoma (1.90%, n=4).

Table IV: Correlation of VIA diagnosis holding histopathological findings as the gold standard (N=210)

VIA	Histopathological Diagnosis		Total
	Positive (n=146)	Negative (n=64)	
Positive (n=157)	140 (TP)	17 (FP)	157
Negative (n=53)	6 (FN)	47 (TN)	53

The correlation between VIA diagnosis and histopathological findings (considered as the gold standard) is summarized in Table 4. Out of the 210 participants, 140 cases were true positives (TP), where VIA correctly identified the presence of cervical lesions that were confirmed by histopathology. 17 cases were false positives (FP), where VIA indicated abnormal findings, but histopathology results were

normal. On the other hand, there were 6 false negatives (FN), where VIA failed to detect abnormalities that were later confirmed by histopathology. Lastly, 47 cases were true negatives (TN), where VIA correctly identified the absence of lesions, as confirmed by histopathological examination.

Table V: Diagnostic values of VIA in detection of cervical lesion, holding histopathological diagnosis as gold standard

Diagnostic Metrics	Values (%)
Sensitivity	95.89
Specificity	73.44
Accuracy	89.05
PPV	89.17
NPV	88.68

The diagnostic performance of VIA in detecting cervical lesions, using histopathological diagnosis as the gold standard, is presented in Table V. The sensitivity of VIA was calculated to be 95.89%, indicating its high ability to correctly identify cases with cervical lesions. The specificity was 73.44%, reflecting the test's moderate capability to correctly identify participants without lesions. The overall accuracy of VIA was 89.05%, showing that the majority of diagnoses, both positive and negative, were accurate. The positive predictive value (PPV) was 89.17%, meaning that a large proportion of positive VIA results truly represented cervical lesions. Similarly, the negative predictive value (NPV) was 88.68%, indicating that most negative VIA results accurately reflected the absence of cervical lesions.

Discussion

This study's findings affirm that Visual Inspection with Acetic Acid (VIA) is a highly sensitive and viable method for early detection of cervical lesions, especially in low-resource settings like Bangladesh. With a sensitivity of 95.89%, VIA proves its utility in detecting cervical abnormalities, allowing healthcare workers to intervene at earlier stages of disease progression. This high sensitivity aligns with the results of Mittal et al., where VIA demonstrated similarly robust sensitivity rates, particularly in LMICs, highlighting VIA's role as an accessible and affordable screening tool in regions lacking the infrastructure or resources for more expensive options like Pap smears or HPV testing.[1] In this context, VIA becomes indispensable, as it facilitates real-time results and allows for immediate action, such as the screen-and-treat approach, which is crucial in reducing cervical cancer-related mortality in LMICs.[11] However, despite its strengths in identifying true positives, VIA's specificity in this study, at 73.44%, indicates a moderate potential for false positives. This is consistent with other research findings, including those of Bhatla et al., who observed VIA's tendency to yield false positive results, often due to benign cervical conditions like ectropion or inflammation, which VIA can misinterpret as potential pre-cancerous lesions.[12] In the current study, 17 false positives were observed, which may lead to unnecessary referrals for further diagnostic procedures or overtreatment, increasing the psychological and financial burden on patients. This issue of false positives underscores the need for integrating adjunctive diagnostic methods or improved follow-up protocols to minimize unnecessary interventions. As Lucas et al. suggested, training programs for healthcare workers could improve specificity, ensuring that VIA identifies lesions more accurately.[13] The overall accuracy of VIA in this study was 89.05%, reinforcing its suitability for mass screening programs. In comparison, Arbyn et al. similarly reported high accuracy rates for VIA in their pooled analysis of studies conducted in LMICs across Africa and India, further validating its use in resource-limited settings where cervical cancer screening infrastructure is limited.[6] However, the moderate specificity seen in these studies, including ours, signals a need for further refinement. This could involve the introduction of adjunctive methods like HPV testing or more widespread histopathological verification in cases where VIA results are ambiguous, as emphasized by Nessa et al., who advocate for

context-specific evaluations of diagnostic accuracy.[14]

Histopathological findings in this study further validate VIA's effectiveness in detecting precancerous and cancerous lesions. Specifically, 24.29% of participants were diagnosed with atypia, while 20.95% and 11.43% were diagnosed with CIN-1 and CIN-2, respectively. These findings are consistent with the results of Zahan et al., who reported similar distributions of precancerous lesions in VIA-positive cases in Bangladesh, highlighting the method's strong capacity to detect early-stage lesions.[8] Moreover, the 8.10% of participants diagnosed with CIN-3 and the 1.90% with early invasive carcinoma align with the progression models discussed in studies like that of Ghosh et al., which detail how early detection through VIA can prevent progression from CIN to invasive cancer, emphasizing the importance of VIA in low-resource settings.[15]

VIA's diagnostic reliability is further supported by the positive predictive value (PPV) of 89.17% and the negative predictive value (NPV) of 88.68% in this study. The high PPV indicates that the majority of VIA-positive cases are true positives, reinforcing VIA's utility as a diagnostic tool, especially in settings where follow-up opportunities may be limited. These findings are in line with Chandekar et al., who reported similarly high PPV rates for VIA, suggesting that VIA is a highly reliable indicator of cervical abnormalities when positive.[16] Additionally, the NPV in this study reflects VIA's capacity to accurately rule out the absence of cervical lesions in most negative cases. The study by Fuke et al. corroborates these findings, illustrating that VIA is particularly useful in identifying women who do not need further invasive diagnostic procedures, thus reducing unnecessary interventions and conserving resources.[17]

However, the existence of false negatives (n=6) in this study, though relatively low, is still a critical concern. Missed diagnoses of cervical abnormalities could delay essential treatments, resulting in progression to more advanced and less treatable stages of cervical cancer. This emphasizes the importance of continued histopathological follow-up and adjunctive testing to ensure that all cases of cervical lesions are accurately identified. Integrating a combination of VIA with HPV testing or cytology, as suggested by Arbyn et al., could improve overall diagnostic accuracy and minimize both false positives and negatives.[6] In conclusion, VIA is a highly effective tool for detecting cervical abnormalities, particularly in low-resource settings such as Bangladesh. Its high sensitivity, accuracy, and relatively high PPV make it an indispensable component of cervical cancer screening programs. However, challenges with specificity and the presence of false positives and negatives suggest that VIA should be complemented by additional diagnostic methods or improved healthcare worker training to enhance its diagnostic precision. As studies by Mittal et al. and Lucas et al. have shown, refining VIA protocols and integrating additional screening tools will be essential to maximize its efficacy in national cervical cancer prevention strategies.[1, 13] Future research should focus on optimizing VIA implementation within specific healthcare settings and evaluating its long-term impact on reducing cervical cancer incidence and mortality.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

Conclusion

This study highlights the significant role of Visual Inspection with Acetic Acid (VIA) as a highly sensitive and effective screening tool for detecting cervical lesions in low-resource settings like Bangladesh. With a sensitivity of 95.89% and an overall accuracy of 89.05%, VIA has proven to be a valuable method for early detection of cervical abnormalities, particularly where resources for more advanced screening methods are limited. However, its moderate specificity (73.44%) and occurrence of false positives and negatives underscore the need for further diagnostic refinement, such as integrating adjunctive tests or improving healthcare worker training. By optimizing VIA protocols, national cervical cancer screening programs in Bangladesh can significantly

improve early detection rates, reduce cervical cancer morbidity and mortality, and ultimately enhance women's health outcomes in resource-constrained settings.

Funding: No funding sources.

Conflict of interest: None declared.

Ethical approval: The study was approved by the Institutional Ethics Committee.

References

1. Mittal S, Biswas J, Basu P. Visual Inspection with Acetic Acid as a Screening Test for Cervical Cancer. Biomedical Research Journal. 2014;1(1):23.
2. Uddin AFMK, Sumon MA, Pervin S, Sharmin F. Cervical Cancer in Bangladesh. South Asian Journal of Cancer. 2023 ;12:036–8.
3. Lee H. Cervical Cancer Screening in Developing Countries: Using Visual Inspection Methods. Number 1 / February 2016; 20(1):79–83.
4. Ansari NP, Saleh FM, Shahida SM, Rahman EN. Comparative Study of Cytology and Histopathology of Cervical Lesion in VIA Positive Patients and Its Correlation with High Risk Human Papilloma Virus. Mymensingh Med J. 2017;26(3):505–13.
5. Sankaranarayanan R, Nessa A, Esmy PO, Dangou JM. Visual inspection methods for cervical cancer prevention. Best Practice & Research Clinical Obstetrics & Gynaecology. 2012 ;26(2):221–32.
6. Arbyn M, Sankaranarayanan R, Muwonge R, Keita N, Dolo A, Mbalawa CG, et al. Pooled analysis of the accuracy of five cervical cancer screening tests assessed in eleven studies in Africa and India. International Journal of Cancer. 2008;123(1):153–60.
7. Kn N, A N, S S, B N, F H, N B. Role of VIA in cervical cancer screening in low-resource countries. Mymensingh medical journal : MMJ [Internet]. 2011, 2024;20(3). Available from: https://pubmed.ncbi.nlm.nih.gov/21804524/
8. Zahan N, Shamima MN, Sultana S, Hossain MA. Detection of cervical intraepithelial neoplasia (CIN) by visual inspection of cervix with acetic acid (VIA) and its comparison to cervical cytology. TAJ: Journal of Teachers Association. 2018;31(1):15–20.
9. Agustiansyah P, Nurmaini S, Nuranna L, Irfannuddin I, Sanif R, Legiran L, . Automated Precancerous Lesion Screening Using an Instance Segmentation Technique for Improving Accuracy. Sensors. 2022 Jan;22(15):5489.
10. Amatullah M, Begum SA. Evaluation of coloscopic and Pap's smear findings among visual inspection with acetic acid cases in detection of precancerous lesion of cervix against histopathology: Colcoposcopy and Pap smear evaluation. Bangladesh Medical Research Council Bulletin. 2019;45(2):103–7.
11. Nayak PK, Mitra S, Agrawal S, Hussain N, Thakur P, Mishra B. Role of various screening techniques in detecting preinvasive lesions of the cervix among symptomatic women and women having unhealthy cervix. Journal of Cancer Research and Therapeutics. 2021 ;17(1):180.
12. Bhatla N, Mukhopadhyay A, Kriplani A, Pandey RM, Gravitt PE, Shah KV,. Evaluation of adjunctive tests for cervical cancer screening in low resource settings. Indian Journal of Cancer. 2007;44(2):51.
13. Lucas E, Murillo R, Arrossi S, Bárcena M, Chami Y, Nessa A, Quantification of impact of COVID-19 pandemic on cancer screening programmes -a case study from Argentina, Bangladesh, Colombia, Morocco, Sri Lanka and Thailand [Internet]. medRxiv; 2023 [cited 2024 Oct 13]. p. 2023.02.07.23285574. Available from: https:// www.medrxiv. org/content/10. 1101/2023.02.07.23285574v1
14. Nessa A, Ara R, Fatema P, Nasrin B, Chowdhury A, Khan KH,. Influence of Demographic and Reproductive Factors on Cervical Pre-Cancer

and Cancer in Bangladesh. Asian Pacific Journal of Cancer Prevention. 2020 ;21(7):1883–9.

15. Ghosh A, Moirangthem A, Dalui R, Ghosh T, Bandyopadhyay A, Dasgupta A,. Expression of matrix metalloproteinase-2 and 9 in cervical intraepithelial neoplasia and cervical carcinoma among different age groups of premenopausal and postmenopausal women. J Cancer Res Clin Oncol. 2014;140(9):1585–93.

16. Swapnil D. Chandekar, Vinod K. Sawaitul, Snehal V. Chavhan, Nitin G. Tiple. Detection of Abnormal Cervical Cytology by Papanicolaou Stained (PAP) Smears in Chandrapur District. IJLSSR [Internet].2016, 2024;2(3). Available from: http://ijlssr. com/IJLSSR- Archives/ IJLSSR-Volume%202-Issue%203-May,%20201 6/IJLSSR-1104-10-2015.pdf

17. Fuke RP, Sonak M, Singh M. Role of Colposcopy in the Evaluation of Unhealthy Cervix and Cervical Intraepithelial Neoplasia. Journal of Evidence based Medicine and Healthcare. 2020 ;7(30):1–6.

TMSS Medical College Journal 2024; 23(21-28):