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Supplemental Materials for

Measuring colposcopy quality in Canada: the development of population-based indicators

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Listing of Supplemental Material(s):

Supplemental Table 1. Literature review of colposcopy indicators and final score

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
1. Colposcopist volumes	Colposcopists should undertake a sufficient number of new patient colposcopies per year to maintain and improve skills in colposcopy practice (Cancer Council Australia 2016).	**Numerator**: N colposcopies per year in a jurisdiction **Denominator**: N colposcopists in a jurisdiction	100	Cancer Council Australia 2016; c-QuIP 2013 (p.12); Moss et al. 2013.	2.37
2. Number of colposcopists per capita	This indicator was suggested at the first colposcopy quality indicators working group meeting.	**Numerator**: N colposcopists in a jurisdiction **Denominator**: Female population of jurisdiction aged 21 to 69		Expert opinion Note: The calculation for this indicator was not derived from the literature and was developed by CPAC for the purposes of scoring.	2.83
3. Referral rate for colposcopy	This measure is not only of economic cost but also of the burden on women (anxiety, time consumption), which must be kept as low as possible, and should be calculated separately by: a) cytology that resulted in referral to colposcopy, b) for initial and subsequent screening	**Numerator**: N screened women referred for colposcopy **Denominator**: N screened women		IARC 2008; NCSS 2014; Arbyn et al. 2010; Ronco et al. 2015; Zappa 2009	2.06

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
4.Compliance with referral for colposcopy	A) An important condition for the success of a screening program is that diagnostic assessment is actually performed when needed. This indicator represents the proportion of women referred for colposcopy/biopsy who underwent colposcopy/biopsy within the program. Calculate separately by: a. different intervals after referral (3 months / 6 months) b. cytology that resulted in referral	**Numerator**: N screened women actually undergoing colposcopy **Denominator**: N screened women referred for colposcopy		IARC 2008; NCSS 2014; Nowakowski et al. 2015; Ronco et al. 2015; Zappa 2009; NHS England West Midlands 2016	2.37
	B) This indicator represents the proportion of women who are referred for colposcopy and fail to attend.	**Numerator**: N screened women failing to attend colposcopy appointment **Denominator**: N screened women referred for colposcopy		NHS England West Midlands 2016	1.80
5. Referral for colposcopy after persistent positive cytology	A) Women should be referred for colposcopy if they have had three tests reported as abnormal at any grade in a 10-year period, even if returned to recall on one or more occasions in that period.	**Numerator**: N women referred for colposcopy after three abnormal tests **Denominator**: N women with three abnormal tests		NHS Scotland 2012; Public Health England 2016	1.43

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
	B) A woman with persistent ASCUS/LSIL or ASCUS HR-HPV positive cytology should be referred for colposcopy.	**Numerator**: N women with persistent ASCUS/LSIL or ASCUS HR-HPV positive cytology referred for colposcopy **Denominator**: N women with persistent ASCUS/LSIL or ASCUS HR-HPV positive cytology		Bentley 2012 (Society of Canadian Colposcopists)	1.83
	C) Women should have a repeat test after a smear showing mild dyskaryosis and should be referred for colposcopy after two tests reported as mild dyskaryosis without a return to routine recall.	**Numerator**: N women referred for colposcopy after two tests reported as mild dyskaryosis **Denominator**: N women with two tests reported as mild dyskaryosis		NHS Scotland 2012	2.00
6. Referral for colposcopy after abnormal cytology result	A) Women must be referred for colposcopy after one test reported as glandular abnormality and endocervical adenocarcinoma.	**Numerator**: N women referred for colposcopy after one test reported as glandular abnormality and endocervical adenocarcinoma **Denominator**: N women with one test reported as glandular abnormality and endocervical adenocarcinoma		NHS Scotland 2012	1.83

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
	B) The finding of an AGC Pap smear warrants colposcopy (II-2A).	**Numerator**: N women referred for colposcopy after AGC Pap smear **Denominator**: N women with AGC Pap smear		Bentley, 2012	2.60
	C) Women must be referred to colposcopy or gynaecology, as per local guidelines, after one test reported as endometrial (or other) adenocarcinoma.	**Numerator**: N women referred for colposcopy after one test reported as endometrial adenocarcinoma **Denominator**: N women with one test reported as endometrial adenocarcinoma		NHS Scotland 2012	1.51
	D) All women with an HSIL test result should have colposcopy.	**Numerator**: N women referred for colposcopy after HSIL test result **Denominator**: N women with HSIL test result		Bentley, 2012	2.66
	E) Women with a cytologic diagnosis suggestive of carcinoma, with or without a visible lesion, should have colposcopy and appropriate biopsies.	**Numerator**: N women referred for colposcopy after cytologic diagnosis suggestive of carcinoma **Denominator**: N women with cytologic diagnosis suggestive of carcinoma		Bentley, 2012	2.03

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
7. Colposcopy uptake	A) Percentage of women with a high-grade Pap test result (AGC, ASC-H, HSIL+) who had a follow-up colposcopy within 6 weeks of the index Pap test report date.	**Numerator**: N women 21 to 69 years of age with high grade Pap test result who had follow-up colposcopy within 6 weeks of the index Pap test report date **Denominator**: N women 21 to 60 years of age with high grade Pap test result.	≥ 90% (CPAC)	CPAC 2016; Murphy et al. 2015 (CCO) Supporting literature: Duggan 2012: Delayed referral of a high-grade Pap test for >3 months reported as a source of failure in 13.2% of screening failures.	2.80
	B) Percentage of women with an ACG, ASC-H, HSIL, or more severe Pap test result who had follow-up colposcopy.	**Numerator**: Number of women who had a colposcopy within 90 days, 6 months, or 12 months of an ACG, ASC-H, HSIL, or more severe Pap test result **Denominator**: Number of women with an ACG, ASC-H, HSIL, or more severe Pap test result reported in a 12-month period.		Decker et al. 2015	3.69

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
	C) Proportion of women with abnormal Pap smear results undergoing colposcopy within 4 weeks.	**Numerator**: N women with abnormal Pap smear results undergoing colposcopy within 4 weeks **Denominator**: N women with abnormal Pap smear result		Bucchi et al. 2013	1.69
	D) Women with a Pap smear suggestive of carcinoma should be seen in a colposcopy clinic within 2 weeks of referral.	**Numerator**: N women with Pap smear suggestive of carcinoma seen for colposcopy within two weeks **Denominator**: N women with Pap smear suggestive of carcinoma		Bentley, 2012 ; NHS Scotland 2012; Supporting article: Fung-Kee-Fung 2010: Generally, less severe cytological findings should be followed up with colposcopy within 8 to 12 weeks, whereas more severe findings should be followed up within a shorter time frame. Supporting article: New Zealand Ministry of Health 2013: Women who have evidence of clinical suspicion of invasive carcinoma must receive a colposcopy or a gynecological appointment within the next 10 working days from when the colposcopy unit received the referral from the smear taker/referrer.	3.00

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
	E) Women whose smear test result is severe dyskaryosis, invasive or endocervical adenocarcinoma or where 'suspicion of malignancy' should been seen for colposcopy within 2 weeks of referral.	**Numerator**: N women whose smear test result is severe dyskaryosis, invasive endocervical adenocarcinoma or where there is "suspicion of malignancy" seen for colposcopy within two weeks of referral **Denominator**: N women whose smear test result is severe dyskaryosis, invasive endocervical adenocarcinoma or where there is "suspicion of malignancy"	93%	NHS Scotland 2012; Public Health England 2016 (target); Murphy et al. 2015 (CCO); NHS England West Midlands 2016	1.86
	F) Women with samples reported as glandular abnormality should be seen for colposcopy within four weeks of referral.	**Numerator**: N women with samples reported as glandular abnormality referred for colposcopy within four weeks of referral **Denominator**: N women with samples reported as glandular abnormality		NHS Scotland, 2012	1.51

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
	G) Women with moderate dyskaryosis, severe dyskaryosis and glandular abnormality should be seen at colposcopy within four weeks of referral.	**Numerator**: N women with moderate dyskaryosis, severe dyskaryosis and glandular abnormality seen for colposcopy within four weeks **Denominator**: N women with moderate dyskaryosis, severe dyskaryosis and glandular abnormality		NHS Scotland, 2012; NHS West Midlands 2016 (2-week target) Supporting article: New Zealand Ministry of Health 2013: Women who have high-grade cervical abnormalities, including glandular abnormalities, must receive a colposcopy appointment to be seen within the next 20 working days from when the colposcopy unit received the referral from the smear taker/referrer	1.60
	H) Women with HSIL should ideally be seen in a colposcopy clinic within 4 weeks of referral.	**Numerator**: N women with HSIL seen for colposcopy within four weeks **Denominator**: N women with HSIL		Bentley, 2012; Murphy et al. 2015 (CCO)	1.89
	I) Women with ASC-H or AGC should be seen in a colposcopy clinic within 6 weeks of referral.	**Numerator**: N women with ASC-H or AGC seen for colposcopy within 6 weeks of referral **Denominator**: N women with ASC-H or AGC		Bentley, 2012	2.66

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
8. Diagnostic colposcopy completion rate	Number of days at which the 90th percentile is reached for women with a high-grade Pap test result who had follow-up colposcopy.	Calculation has not yet been developed.		CPAC, 2016	1.77
9.Time to receipt of colposcopy/biopsy results	Proportion of women to receive colposcopy/biopsy results within 4 weeks from date of test.	**Numerator**: N women receiving colposcopy/biopsy results within 4 weeks from date of test **Denominator**: N women receiving colposcopy/biopsy		NHS England West Midlands, 2016	2.40
10. Time to treatment after first colposcopy	A) Women having definitive treatment for high grade CIN must be treated within eight weeks from first colposcopy appointment (pregnant women excluded).	**Numerator**: N women having treatment for high grade CIN within eight weeks from first colposcopy appointment **Denominator**: Total N women having treatment for high grade CIN	≥ 90%	NHS Scotland, 2012 Supporting article: New Zealand Ministry of Health 2013: Women with high-grade lesions are treated within eight weeks of histological confirmation. Target = 90%.	2.00

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
	B) Definitive treatment for high grade CIN within 4 weeks of the colposcopy clinic receiving a diagnostic biopsy report.	**Numerator**: N women having treatment for high grade CIN within four weeks of the colposcopy clinic receiving a diagnostic biopsy report **Denominator**: Total N women having treatment for high grade CIN		NHS England West Midlands, 2016	1.86
11.Positive predictive value of cervical screening test	A) Percentage of Pap tests with ASC-H/HSIL+ results investigated with a biopsy that had a histological diagnosis of ASC-H/HSIL+ within 12-months of the Pap test for women 21 to 69 years of age.	**Numerator**: Number of Pap tests with a with an ASC-H, HSIL, or more severe result with histological confirmation of CIN 2 or CIN 3 within 12 months of the Pap test **Denominator**: Number of Pap tests with an ASC-H, HSIL, or more severe result that had histological work-up within 12 months of the ASC-H, HSIL, or more severe Pap test	≥ 65%	CPAC 2016; Decker et al. 2015; IARC 2008; NCSS 2014; Arybyn 2014; Zappa 2009; c-QUIP 2013 (p.11) (no calculation) Cancer Council Australia also recommends PPV ≥ 65%	3.03

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
	B) PPV of referral to colposcopy because of ASC-US+ cytology for histologically confirmed CIN2+.	**Numerator**: number of the latter who had CIN2 or more severe detected (histologically confirmed – most severe lesion within six months from cytology considered). **Denominator**: number of women who underwent colposcopy because of ASC-US or more severe cytology		Ronco et al. 2015	2.80
12.Specificity of screening test	A) Calculate overall, and separately by: a. cytology (<ASC-US, <LSIL, <HSIL) b. histology (CIN1+, CIN2+, CIN3+, Invasive Ca) c. initial and subsequent screening	**Numerator**: N screened women not referred for colposcopy **Denominator**: N screened women who had no histologically confirmed CIN+		IARC 2008; NCSS 2014; Arbyn et al. 2010	1.31

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
	B) Calculate overall, and separately by: a. cytology (<ASC-US, <LSIL, <HSIL) b. histology (CIN1+, CIN2+, CIN3+, Invasive Ca) c. initial and subsequent screening	**Numerator**: N screened women with normal screening test results **Denominator**: N screened women who had no histologically confirmed CIN+ Can use this formula for approximation: **Numerator**: N women with negative screening test results **Denominator**: (N screened women – N women with confirmed CIN).		IARC 2008; NCSS 2014; Arbyn et al. 2010	1.49
13.Histological investigation	A) Percentage of women with a high-grade Pap test result (ASC-H or HSIL+) who had a colposcopy and histology within 12 months of the Pap test.	**Numerator**: Number of women who had a biopsy within 12 months of an ASC-H, HSIL, or more severe Pap test result. **Denominator**: Number of women who had a colposcopy within 12 months of a Pap test with an ASC-H, HSIL, or more severe Pap test result.		CPAC 2016; Decker et al. 2015	2.83

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
	B) Proportion of women with Pap smear results of HSIL and carcinoma undergoing biopsy.	**Numerator**: N women with Pap smear results of HSIL and carcinoma undergoing biopsy **Denominator**: N women with Pap smear results of HSIL and carcinoma		Bucchi et al. 2013	3.09
	C) Performance of a biopsy (punch or excision) in more than 95% of women with high grade cytological abnormalities (excluding pregnant women).	**Numerator**: N biopsies taken in women with high grade cytological abnormalities **Denominator**: N women with high grade cytological abnormalities	95% (CCA); >90% (Nooh)	Cancer Council Australia, 2016 (p. 189); c-QUIP 2013 (p.11); Nooh et al. 2007	2.63
14. Biopsy quality	Biopsies should be suitable for histological investigation.	**Numerator**: N biopsies taken at colposcopy suitable for histological investigation **Denominator**: N biopsies taken at colposcopy	90%	Public Health England 2016, Cancer Council Australia 2016 (p.189); c-QUIP 2013 (p.11)	2.51

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
15. Colposcopy-histology concordance	Proportion of women with colposcopic findings interpreted as abnormal-grade 2 and suspected invasive cancer diagnosed with CIN3 and carcinoma.	**Numerator:** N women with colposcopic findings interpreted as abnormal-grade 2 and suspected invasive cancer diagnosed with CIN3 and carcinoma **Denominator:** N women with colposcopic findings interpreted as abnormal-grade 2 and suspected invasive cancer	>80% (CCO)	Bucchi et al. 2013, CCO 2015	2.71
16. Biopsies conducted after an abnormal low-grade Pap test	This indicator was suggested at the first colposcopy quality indicators working group meeting.	**Numerator:** N women receiving biopsy at first visit to colposcopy after an abnormal low-grade Pap test result **Denominator:** N women having colposcopy after an abnormal low-grade Pap test result		Expert opinion	2.74
17. Treatment at first visit after CIN 2/3 or GIN	Women treated at first visit should have evidence of CIN 2/3 or cGIN on histology.	**Numerator**: N women treated at first visit who have evidence of CIN 2/3 or cGIN on histology **Denominator**: N women treated at first visit	≥ 90% >80% (CCA)	NHS Scotland 2012; Public Health England 2016; Cancer Council Australia 2016; C-QuIP 2013	2.71

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
18. Treatment at first visit to colposcopy for low-grade dyskaryosis	Treatment at first visit to colposcopy for a referral of borderline or low-grade dyskaryosis should not be performed.	**Numerator**: N women treated at first visit to colposcopy for low-grade dyskaryosis **Denominator**: N women receiving colposcopy for low-grade dyskaryosis		Public Health England 2016 Supporting article: New Zealand Ministry of Health 2013: The number of women who are treated with low-grade lesions (less than CIN2 on histology) is minimized. Note that treatment is not recommended for women with low-grade abnormalities. Number of women treated with less than CIN2 eventual diagnosis on pathology should be minimized (C-QuIP 2013)	3.09
19. Percentage of treatments completed as an outpatient versus inpatient	This indicator was suggested at the first colposcopy quality indicators working group meeting.	**Numerator:** Number of treatments completed as an outpatient **Denominator**: Number of treatments completed as an outpatient + Number of treatments completed as an inpatient		Expert opinion	2.80
20. Follow-up after treatment	A) Women should have annual follow up for five years after treatment of cGIN or microinvasive managed conservatively before returning to routine screening.	**Numerator**: N women with annual follow up for five years after treatment of cGIN **Denominator**: N women with treatment of cCIN		NHS Scotland 2012	2.43

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
	B) Follow up of women who are treated for high grade histologic abnormality should be maximized, with at least 90% seen within 15 months of treatment (Cancer Council Australia, 2016).	**Numerator**: N women with follow-up within 15 months of treatment for high grade histological abnormality **Denominator**: N women with treatment for high grade histological abnormality	≥90% (CCA)	Cancer Council Australia, 2016; .	2.57
	C) Proportion of women who have at least one test within 9 months of treatment for high-grade histologically confirmed abnormality (c-QuIP 2013).	**Numerator**: Number of women who have at least one test within 9 months of treatment for high-grade histologically confirmed abnormality **Denominator:** Number of women treated for histologically confirmed high-grade lesion		C-QuIP 2013	3.34

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
21. Return to routine screening	Women should have annual follow-up for five years after treatment of cGIN or microinvasive managed conservatively before returning to routine screening.	**Numerator**: N women with negative cytology and biopsy results returning to routine screening 5 years after treatment **Denominator**: N women receiving treatment		NHS Scotland 2012 The Society of Canadian Colposcopists (2012) recommend either one of the following options with regards to discharge to routine screening: 1. Women should be followed with cytology testing and colposcopy at 6-month intervals for 2 visits. If both cytology and any biopsies are negative, they will then return to screening per provincial/territorial guidelines. (II-2B) 2. HPV testing at 6 months combined with cytology testing is acceptable. If both are negative, women may return to screening per provincial/ territorial guidelines. (II-2B)	1.69
22. Length of time women stay in a colposcopy clinic rotation	This indicator measures whether exit planning for transfer to regular screening services is appropriate. This indicator was suggested at the first colposcopy quality indicators working group meeting.	Calculation has not yet been developed.		Expert opinion	1.29

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
23. Complications after treatment	The proportion of cases with complications after treatment.	**Numerator:** N women with complications after treatment **Denominator**: N women receiving treatment	<5%	CCO 2015; RANZCOG	1.03
24. Re-admission due to complications after treatment	The proportion of cases admitted in as patients because of treatment complications.	**Numerator**: N women admitted as patients due to treatment complications **Denominator**: N women receiving treatment	<2%	Public Health England 2016; Nooh et al. 2007; CCO 2015; RANZCOG	0.94
25. Residual disease after treatment	A) The proportion of confirmed high grade histological abnormalities should not exceed 5% within 15 months of treatment. (CCA 2016)	**Numerator**: N women with confirmed high grade histological abnormalities within 15 months of treatment **Denominator**: N women receiving treatment	<5% (CCA)	Cancer Council Australia 2016, Murphy et al. 2015 (CCO); RANZCOG.	1.51
	B) Proportion of women with high-grade histology within 12 months of treatment for high-grade histology (c-QuIP 2013).	**Numerator**: Number of women with high-grade histology within 12 months of treatment for high-grade histology **Denominator**: Number of women receiving treatment for high-grade histologically confirmed lesion	<5%	c-QuIP 2013	2.20

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
26. Retreatment rate	Proportion of cases retreated within n months of first treatment.	**Numerator:** N women retreated within n months of first treatment **Denominator:** N women receiving treatment	<3%	Murphy et al. 2015 (CCO); RANZCOG	2.57
27. Colposcopy after abnormal cytology in women with previous hysterectomy	If HPV is positive and/or cytology > mild dyskaryosis, then patients require referral to colposcopy.	**Numerator**: N women referred to colposcopy after HPV+ result or cytology > mild dyskaryosis following hysterectomy **Denominator**: N women with HPV+ result or cytology > mild dyskaryosis following hysterectomy		NHS Scotland 2012	2.26
28. Colposcopy in women under 30 with positive HPV result and normal cytology	Women less than 30 years old who are HR-HPV positive and have normal cytology should be followed as per provincial/territorial guidelines; colposcopy is not required.	**Numerator**: N women under 30 who are HPV+ with normal cytology undergoing colposcopy **Denominator**: N women under 30 and HPV+ and normal cytology		Bentley 2012	2.37

Indicator	Context/Background	Calculation	Target	Source(s) and Notes	Score (out of 4)
29. Test of cure and associated HPV testing	This indicator was suggested at the first colposcopy quality indicators working group meeting.	**Numerator:** N women having an HPV test for cure n months after treatment cervical abnormalities **Denominator**: N women receiving treatment for cervical abnormalities		Expert opinion Note: The calculation for this indicator was not derived from the literature and was developed by CPAC for the purposes of scoring.	3.23
30. Management of pregnant women with high abnormal cytology result	Pregnant women with HSIL, ASC-H, or AGC should be referred for colposcopy within 4 weeks.	**Numerator**: N pregnant women with HSIL, ASC-H or AGC referred to colposcopy within 4 weeks **Denominator**: N pregnant women with HSIL, ASC-H or AGC		Bentley 2012 Related article: Kyrgiou 2006 - During pregnancy, the need for colposcopy may arise. Conservative management and surveillance could be adopted even when the index smear indicates high grade SIL with repeat cytology and colposcopy every 2–3 months antenatally aiming to exclude a progression to microinvasive or invasive cervical cancer.	2.06

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