

Colonoscopy Result of
The Specialists Surgery and Endoscopy Centre
2016-2018

Prepared by

Dr. Lam WF Percy, MBBS (HK), FRCSEd, FRACS, FCSHK, FHKAM (Surgery)

Mr. Lam CF Sam, BSc (CUHK)

11 November 2020

Table of Content

1. Introduction	2
1.1. Survey objective	2
2. Methodology and Samples	3
2.1. Survey Period	3
2.2. Sample Frame.....	3
2.3. Methodology	3
3. Survey Result	4
3.1. Colonoscopy procedure caseload from 2016 to 2018	4
3.2. The qualities of bowel preparation	9
3.3. The Caecal intubation rate	11
3.3.1. The Caecal Intubation rate	11
3.3.2. The Ileal Intubation rate	15
3.4. The morbidity and operative mortality rate	19
3.4.1. The operative mortality rate	19
3.4.2. The perforation rate	19
3.4.3. The post-polypectomy bleeding rate	19
3.4.4. Other major complications.....	23
3.5. Polyp.....	24
3.5.1. The polyp detection rate	24
3.6. Adenoma	29
3.6.1. The adenoma detection rate (ADR) in overall cases	29
3.6.2. The adenoma detection rate in overall cases by procedure year.....	29
3.6.3. The adenoma detection rate in overall cases by gender group.....	33
3.6.4. The chance of having an adenoma and no. of adenoma detected during each colonoscopy procedure	34
3.6.5. The adenoma detection rate by age group	36
3.6.6. The size of adenoma discovered	37
3.6.7. The location of adenoma discovered	38
3.7. Cancer.....	39
3.7.1. Cancer detection rate	39
3.7.2. Cancer location	42
4. Discussion and conclusion	45
4.1. Discussion and conclusion.....	45

1. Introduction

The Specialists Surgery and Endoscopy Centre (**TSSEC**) has been providing day-case colonoscopy service to public since June 2006. We audit our colonoscopy result periodically as a performance assessment of our colonoscopy centre and our endoscopists in order to keep up with international quality standards and to look for areas for improvement, and reviewing the findings of colonoscopy especially on adenoma detection rate and colorectal cancer rate in our series. In year 2016, TSSEC published a report analysed the colonoscopy result from 2006 to 2015. To follow the last analysis, colonoscopy results from 2016 to 2018 were analysed and compared with the result of our last audit.

1.1. Survey objectives

The objectives of the survey are to gauge the performance of TSSEC on colonoscopy and patients' health condition of lower digestive system:

1. The frequency of procedure from 2016 to 2018 (section 3.1);
2. The qualities of bowel preparation (section 3.2);
3. The caecal and Ileal intubation rate (section 3.3);
4. The morbidity and mortality rate (section 3.4);
5. The polyp detection rate (section 3.5);
6. The adenoma detection rate (section 3.6); and
7. The cancer detection rate (section 3.7).

2. Methodology and Samples

2.1. Survey Period

The period of the study was from 1 January 2016 to 31 December 2018.

2.2. Sample Frame

All colonoscopy cases performed inside TSSEC within the survey period were included in the report.

Full list of patients conducted colonoscopy examination in TSSEC in the survey period were exported from our endoscopy reporting system. A total of 16790 cases were exported. After screening, 51 cases belonged to suspected post-polypectomy bleeding cases while 21 cases were sigmoidoscopy cases, which both of them were not included for analysis. Moreover, 114 cases were not suitable as they are invalid entries. Hence, a total of 16604 cases were included for analysis.

2.3. Methodology

This study is a retrospective study for all colonoscopy cases done in TSSEC between 2016 and 2018.

All information was gathered from three main sources:

1. Colonoscopy report prepared by TSSEC after procedure
2. Colonoscopy diagram drafted by clinical staff in TSSEC during procedure
3. Histopathology report prepared by a 3rd party laboratory (only for cases that had specimen sent to laboratory)

For colonoscopy reports, they were exported directly from our endoscopy reporting system to reduce the amount of typos. For the other two sources, hardcopy records were reviewed and inputted by our research assistants. Data processing and analysis was done by TSSEC using Excel and SPSS. International standards from American Society for Gastrointestinal Endoscopy (ASGE) ¹ and European Society for Gastrointestinal Endoscopy (ESGE)² were used as a reference for comparison with our performance.

¹ ASGE.(2014). Quality indicators for GI endoscopic procedures - complete set. https://www.asge.org/docs/default-source/education/practice_guidelines/doc-2014_quality_in_endoscopy_set.pdf

² ESGE.(2019). Performance measures for small-bowel endoscopy: a European Society of Gastrointestinal Endoscopy (ESGE) Quality Improvement Initiative. <https://www.esge.com/performance-measures-for-small-bowel-endoscopy/>

3. Survey Result

3.1. Colonoscopy procedure caseload from 2016 to 2018

The total number of colonoscopy procedures done from 2016 to 2018 was 16604. The number of procedures done increased from 4989 in 2016 to 6120 in 2018.

Table 3.1.1 Number of colonoscopy procedures from 2016 to 2018 (N=16604)

Year	No. of procedure	Annual change	Percentage change
2016	4989	701 ⁽¹⁾	+14.1%
2017	5495	506	+9.2%
2018	6120	625	+10.2%
Total	16604		

(1) 4288 colonoscopy procedures done in 2015

The gender ratio reflects the increasing proportion of female patients over the past few years. It was 50.3% in year 2015 and that increased to 54.0% in year 2018.

Table 3.1.2 Number of colonoscopy procedures from 2016 to 2018 by gender (N=16604)

Year	Male		Female	
	No. of procedure	Percentage	No. of procedure	Percentage
2016	2389	47.9%	2600	52.1%
2017	2571	46.8%	2924	53.2%
2018	2813	46.0%	3307	54.0%
Total	7773	46.8%	8831	53.2%

From 2016 to 2018, 6 endoscopists performed colonoscopy in TSSEC. During this period, 39.3% of the cases were conducted by Dr. A, followed by Dr. B (33.2%) and Dr. C (21.2%). The amount of colonoscopy cases done by different endoscopists varies from one to another mainly because certain endoscopists joined or leave our centre at different time during this study period.

Table 3.1.3 Number of colonoscopy procedures from 2016 to 2018 by endoscopist (N=16604)

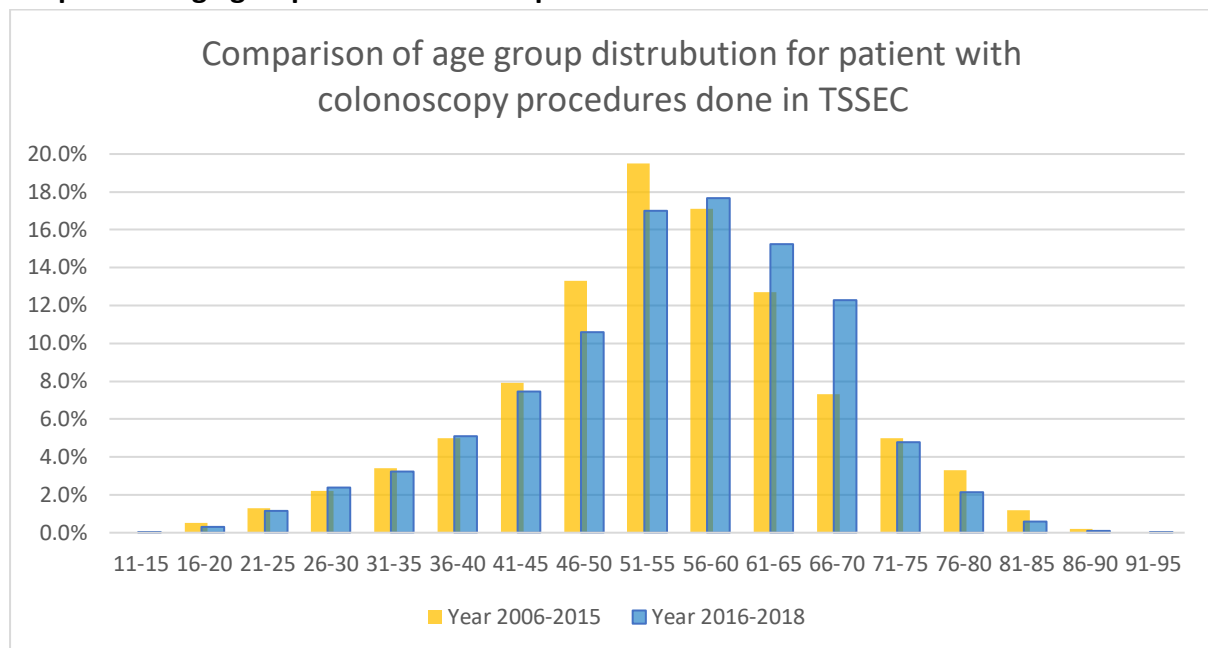
Endoscopist	2016		2017		2018		Total	
	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage
Dr. A	2431	48.8%	2316	42.1%	1777	29.0%	6524	39.3%
Dr. B	1848	37.0%	1737	31.6%	1933	31.6%	5518	33.2%
Dr. C	703	14.1%	1434	26.1%	1390	22.7%	3527	21.2%
Dr. D	0	0.0%	0	0.0%	930	15.2%	930	5.6%
Dr. E	0	0.0%	0	0.0%	88	1.4%	88	0.5%
Dr. F	7	0.1%	8	0.1%	2	0.0%	17	0.1%
Total	4989	100.0%	5495	100.0%	6120	100.0%	16604	100.0%

The largest age group conducted colonoscopy procedure from 2016 to 2018 was “age 56 – 60” (17.7%). Compared with year 2006 to 2015, the percentage of patient in the age group “age 66 - 70” and “age 61 - 65” increased by 5.0% and 2.5% respectively. On the other hand, the percentage of patient in the age group “age 46 - 50” and “age 51 - 55” decreased 2.7% and 2.5% respectively.

Table 3.1.4 Number of colonoscopy procedures from 2016 to 2018 by age group (N=16604)

Age Group	2006-2015		2016-2018		Percentage change
	No. of procedure	Percentage	No. of procedure	Percentage	
age 11 - 15	9	0.04%	2	0.01%	-0.03%
age 16 - 20	98	0.47%	50	0.30%	-0.17%
age 21 - 25	282	1.34%	189	1.14%	-0.20%
age 26 - 30	471	2.24%	397	2.39%	0.15%
age 31 - 35	707	3.37%	535	3.22%	-0.14%
age 36 - 40	1056	5.03%	847	5.10%	0.07%
age 41 - 45	1651	7.86%	1239	7.46%	-0.40%
age 46 - 50	2794	13.30%	1758	10.59%	-2.72%
age 51 - 55	4101	19.53%	2825	17.01%	-2.51%
age 56 - 60	3597	17.13%	2932	17.66%	0.53%
age 61 - 65	2671	12.72%	2533	15.26%	2.54%
age 66 - 70	1527	7.27%	2038	12.27%	5.00%
age 71 - 75	1054	5.02%	791	4.76%	-0.25%
age 76 - 80	687	3.27%	352	2.12%	-1.15%
age 81 - 85	244	1.16%	97	0.58%	-0.58%
age 86 - 90	51	0.24%	18	0.11%	-0.13%
age 91 - 95	3	0.01%	1	0.01%	-0.01%
Total	21003	100.0%	16604	100.0%	

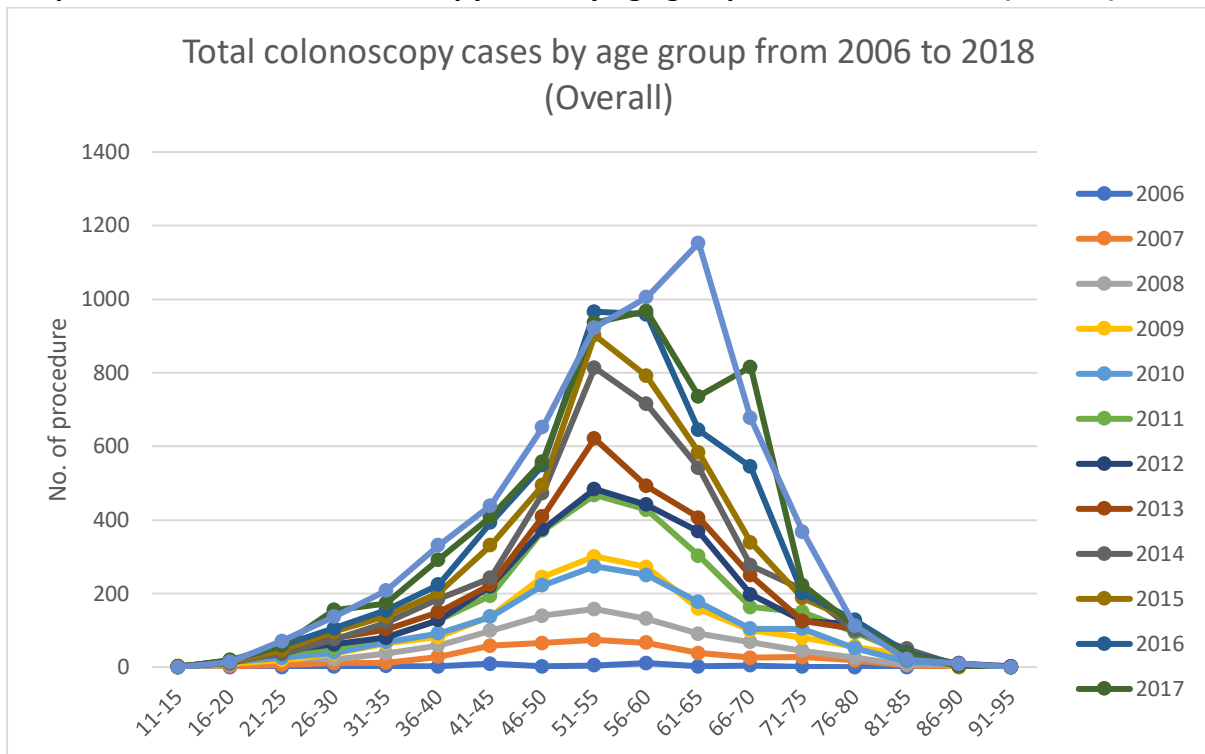
Graph 3.1.1 Age group distribution comparison



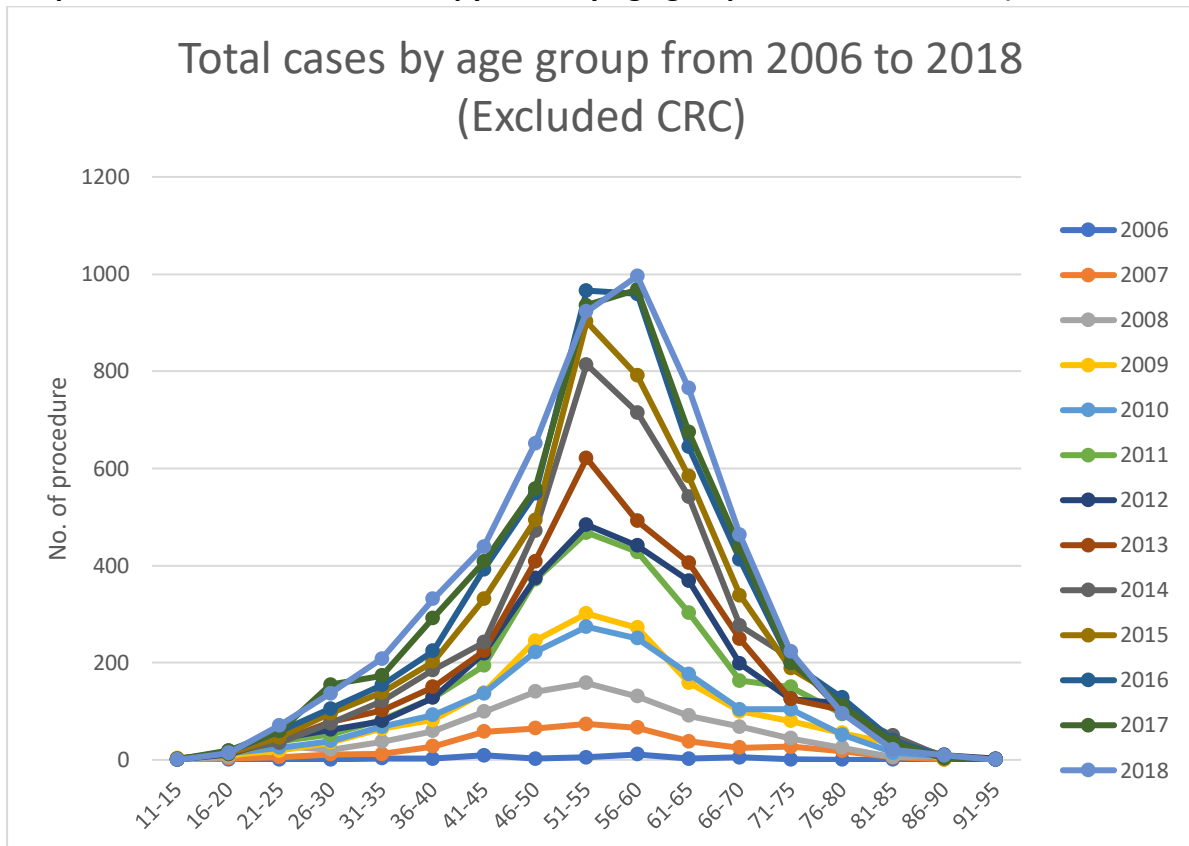
Note: Levene’s test for equal variance showed the two samples had equal variance ($p=0.664$), T-test for equality of means showed that the mean age for 2016 to 2018 was higher than that in 2006 to 2015 ($p<0.001$)

Graph 3.1.1 shown a small shift to the right hand side for the age group distribution. Colorectal Cancer Screening Program (CRC) was one of the reasons for that change. From the result of graph 3.1.2 to 3.1.5, when CRC cases are excluded, age 51-60 was the largest patient group for most of the years. Moreover, the age group distribution was almost the same since 2006 when we excluded CRC cases. (The variation is larger for year 2006 to 2008 due to the small number of cases)

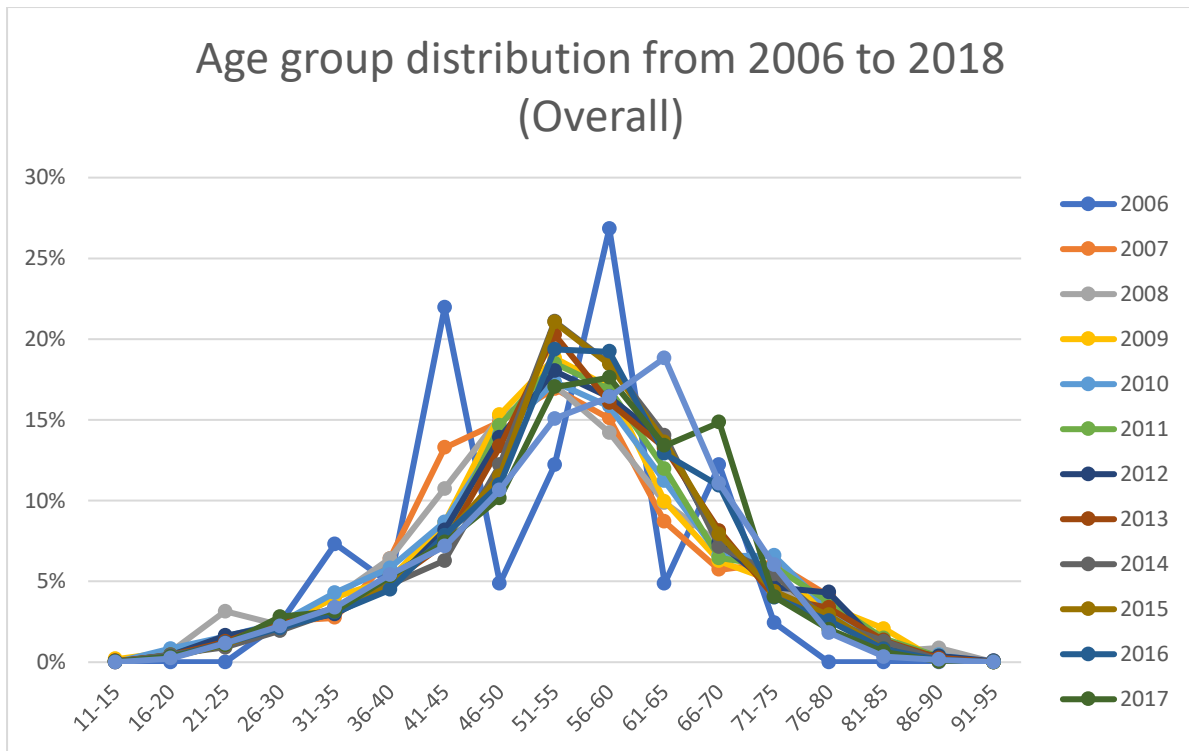
Graph 3.1.2 Number of colonoscopy cases by age group from 2006 to 2018 (Overall)



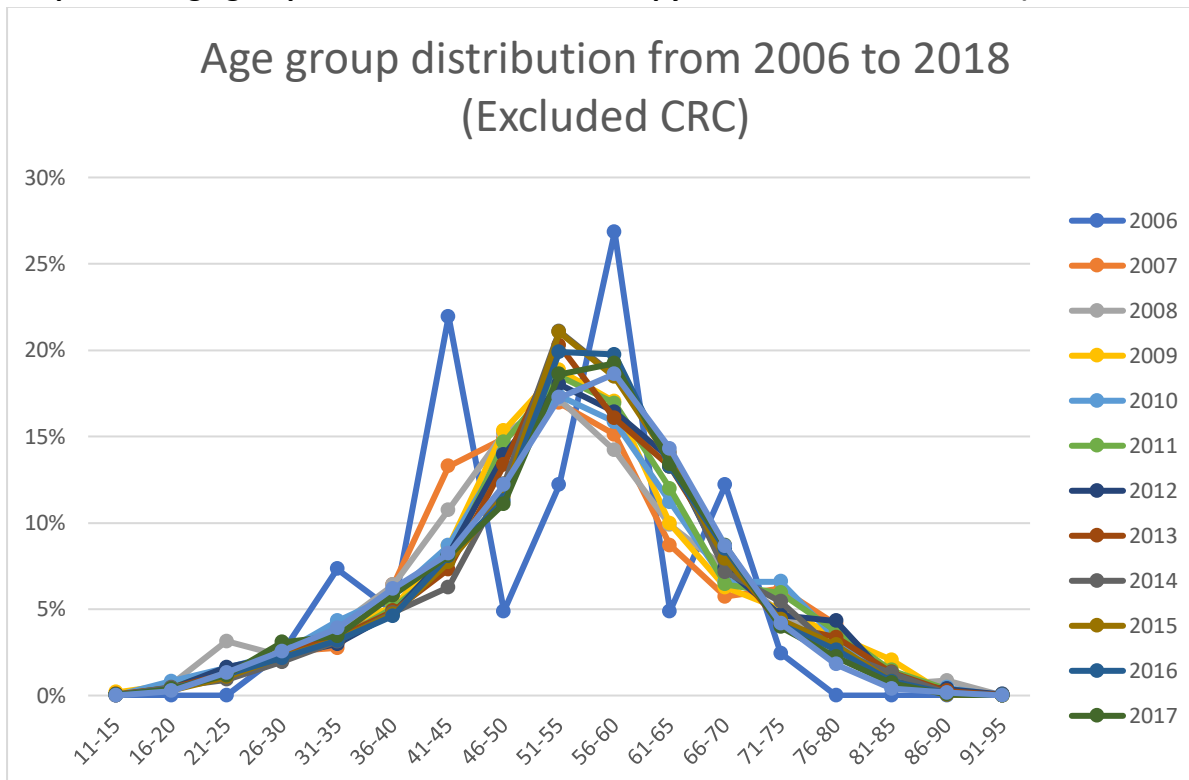
Graph 3.1.3 Number of colonoscopy cases by age group from 2006 to 2018 (Excluded CRC)



Graph 3.1.4 Age group distribution for colonoscopy cases from 2006 to 2018 (Overall)



Graph 3.1.5 Age group distribution for colonoscopy cases from 2006 to 2018 (Excluded CRC)



3.2. The qualities of bowel preparation

It is to clean and empty the colon and rectum for colonoscopy examination, which includes a series of communication between our staff and patient involved on diet and drug adjustment, choice of bowel preparation solution, timing and method of solution consumption and precaution. A satisfactory bowel preparation helped doctors to view the lining and interior structure of the colon clearly and so thoroughly examined it and is a part of the quality of colonoscopy examination. It also assessed the efficiency of our staff communication and the appropriateness of our workflow on bowel preparation to our patient. According to the ESGE guideline in 2019, the target standard for the percentage of patients receiving bowel preparation instruction appropriately was 95%. We defined our classification “Good” to “Satisfactory after irrigation” as receiving appropriate bowel preparation while “Fair” and “poor” as non-appropriate bowel preparation.

Reference table of TSSEC classification to ESGE classification on bowel preparation standard:

TSSEC classification	ESGE classification
(i) Good - Almost no irrigation with full assessment	Receive bowel preparation instruction appropriately
(ii) Normal - Minimal irrigation with full assessment	
(iii) Satisfactory - Little irrigation with full assessment.	
(iv) Satisfactory after irrigation - Moderate irrigation to achieve full assessment.	
(v) Fair - Taking long time and copious irrigation to achieve full assessment.	Receive bowel preparation instruction inappropriately
(vi) Poor - Cannot have completed assessment nor be cleared up with irrigation; abandoned procedure was needed.	

In TSSEC, 99.6% of the patients having colonoscopy procedures conducted from 2016 to 2018 receiving bowel preparation instruction appropriately. This percentage reached 99.9% in both 2017 and 2018. The difference between the year 2016 and the other two were significant by Tukey's post hoc test ($p < 0.001$).

Table 3.2.1 The quality of bowel preparation by procedure year (N=16604)

Quality of bowel preparation	2016		2017		2018		Total	
	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage
Good	2	0.04%	3	0.05%	1	0.02%	6	0.04%
Normal	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Satisfactory	310	6.21%	99	1.80%	1	0.02%	410	2.47%
Satisfactory After Irrigation	4618	92.56%	5388	98.05%	6112	99.87%	16118	97.07%
<i>Subtotal: Appropriate bowel preparation</i>	<i>4930</i>	<i>98.82%</i>	<i>5490</i>	<i>99.91%</i>	<i>6114</i>	<i>99.90%</i>	<i>16534</i>	<i>99.58%</i>
Fair	49	0.98%	2	0.04%	1	0.02%	52	0.31%
Poor	10	0.20%	3	0.05%	5	0.08%	18	0.11%
<i>Subtotal: Inappropriate bowel preparation</i>	<i>59</i>	<i>1.18%</i>	<i>5</i>	<i>0.09%</i>	<i>6</i>	<i>0.10%</i>	<i>70</i>	<i>0.42%</i>
Total	4989	100.0%	5495	100.0%	6120	100.0%	16604	100.0%

Note: Two-way ANOVA shows a significant difference between years and appropriate bowel preparation ($p < 0.001$)

3.3. The Caecal intubation rate

The caecal intubation rate is the reach-the-caecum rate (proximal end of colon) in a colonoscopy assessment, which is an indication of a complete assessment of colon or a successful colonoscopy, is one of the assessment criteria of endoscopist's technical competency. It was suggested by the guidelines from ASGE in 2014 that it should be achieved over 90%. Cancer obstruction is usually excluded in view of a quality assessment.

3.3.1 The Caecal intubation rate

Overall, the success rate of caecal intubation was 99.3%, only 115 out of 16,604 cases were failed (see table 3.3.1.1). The success rate increased to 99.98% when it excluded cancer obstruction cases (see table 3.3.1.3). For the cancer cases, the endoscopy can pass through cancer to reach caecum in 73.4% of cases (see table 3.3.1.2).

Table 3.3.1.1 The caecal intubation rate (Overall) (N=16604)

	No. of procedure	Percentage
Fail	115	0.7%
Success	16489	99.3%
Total	16604	100.0%

Table 3.3.1.2 The caecal intubation rate (Cancer cases only) (N=421)

	No. of procedure	Percentage
Fail	112	26.6%
Success	309	73.4%
Total	421	100.0%

Table 3.3.1.3 The caecal intubation rate (Excluding cancer obstruction cases) (N=16492)

	No. of procedure	Percentage
Fail	3 ⁽¹⁾	0.02%
Success	16489	99.98%
Total	16492 ⁽²⁾	100.0%

(1) Overall no. of procedure fails to reach caecum (N=115) deducted cancer obstruction cases (N=112)

(2) Total cases (N=16604) deducted cancer obstruction cases (N=112)

When we analysed the data by endoscopist, Dr. B (99.7%) and Dr. A (99.4%) also has success rate of over 99%. The sample size is too small to make any meaningful conclusions for Dr. F.

Table 3.3.1.4 The caecal intubation rate by endoscopist (Overall) (N=16604)

Endoscopist	Fail		Success		Total
	No. of procedure	Percentage	No. of procedure	Percentage	
Dr. A	37	0.6%	6487	99.4%	6524
Dr. B	18	0.3%	5500	99.7%	5518
Dr. C	46	1.3%	3481	98.7%	3527
Dr. D	13	1.4%	917	98.6%	930
Dr. E	1	1.1%	87	98.9%	88
Dr. F	0	0.0%	17	100.0%	17
Total	115	0.7%	16489	99.3%	16604

Note: Two-way ANOVA show significant difference between endoscopists ($p < 0.001$)

Within group comparison was then made, result shown that Dr. A and Dr. B had success rate significantly higher than Dr. C and Dr. D.

When cancer obstruction cases were excluded, most endoscopists had caecal intubation rate of 100.0% except Dr. C (99.9%). We further investigate the reasons for the 3 failed caecal intubation cases. The reasons are

1. Fibrotic stricture at proximal transverse colon;
2. Severe looping in transverse colon; and
3. Poor bowel preparation.

Table 3.3.1.5 The caecal intubation rate by endoscopist (Excluding cancer obstruction cases) (N=16492)

Endoscopist	Fail		Success		Total
	No. of procedure	Percentage	No. of procedure	Percentage	
Dr. A	0	0.00%	6487	100.00%	6487
Dr. B	0	0.00%	5500	100.00%	5500
Dr. C	3	0.09%	3481	99.91%	3484
Dr. D	0	0.00%	917	100.00%	917
Dr. E	0	0.00%	87	100.00%	87
Dr. F	0	0.00%	17	100.00%	17
Total	3	0.02%	16489	99.98%	16492

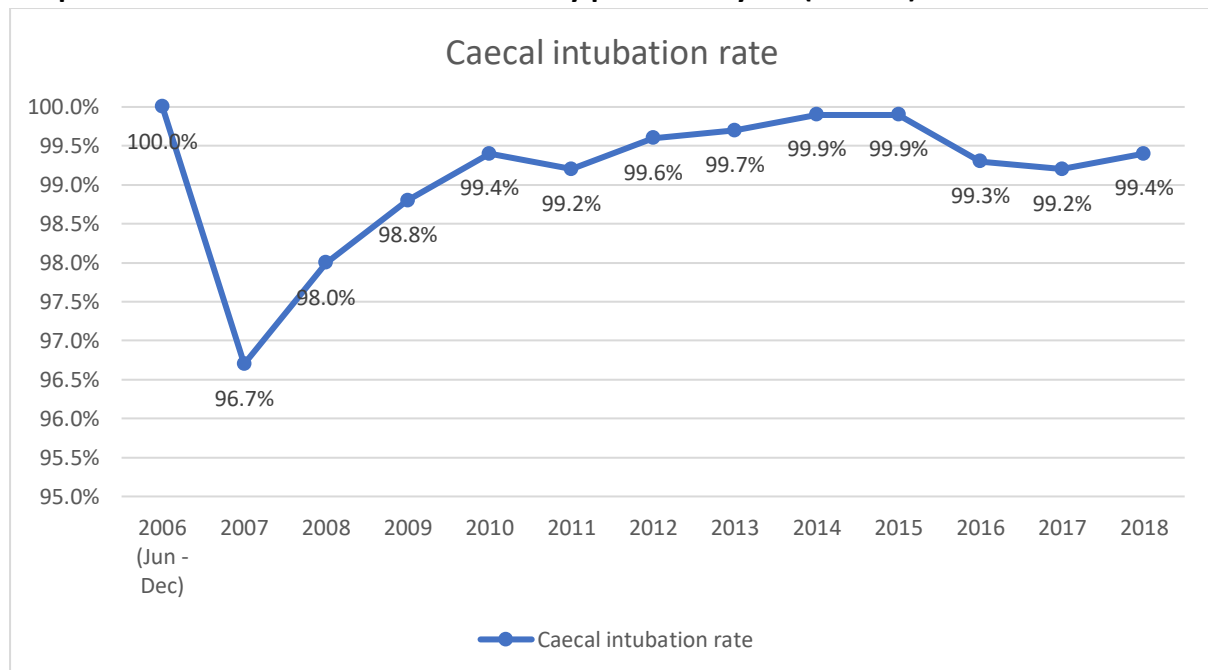
The caecal intubation rate between the year 2016 and 2018 ranged from 99.2% to 99.3%. Results have shown that all our TSSEC endoscopists had caecal intubation rate over 99.0% for the past 9 years, which higher than the target standard (90.0%) suggested by ASGE in 2014.

Table 3.3.1.6 The caecal intubation rate by procedure year (Overall) (N=16604)

Year	Fail		Success		Total	
	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage
2016	34	0.7%	4955	99.3%	4989	100.0%
2017	42	0.8%	5453	99.2%	5495	100.0%
2018	39	0.6%	6081	99.4%	6120	100.0%
Total	115	0.7%	16489	99.3%	16604	100.0%

Note: Chi-square test show no significant difference between years (p=0.707)

Graph 3.3.1.1 The caecal intubation rate by procedure year (Overall)



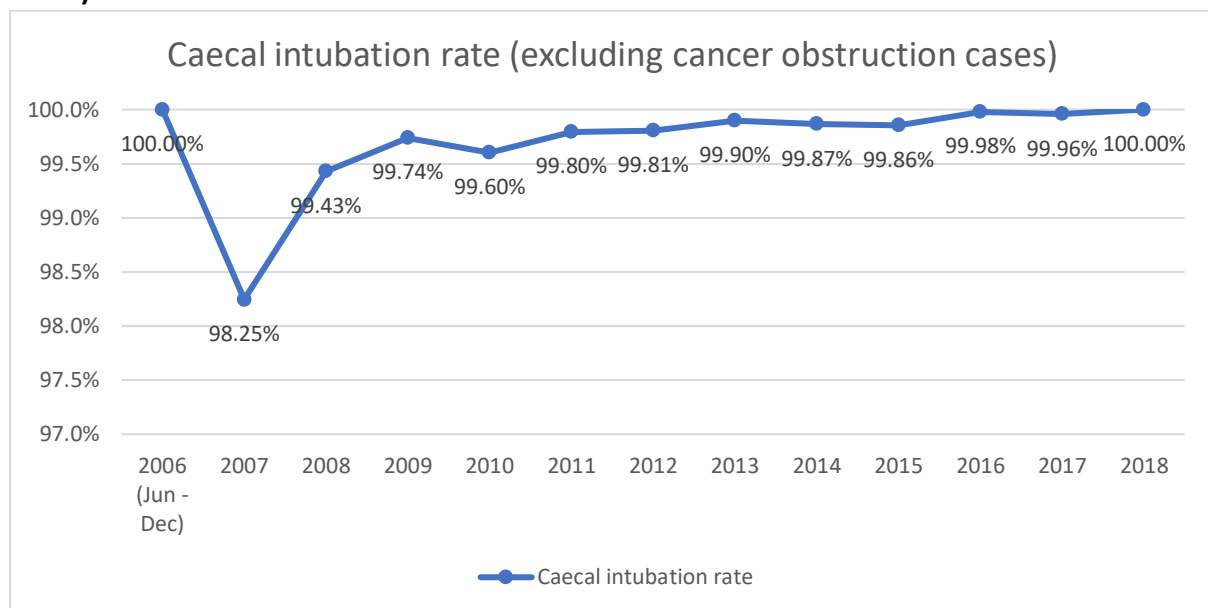
Cancer obstruction was one of the common reasons for failure in caecal intubation. However, failure due to obstructing cancer was not related to technical assessment. When cancer cases are ignored in our study, the failure rates were then largely reduced. Only 3 cases failed to reach caecum during the period.

Table 3.3.1.7 The caecal intubation rate by procedure year (Excluding cancer obstruction cases) (N=16492)

Year	Fail		Success		Total		Cancer obstruction case
	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage	
2016	1	0.02%	4955	99.98%	4956	100.0%	33
2017	2	0.04%	5453	99.96%	5455	100.0%	40
2018	0	0.0%	6081	100.0%	6081	100.0%	39
Total	3	0.02%	16489	99.98%	16492	100.0%	112

Note: Chi-square test show no significant difference between years (p=0.343)

Graph 3.3.1.2 The caecal intubation rate by procedure year (Excluding cancer obstruction cases)



3.3.2. The Ileal Intubation rate

The success rate of ileal intubation was 99.2%, only 135 out of 16,604 cases were failed to be advanced to ileum (see table 3.3.2.1). The ileal intubation rate increased to be 99.9% when it excluded cancer obstruction cases (see table 3.3.2.3). For the cancer cases, the ileal intubation rate was 72.7% (see table 3.3.2.2).

Table 3.3.2.1 The Ileal intubation rate (Overall) (N=16604)

	No. of procedure	Percentage
Fail	135	0.8%
Success	16469	99.2%
Total	16604	100.0%

Table 3.3.2.2 The Ileal intubation rate (Cancer cases only) (N=421)

	No. of procedure	Percentage
Fail	115	27.3%
Success	306	72.7%
Total	421	100.0%

Table 3.3.2.3 The Ileal intubation rate (Excluding cancer obstruction cases) (N=16489)

	No. of procedure	Percentage
Fail	20 ⁽¹⁾	0.12%
Success	16469	99.88%
Total	16489 ⁽²⁾	100.0%

(1) Overall no. of procedure fail to reach ileum (N=135) deducted cancer obstruction cases (N=115)

(2) Total cases (N=16604) deducted cancer obstruction cases (N=115)

Table 3.3.2.4 The ileal intubation rate by endoscopist (Overall) (N=16604)

Endoscopist	Fail		Success		Total
	No. of procedure	Percentage	No. of procedure	Percentage	
Dr. A	43	0.7%	6481	99.3%	6524
Dr. B	20	0.4%	5498	99.6%	5518
Dr. C	56	1.6%	3471	98.4%	3527
Dr. D	13	1.4%	917	98.6%	930
Dr. E	2	2.3%	86	97.7%	88
Dr. F	1	5.9%	16	94.1%	17
Total	135	0.8%	16469	99.2%	16604

Note: Two-way ANOVA show a significant difference between endoscopists ($p < 0.001$)

When we analysed the data by endoscopist, Dr. B (99.6%) and Dr. A (99.3%) both had ileal intubation rate of over 99%.

After we ignored cancer obstruction cases, most endoscopists had the ileal intubation rate of 99.5% or above except Dr. F.

Table 3.3.2.5 The ileal intubation rate by endoscopist (Excluding cancer obstruction cases) (N=16489)

Endoscopist	Fail		Success		Total
	No. of procedure	Percentage	No. of procedure	Percentage	
Dr. A	6	0.09%	6481	99.91%	6487
Dr. B	1	0.02%	5498	99.98%	5499
Dr. C	12	0.34%	3471	99.65%	3483
Dr. D	0	0.00%	917	100.00%	917
Dr. E	0	0.00%	86	100.00%	86
Dr. F	1	5.88%	16	94.12%	17
Total	20	0.12%	16469	99.88%	16489

Note: Two-way ANOVA show significant difference between endoscopists ($p < 0.001$)

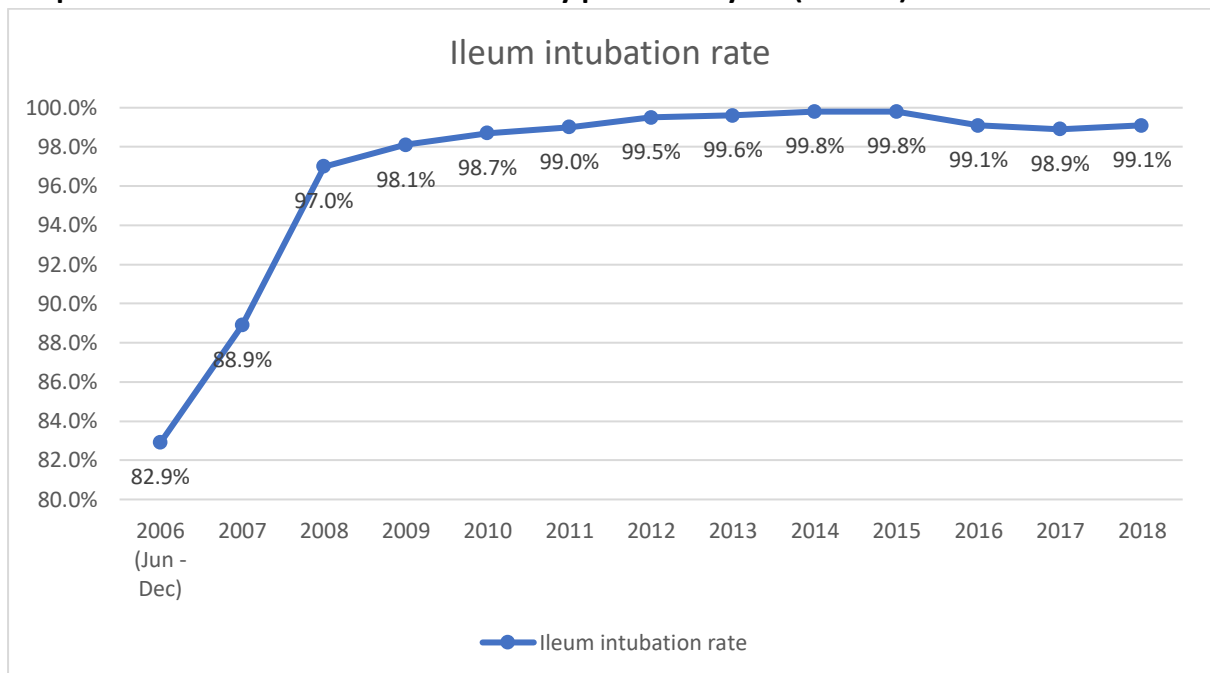
The ileal intubation rate between the year 2016 and 2018 ranged from 99.1% to 99.3%.

Table 3.3.2.6 The ileum intubation rate by procedure year (Overall) (N=16604)

Year	Fail		Success		Total	
	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage
2016	37	0.7%	4952	99.3%	4989	100.0%
2017	50	0.9%	5445	99.1%	5495	100.0%
2018	48	0.8%	6072	99.2%	6120	100.0%
Total	135	0.8%	16469	99.2%	16604	100.0%

Note: Chi-square test show no significant difference between years (p=0.601)

Graph 3.3.2.1 The ileum intubation rate by procedure year (Overall)



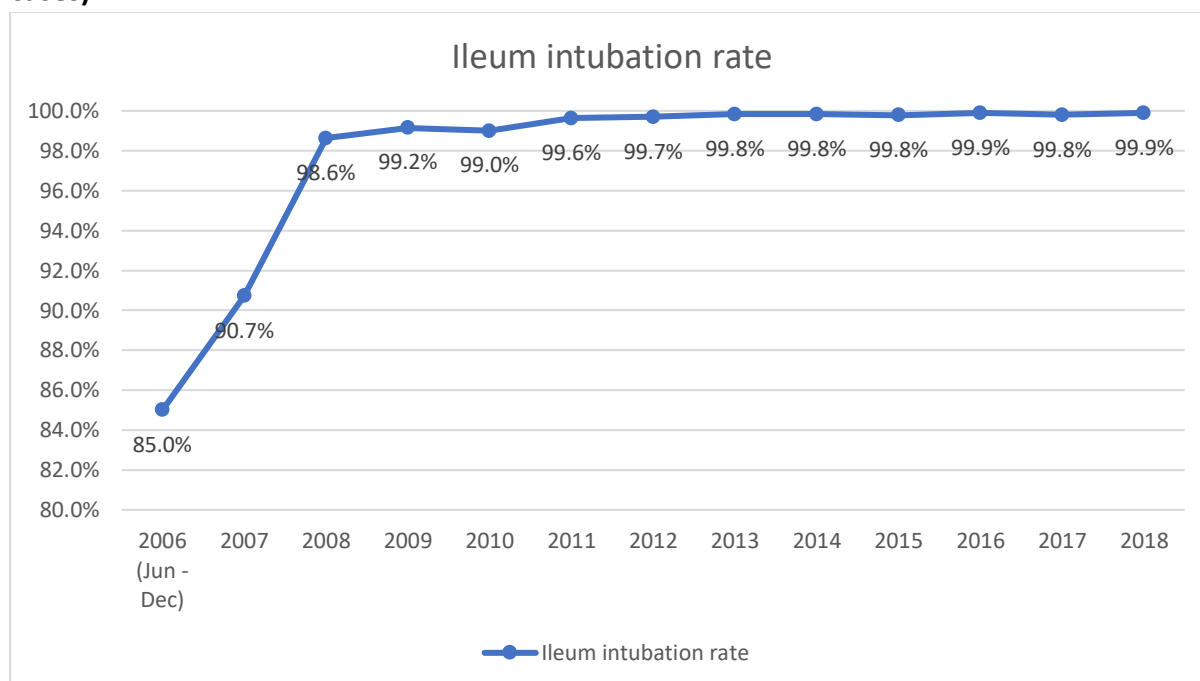
The overall ileum intubation rate dropped slightly in 2016-2018 compared with the previous years. However, once the cancer cases were excluded, the ileum intubation rates were similar to the previous years (99.8% ~ 99.9%).

Table 3.3.2.7 The ileum intubation rate by procedure year (Excluding cancer obstruction cases) (N=16489)

Year	Fail		Success		Total		Cancer obstruction case
	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage	
2016	4	0.1%	4952	99.9%	4956	100.0%	33
2017	9	0.2%	5445	99.8%	5454	100.0%	41
2018	7	0.1%	6072	99.9%	6079	100.0%	41
Total	20	0.1%	16469	99.9%	16489	100.0%	115

Note: Chi-square test show no significant difference between years (p=0.460)

Graph 3.3.2.2 The ileum intubation rate by procedure year (Excluding cancer obstruction cases)



3.4. The morbidity and operative mortality rate

3.4.1. The operative mortality rate

The operative mortality rate describes the mortality happened during a procedure or during the stay in TSSEC related to our procedure and sedation or in surgery period.

The operative and in-centre mortality rate of TSSEC kept at zero from 2016 to 2018, which was the same as the previous study.

3.4.2. The perforation rate

Perforation during colonoscopy is a major complication which will cause peritonitis and put the patient at risk. According to ASGE guideline in 2014, the perforation rate should be lower than 0.1% as the quality indicator.

No perforation happened between the year 2016 and 2018. The rate was 0%. The perforation rate in the previous study was 0.0095% (2 cases out of 21004 cases). Hence, the overall perforation rate (2006-2018) was 0.0053% (2 cases out of 37608 cases).

3.4.3. The post-polypectomy bleeding rate

It describes another common complication after polypectomy. The post-polypectomy bleeding referred to the delay bleeding happened > 24 hours, usually at 7-9 days after polypectomy, as a result of submucosal vessel eroded through polypectomy wound. All polypectomy has satisfactory haemostasis before end of the procedure.

There was a total of 51 colonoscopies done due to suspect of post-polypectomy bleeding. 38 cases had post-polypectomy bleeding at one polypectomy site, and 2 cases had post-polypectomy bleeding at two polypectomy sites. Total of 42 polypectomy site bleeding in 40 colonoscopy procedures was recorded. The remaining 11 cases did not show any bleeding at polypectomy sites.

The post-polypectomy bleeding rate was 0.09% after each polypectomy, 0.24% after each colonoscopy procedure or 0.31% after each colonoscopy procedure with polypectomy. All bleeding cases were controlled by endoscopic means. However, two had rebleeding after control and need another endoscopic haemostasis.

Table 3.4.3.1 Post-polypectomy bleeding rate by total number of procedure (N=16604)

	No. of procedure	Percentage
With post-polypectomy bleeding	40	0.24%
Without post-polypectomy bleeding	16564	99.76 %
Total	16604	100.0%

Table 3.4.3.2 Post-polypectomy bleeding rate by total number of procedures with polypectomy (N=12968)

	No. of procedure	Percentage
With post-polypectomy bleeding	40	0.31%
Without post-polypectomy bleeding	12928	99.69 %
Total	12968	100.0%

Table 3.4.3.3 Post-polypectomy bleeding rate by total number of polypectomy sites (N=44944)

	No. of polypectomy site	Percentage
With bleeding	42	0.09%
Without bleeding	44902	99.91 %
Total	44944	100.0%

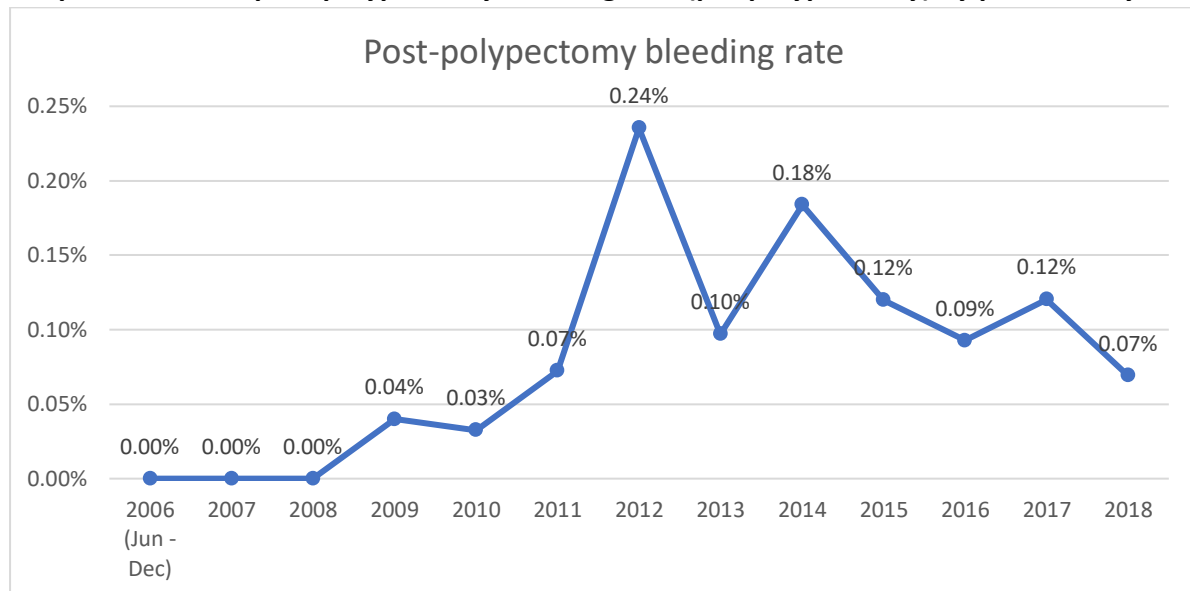
Regarding the post-polypectomy bleeding rate of polypectomy by procedure year, TSSEC had ranged from 0.07% to 0.12% between 2016 and 2018.

Table 3.4.3.4 The post-polypectomy bleeding rate (per polypectomy) by procedure year (N=44944)

	2016		2017		2018	
	No. of polypectomy site	Percentage	No. of polypectomy site	Percentage	No. of polypectomy site	Percentage
With bleeding	13	0.09%	18	0.12%	11	0.07%
Without bleeding	13982	99.91%	14987	99.88%	15933	99.93%
Total	13995	100.0%	15005	100.0%	15944	100.0%

Note: Two-way ANOVA show no significant difference between procedure years ($p=0.531$)

Graph 3.4.3.1 The post-polypectomy bleeding rate (per polypectomy) by procedure year



Dr. A (0.14%) had the highest rate of post-polypectomy bleeding among all endoscopists. For the year 2018, all endoscopists had achieved a post-polypectomy bleeding rate of lower than 0.1% (less than 1 in 1000 polypectomy sites).

Table 3.4.3.5 The post-polypectomy bleeding rate (per polypectomy) by endoscopist by year (N=44944)

		With post-polypectomy bleeding		Without post-polypectomy bleeding		Total
		No. of polypectomy site	Percentage	No. of polypectomy site	Percentage	
Dr. A	2016	11	0.15%	7524	99.85%	7535
	2017	12	0.18%	6776	99.82%	6788
	2018	4	0.08%	4863	99.92%	4867
	total	27	0.14%	19163	99.86%	19190
Dr. B	2016	0	0.00%	4433	100.00%	4433
	2017	3	0.07%	4587	99.93%	4590
	2018	4	0.09%	4678	99.91%	4682
	total	7	0.05%	13698	99.95%	13705
Dr. C	2016	2	0.10%	2006	99.90%	2008
	2017	3	0.08%	3576	99.92%	3579
	2018	1	0.03%	3178	99.97%	3179
	total	6	0.07%	8760	99.93%	8766
Dr. D	2018	2	0.07%	3071	99.93%	3073
Dr. E	2018	0	0.00%	142	100.00%	142
Dr. F	2016	0	0.00%	19	100.00%	19
	2017	0	0.00%	48	100.00%	48
	2018	0	0.00%	1	100.00%	1
	total	0	0.00%	68	100.00%	68
Total		42	0.09%	44902	99.91%	44944

Table 3.4.3.6 Post-polypectomy bleeding site (N=42)

	No. of polypectomy site	Percentage
Ascending Colon	16	38.1%
Sigmoid Colon	8	19.0%
Transverse Colon	7	16.7%
Caecum	5	11.9%
Descending Colon	3	7.1%
Rectum	3	7.1%
Total	42	100.0%

Ascending colon was the most common location where post-polypectomy bleeding occurred. Over one-third (38.1%) of the bleeding sites were found in the ascending colon.

3.4.4 Other major complications

Two patients had rebleeding after successful endoscopic haemostasis for post-polypectomy bleeding. Both, however, were successfully controlled with another endoscopic haemostasis procedure. These two procedures were not counted in the post-polypectomy bleeding data.

3.5. Polyp

It is the abnormal growth of epithelial tissue of colon with any protrusion from the mucosal surface. There are mainly four types of polyps that depends on the cell type constituent of it, namely neoplastic, hyperplastic/metaplastic, peutz-Jehger polyps and juvenile polyps. The neoplastic polyp, which is an adenoma, has the potential to develop into cancer and is considered to be a pre-cancerous entity that needed to be removed. Sessile serrated polyp (SSA), a variant between adenoma and hyperplastic polyp, also has cancerous potential that needed to be removed. All suspected adenomatous polyp or suspected SSA will be removed. Polyp which looks obviously to be hyperplastic with or without the aid of narrow band imaging (NBI) will not be removed. However, most of the times, the type of polyp is known only after removal and pathological examination, so that any polyp suspicious to be adenoma was removed.

3.5.1. The polyp detection rate

The polyp detection rate was 78.1% (slightly higher than 76.0% in the previous report), more than three-fourths of the patients have at least one polyp detected during the colonoscopy procedure.

Table 3.5.1.1 The polyp detection rate (N=16604)

	No. of procedure	Percentage
No polyp detected	3636	21.9%
At least one polyp detected / removed	12968	78.1%
Total	16604	100.0%

83.7% male patients had at least one polyp detected during colonoscopy examination, which was significantly higher than that of female (73.2%).

Table 3.5.1.2 The polyp detection rate by gender group (N=16604)

	Male		Female	
	No. of procedure	Percentage	No. of procedure	Percentage
No polyp detected	1268	16.3%	2368	26.8%
At least one polyp detected / removed	6505	83.7%	6463	73.2%
Total	7773	100.0%	8831	100.0%

Note: Chi-squared test show a significant difference between gender groups (p<0.001)

Dr. A had the highest polyp detection rate (81.3%) among all endoscopists from 2016 to 2018. Followed by Dr. D (79.5%) and Dr. C (76.1%).

However, as different endoscopists had patients in quite a different gender ratio. Hence, we separate the dataset by gender and perform analysis again in table 3.5.4 and 3.5.5.

Table 3.5.1.3 The polyp detection rate by endoscopists (N=16604)

Endoscopist	No polyp detected		At least one polyp detected		Total	
	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage
Dr. A	1222	18.7%	5302	81.3%	6524	100.0%
Dr. B	1343	24.3%	4175	75.7%	5518	100.0%
Dr. C	842	23.9%	2685	76.1%	3527	100.0%
Dr. D	191	20.5%	739	79.5%	930	100.0%
Dr. E	32	36.4%	56	63.6%	88	100.0%
Dr. F	6	35.3%	11	64.7%	17	100.0%
Total	3636	21.9%	12968	78.1%	16604	100.0%

For male patients, the polyp detection rate was apparently different between endoscopists. Tukey's post-hoc test showed Dr. E had significantly less polyp detection rate than other endoscopists except for Dr. F. (p-value range = 0.002 ~ 0.010)

Table 3.5.1.4 The polyp detection rate by endoscopists (male patients only) (N=7773)

Endoscopist	No polyp detected		At least one polyp detected		Total	
	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage
Dr. A	735	16.2%	3800	83.8%	4535	100.0%
Dr. B	175	14.9%	996	85.1%	1171	100.0%
Dr. C	234	17.0%	1146	83.0%	1380	100.0%
Dr. D	106	16.8%	525	83.2%	631	100.0%
Dr. E	17	35.4%	31	64.6%	48	100.0%
Dr. F	1	12.5%	7	87.5%	8	100.0%
Total	1268	16.3%	6505	83.7%	7773	100.0%

Note: Two-way ANOVA show a significant difference between endoscopists (p=0.010)

For female patients, the polyp detection rate was also apparently different between endoscopists. However, Tukey's post-hoc test did not show any significant difference

in female polyp detection rate for any two endoscopists. (p-value range = 0.060 ~ 1.000)

Table 3.5.1.5 The polyp detection rate by endoscopists (female patients only) (N=8831)

Endoscopist	No polyp detected		At least one polyp detected		Total	
	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage
Dr. A	487	24.5%	1502	75.5%	1989	100.0%
Dr. B	1168	26.9%	3179	73.1%	4347	100.0%
Dr. C	608	28.3%	1539	71.7%	2147	100.0%
Dr. D	85	28.4%	214	71.6%	299	100.0%
Dr. E	15	37.5%	25	62.5%	40	100.0%
Dr. F	5	55.6%	4	44.4%	9	100.0%
Total	2368	26.8%	6463	73.2%	8831	100.0%

Note: Two-way ANOVA show significant difference between endoscopists (p=0.013)

3.5.1.1. Number of polyp detected during colonoscopy

21.9% of patients did not have any polyps during colonoscopy. A majority of patients (51.6%) detected 1-3 polyps. 22.5% of patients detected 4-9 polyps, while only 4.0% of patients had 10 or more polyps detected.

Graph 3.5.1.1.1 Cumulative percentage for the number of polyps detected

Cumulative percentage for the number of polyps detected

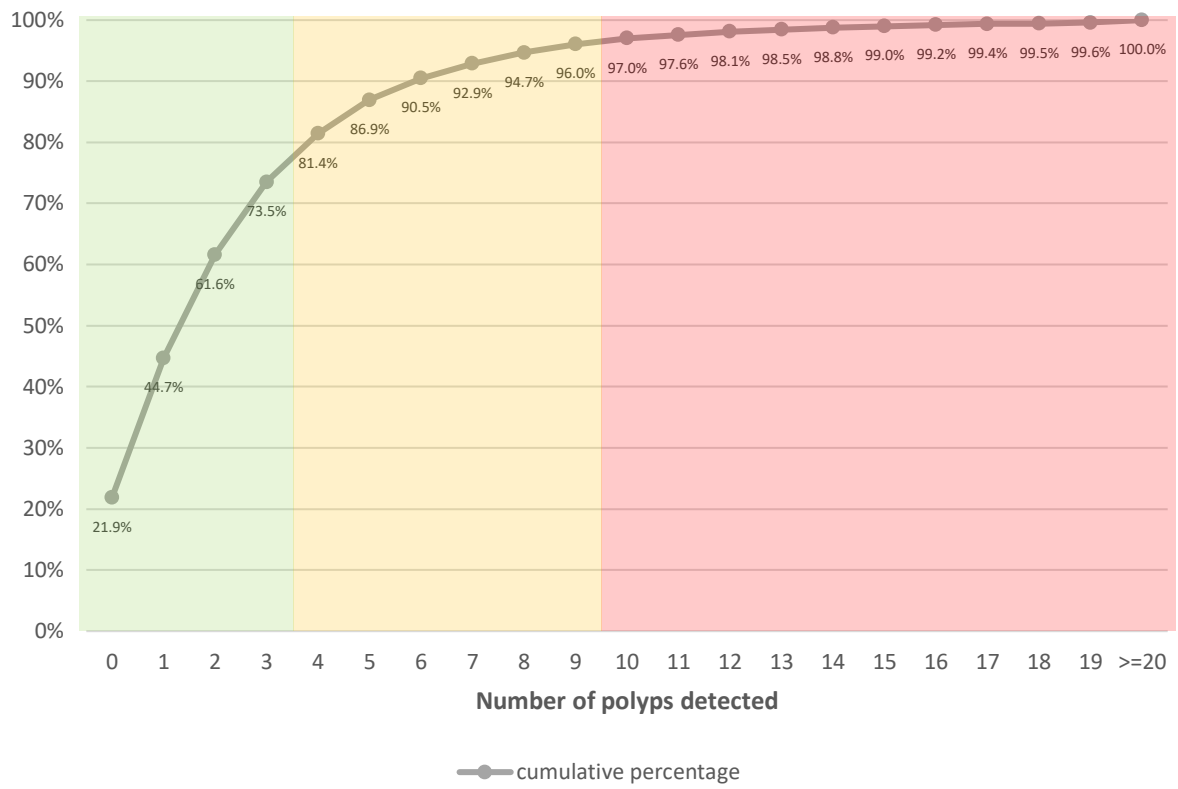


Table 3.5.1.1.1 Number of polyps detected (N=16604)

	No. of procedure	Percentage	Cumulative Percentage
No polyp	3636	21.90%	21.90%
At least one polyp detected	12968	78.10%	
Number of polyps:			
1	3788	22.81%	44.71%
2	2809	16.92%	61.63%
3	1973	11.88%	73.51%
4	1315	7.92%	81.43%
5	913	5.50%	86.93%
6	587	3.54%	90.47%
7	404	2.43%	92.90%
8	299	1.80%	94.70%
9	222	1.34%	96.04%
10	161	0.97%	97.01%
11	95	0.57%	97.58%
12	88	0.53%	98.11%
13	58	0.35%	98.46%
14	53	0.32%	98.78%
15	39	0.23%	99.01%
16	30	0.18%	99.19%
17	26	0.16%	99.35%
18	16	0.10%	99.45%
19	20	0.12%	99.57%
20	15	0.09%	99.66%
21	17	0.10%	99.76%
22	3	0.02%	99.78%
23	2	0.01%	99.79%
24	2	0.01%	99.80%
25	6	0.04%	99.84%
26	3	0.02%	99.86%
27	5	0.03%	99.89%
28	2	0.01%	99.90%
30	4	0.02%	99.92%
31	2	0.01%	99.94%
32	2	0.01%	99.95%
33	1	0.01%	99.95%
37	1	0.01%	99.96%
39	1	0.01%	99.97%
40	2	0.01%	99.98%
41	1	0.01%	99.98%
44	1	0.01%	99.99%
52	1	0.01%	99.99%
63	1	0.01%	100.00%
Total	16604	100.00%	100.00%

3.6. Adenoma

It is a benign tumour, representing the benign period of a cancer development process, i.e. adenoma-carcinoma sequence. It may develop into cancer in 5-10 years. As long as it was a benign tumour, complete excision with polypectomy can prevent cancer development. Removal of cancer precursor to halt cancer development and to detect early cancer allowing early resection to get better survival was the prime role of colonoscopy in the matter of colorectal cancer treatment and prevention. Adenoma detection rate (ADR) was defined as the rate detection of at least one adenoma during colonoscopy, which reflects the quality of colonoscopy and performance of endoscopist, it also reflects the incidence of adenoma in our locality.

3.6.1. The adenoma detection rate (ADR) in overall cases

The American Society for Gastrointestinal Endoscopy (ASGE) recommended that the adenoma detection rate should be at least 25% to meet the standard. The higher the adenoma detection rate, implying more patient was prevented from colorectal cancer or arousing more at-risk patient to undertaking future preventive measure; and the end-point is to reduce colorectal cancer and its resulting mortality. However, it may also imply incidences of colorectal adenoma and carcinoma were rising in our locality.

The adenoma detection rate was 58.1% (2006-2015: 54.8%), over half of the patients (9,647 of 16,604 cases) could be detected at least one spot related to adenoma.

Table 3.6.1.1 The adenoma detection rate in overall cases (N=16604)

	No. of procedure	Percentage
No polyp	3636	21.9%
At least one adenoma polyp detected	9647	58.1%
Non-adenoma polyp / unknown polyp detected	3321	20.0%
Total	16604	100.0%

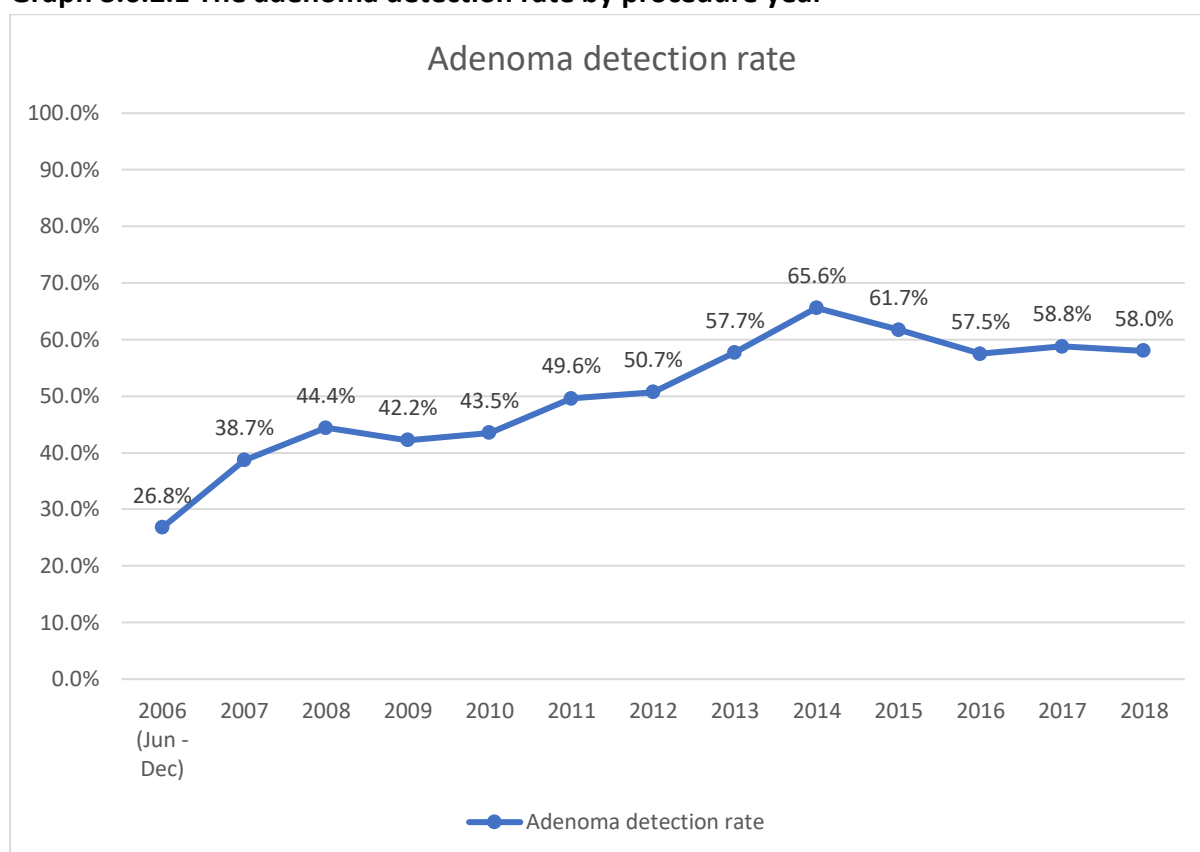
3.6.2. The adenoma detection rate in overall cases by procedure year

The percentage of patient without any polyp detected increased from 20.1% in 2016 to 23.8% in 2018.

Table 3.6.2.1 The adenoma detection rate in overall cases by procedure year (N=16604)

Year	No polyp		At least one adenoma polyp detected		Non-adenoma polyp / unknown polyp detected		Total	
	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage
2016	1001	20.1%	2869	57.5%	1119	22.4%	4989	100.0%
2017	1177	21.4%	3229	58.8%	1089	19.8%	5495	100.0%
2018	1458	23.8%	3549	58.0%	1113	18.2%	6120	100.0%
Total	3636	21.9%	9647	58.1%	3321	20.0%	16604	100.0%

Graph 3.6.2.1 The adenoma detection rate by procedure year



Dr. D had the highest adenoma detection rate (64.9%) among all endoscopists from 2016 to 2018. Followed by A (62.4%) and Dr. B (55.3%).

Table 3.6.2.2 The adenoma detection rate in overall cases by endoscopists (N=16604)

Endoscopist	No polyp		At least one adenoma polyp detected		Non-adenoma polyp / unknown polyp detected		Total	
	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage
Dr. A	1222	18.7%	4070	62.4%	1232	18.9%	6524	100.0%
Dr. B	1343	24.3%	3052	55.3%	1123	20.4%	5518	100.0%
Dr. C	842	23.9%	1866	52.9%	819	23.2%	3527	100.0%
Dr. D	191	20.5%	604	64.9%	135	14.5%	930	100.0%
Dr. E	32	36.4%	47	53.4%	9	10.2%	88	100.0%
Dr. F	6	35.3%	8	47.1%	3	17.6%	17	100.0%
Total	3636	22.0%	9647	58.0%	3321	20.0%	16604	100.0%

Note: Two-way ANOVA show a significant difference between endoscopists ($p < 0.001$)

Among the 12968 polyp detected cases, the rate of at least one adenoma polyp detected increased from 71.9% in 2016 to 76.1% in 2018, which showed that the chance of having adenoma in each case with polypectomy done kept increased.

Table 3.6.2.3 The ADR by procedure year (excluding no polyp cases) (N=12968)

Year	At least one adenoma polyp detected		Non-adenoma polyp / unknown polyp detected		Total	
	No. of procedure with polyp	Percentage	No. of procedure with polyp	Percentage	No. of procedure with polyp	Percentage
2016	2869	71.9%	1119	28.1%	3988	100.0%
2017	3229	74.8%	1089	25.2%	4318	100.0%
2018	3549	76.1%	1113	23.9%	4662	100.0%
Total	9647	74.4%	3321	25.6%	12968	100.0%

Note: Two-way ANOVA show a significant difference between years ($p < 0.001$), Tukey's post hoc test showed a significant difference for year 2016 vs 2018 ($p = 0.009$), also 2017 vs 2018 ($p < 0.001$).

When “no polyp” cases were excluded, Dr. E (83.9%) had the highest adenoma detection rate, followed by Dr. D (81.7%) and Dr. A (76.8%).

Table 3.6.2.4 The adenoma rate by endoscopists (excluding no polyp cases) (N=12968)

Endoscopist	At least one adenoma polyp detected		Non-adenoma polyp / unknown polyp detected		Total	
	No. of procedure with polyp	Percentage	No. of procedure with polyp	Percentage	No. of procedure with polyp	Percentage
Dr. A	4070	76.8%	1232	23.2%	5302	100.0%
Dr. B	3052	73.1%	1123	26.9%	4175	100.0%
Dr. C	1866	69.5%	819	30.5%	2685	100.0%
Dr. D	604	81.7%	135	18.3%	739	100.0%
Dr. E	47	83.9%	9	16.1%	56	100.0%
Dr. F	8	72.7%	3	27.3%	11	100.0%
Total	9647	74.4%	3321	25.6%	12968	100.0%

Note: Two-way ANOVA show significant difference between endoscopists (p<0.001)

3.6.3. The adenoma detection rate in overall cases by gender group

In the male population, 65.1% (2006-2015: 58.8%) of them were found at least one adenoma polyp, while 51.9% (2006-2015: 50.8%) of female patients were found at least one adenoma polyp. Both percentages are higher than those in the previous report.

Table 3.6.3.1 The adenoma rate in overall cases by gender group (N=16604)

Polyp Status	Male		Female	
	No. of procedure	Percentage	No. of procedure	Percentage
No polyp	1268	16.3%	2368	26.8%
At least one adenoma polyp	5064	65.1%	4583	51.9%
Non-adenoma polyp / unknown polyp detected	1441	18.5%	1880	21.3%
Total	7773	100.0%	8831	100.0%

Note: Two-way ANOVA show a significant difference between different gender (p<0.001)

Table 3.6.3.2 The adenoma detection rate in overall cases by endoscopists (Male patient only) (N=7773)

Endoscopist	No polyp		At least one adenoma polyp detected		Non-adenoma polyp / unknown polyp detected		Total	
	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage
Dr. A ⁽¹⁾	735	16.2%	2950	65.0%	850	18.7%	4535	100.0%
Dr. B ⁽²⁾	175	14.9%	804	68.7%	192	16.4%	1171	100.0%
Dr. C ⁽²⁾	234	17.0%	843	61.1%	303	22.0%	1380	100.0%
Dr. D ⁽¹⁾	106	16.8%	435	68.9%	90	14.3%	631	100.0%
Dr. E ⁽²⁾	17	35.4%	27	56.3%	4	8.3%	48	100.0%
Dr. F ⁽¹⁾	1	12.5%	5	62.5%	2	25.0%	8	100.0%
Total	1268	16.3%	5064	65.1%	1441	18.5%	7773	100.0%

(1) Male endoscopists

(2) Female endoscopists

Table 3.6.3.3 The adenoma detection rate in overall cases by endoscopists (Female patient only) (N=8831)

Endoscopist	No polyp		At least one adenoma polyp detected		Non-adenoma polyp / unknown polyp detected		Total	
	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage
Dr. A ⁽¹⁾	487	24.5%	1120	56.3%	382	19.2%	1989	100.0%
Dr. B ⁽²⁾	1168	26.9%	2248	51.7%	931	21.4%	4347	100.0%
Dr. C ⁽²⁾	608	28.3%	1023	47.6%	516	24.0%	2147	100.0%
Dr. D ⁽¹⁾	85	28.4%	169	56.5%	45	15.1%	299	100.0%
Dr. E ⁽²⁾	15	37.5%	20	50.0%	5	12.5%	40	100.0%
Dr. F ⁽¹⁾	5	55.6%	3	33.3%	1	11.1%	9	100.0%
Total	2368	26.8%	4583	51.9%	1880	21.3%	8831	100.0%

(1) Male endoscopists

(2) Female endoscopists

From data in table 3.6.3.2 and 3.6.3.3, it is observed that male endoscopists had more male patient cases and female endoscopists had more female patient cases in our centre. Gender is one of the factors for polyp detection rate and adenoma detection rate.

3.6.4. The chance of having an adenoma and no. of adenoma detected during each colonoscopy procedure

There was a slight increase in the adenoma detection rate compared with the previous report. The mean number of adenomas detected in overall cases (N=16,604) was 1.59 (2006-2015: 1.47). The average number of adenoma polyps detected for cases with at least one adenoma polyp detected (N=9,647) was 2.73 (2006-2015: 2.69).

41.9% of patients did not have any adenoma found in colonoscopy examination. 24.3% of patients had 1 adenoma polyp, 12.6% had 2 adenoma polyps and 12.1% had 3-4 adenoma polyps.

Table 3.6.4.1 Number of adenomas detected (N=16604)

	No. of procedure	Percentage	Cumulative Percent
No polyp	3636	21.90%	21.90%
Non-adenoma polyp / unknown polyp detected	3321	20.00%	41.90%
At least one adenoma polyp detected	9647	58.10%	
Number of adenomas:			
1	4041	24.34%	66.24%
2	2099	12.64%	78.88%
3	1234	7.43%	86.31%
4	782	4.71%	91.02%
5	473	2.85%	93.87%
6	297	1.79%	95.66%
7	205	1.23%	96.89%
8	146	0.88%	97.77%
9	89	0.54%	98.31%
10	69	0.42%	98.72%
11	59	0.36%	99.08%
12	42	0.25%	99.33%
13	24	0.14%	99.48%
14	18	0.11%	99.58%
15	12	0.07%	99.66%
16	10	0.06%	99.72%
17	13	0.08%	99.80%
18	5	0.03%	99.83%
19	7	0.04%	99.87%
20	2	0.01%	99.88%
21	6	0.04%	99.92%
22	2	0.01%	99.93%
24	1	0.01%	99.93%
25	4	0.02%	99.96%
29	1	0.01%	99.96%
30	1	0.01%	99.97%
32	1	0.01%	99.98%
38	1	0.01%	99.98%
39	2	0.01%	99.99%
52	1	0.01%	100.00%
Total	16604	100.00%	100.00%

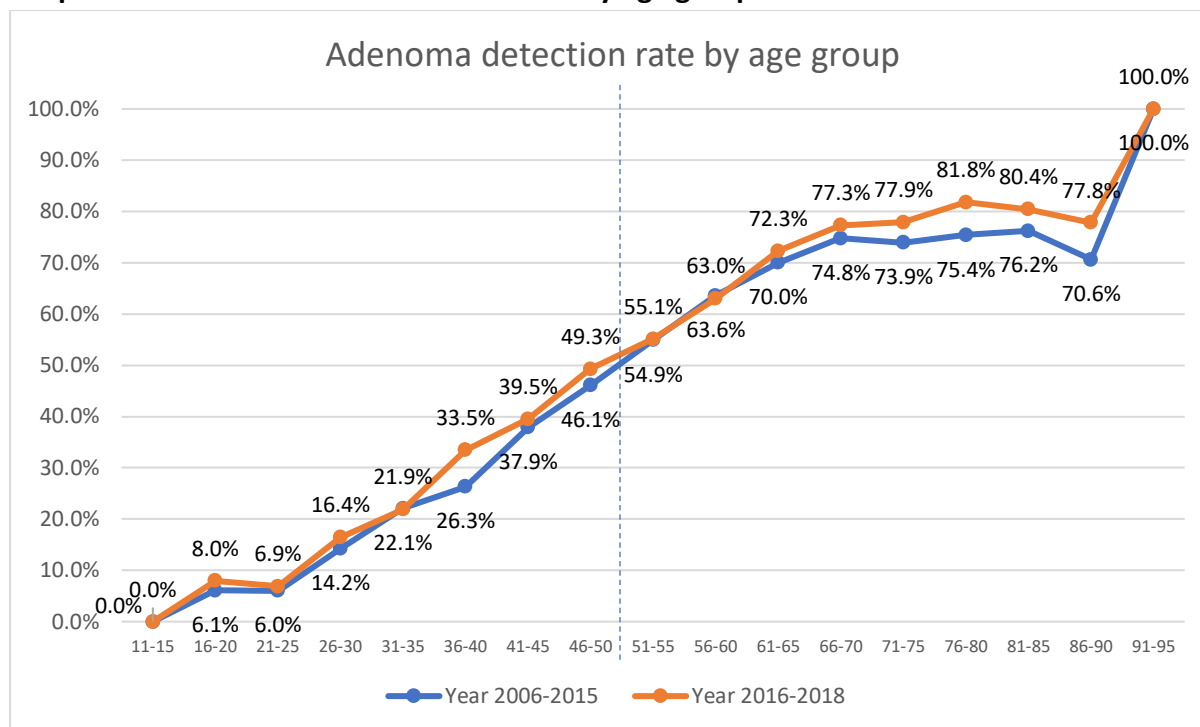
3.6.5. The adenoma detection rate by age group

For the adenoma detection rate, the adenoma detection rate was increasing with ascending age group. The average number of adenoma polyps detected also increased with increasing age group. The age range of patients who had at least one adenoma detected was 16-95. For patients older than 50, their adenoma detection rate raised to over 50%. A more important fact to point out here is that for patients younger than 50, there was a quite significant percentage of colonoscopy found to have adenoma, even at their 20's and 30's.

Table 3.6.5.1 The adenoma detection rate by age group (N=16604)

Age group	No polyp		At least one adenoma polyp detected		Non-adenoma polyp / unknown polyp detected		Number of Adenoma Polyp		Total
	No. of procedure	Percentage	No. of procedure	Percentage	No. of procedure	Percentage	Mean	Range	
age 11 - 15	1	50.0%	0	0.0%	1	50.0%	/	/	2
age 16 - 20	36	72.0%	4	8.0%	10	20.0%	1.00	1-1	50
age 21 - 25	143	75.7%	13	6.9%	33	17.5%	1.54	1-5	189
age 26 - 30	238	59.9%	65	16.4%	94	23.7%	1.26	1-4	397
age 31 - 35	291	54.4%	117	21.9%	127	23.7%	1.30	1-4	535
age 36 - 40	330	39.0%	284	33.5%	233	27.5%	1.45	1-8	847
age 41 - 45	409	33.0%	490	39.5%	340	27.4%	1.72	1-11	1239
age 46 - 50	466	26.5%	867	49.3%	425	24.2%	1.93	1-39	1758
age 51 - 55	619	21.9%	1557	55.1%	649	23.0%	2.11	1-14	2825
age 56 - 60	504	17.2%	1846	63.0%	582	19.8%	2.41	1-17	2932
age 61 - 65	311	12.3%	1832	72.3%	390	15.4%	3.11	1-52	2533
age 66 - 70	177	8.7%	1575	77.3%	286	14.0%	3.82	1-39	2038
age 71 - 75	66	8.3%	616	77.9%	109	13.8%	3.78	1-21	791
age 76 - 80	31	8.8%	288	81.8%	33	9.4%	3.73	1-21	352
age 81 - 85	12	12.4%	78	80.4%	7	7.2%	4.17	1-22	97
age 86 - 90	2	11.1%	14	77.8%	2	11.1%	3.93	1-7	18
age 91 - 95	0	0.0%	1	100.0%	0	0.0%	3.00	3-3	1
Total	3636	21.9%	9647	58.1%	3321	20.0%	2.73	1-52	16604

Graph 3.6.5.1 The adenoma detection rate by age group



3.6.6. The size of adenoma discovered

With a total of there were 26,404 adenoma polyps discovered, 68.7% were within 3mm, 19.0% were 4-5 mm, 7.2% were within 6-9mm. Only 5.2% of them were 10mm or above.

Table 3.6.6.1 Adenoma size (N=26404)

	No. of adenoma	Percentage
Within 3mm	18129	68.7%
4-5mm	5005	19.0%
6-9mm	1895	7.2%
10-14mm	793	3.0%
15-19mm	312	1.2%
20mm or above	270	1.0%
Total	26404	100.0%

3.6.7. The location of adenoma discovered

With total of there were 26,404 adenoma polyps discovered, the top 3 locations with the highest detection rate are ascending colon (24.64%), sigmoid colon (21.68%) and transverse colon (21.24%).

Table 3.6.7.1 Location of Adenoma Polyp discovered (N=26404)

	No. of adenoma	Percentage
Ileocaecal Valve	17	0.06%
Appendix Aperture	1	0.00%
Caecum	2180	8.26%
Ascending Colon	6506	24.64%
Hepatic Flexure	9	0.03%
Transverse Colon	5608	21.24%
Descending Colon	4417	16.73%
Sigmoid Colon	5724	21.68%
Rectum	1933	7.32%
Anal Canal	9	0.03%
Total	26404	100.00%

3.7. Cancer

Adenocarcinoma, which is the most common type of cancerous growth in colon and rectum, is the type that we refer to as colonic or rectal cancer. Most of them are developed from an adenoma while some are from sessile serrated polyp (through alternative pathway). It can rarely be developed de-novo (without polyp stage). It can invade and spread to the organ, and cause death eventually. It needs a radical resection which is the resection of cancer segment and related lymph node area. Some may require additional chemotherapy and/or radiotherapy. Even with complete resection, there is still about 30% chance of recurrence and subsequent death.

3.7.1. Cancer detection rate

For the cancer detection rate, no cancer detected for 97.5% of cases, while 2.5% of cases detected at least one cancer in the colonoscopy procedure.

Table 3.7.1.1 The cancer detection rate (N=16604)

	No. of procedure	Percentage
No Cancer spotted	16183	97.5%
Cancer Spotted	421	2.5%
Total	16604	100.0%

3.2% (2006-2015: 3.8%) of male patients detected cancer during the colonoscopy examination while the rate for female patients is 1.9% (2006-2015: 2.7%). Both rates are lower than that in the previous report.

Results from Chi-square test showed that the gender effect had an association with the cancer detection rate, which male had a higher cancer detection rate than female.

Table 3.7.1.2 The cancer detection rate by gender group (N=16604)

	Male		Female	
	No. of procedure	Percentage	No. of procedure	Percentage
No Cancer spotted	7521	96.8%	8662	98.1%
Cancer Spotted	252	3.2%	169	1.9%
Total	7773	100.0%	8831	100.0%

Note: Chi-square test show the two variables are dependent (p<0.001)

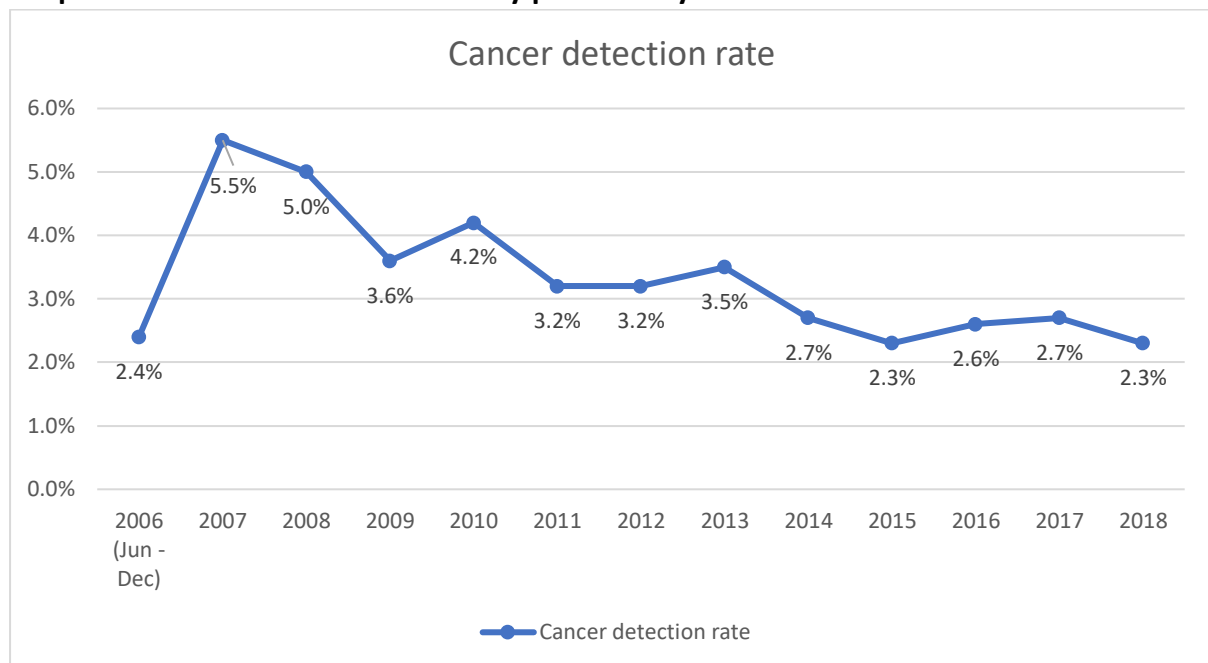
During the study period, the cancer detection rate is the lowest in 2018, with only 2.3% of the patients detected cancer during colonoscopy examination.

Table 3.7.1.3 Cancer detection rate by procedure year (N=16604)

Year	No Cancer spotted		Cancer Spotted	
	No. of procedure	Percentage	No. of procedure	Percentage
2016	4859	97.4%	130	2.6%
2017	5347	97.3%	148	2.7%
2018	5977	97.7%	143	2.3%
Total	16183	97.5%	421	2.5%

Note: Chi-square test show the two variables are independent (p=0.442)

Graph 3.7.1.1 Cancer detection rate by procedure year



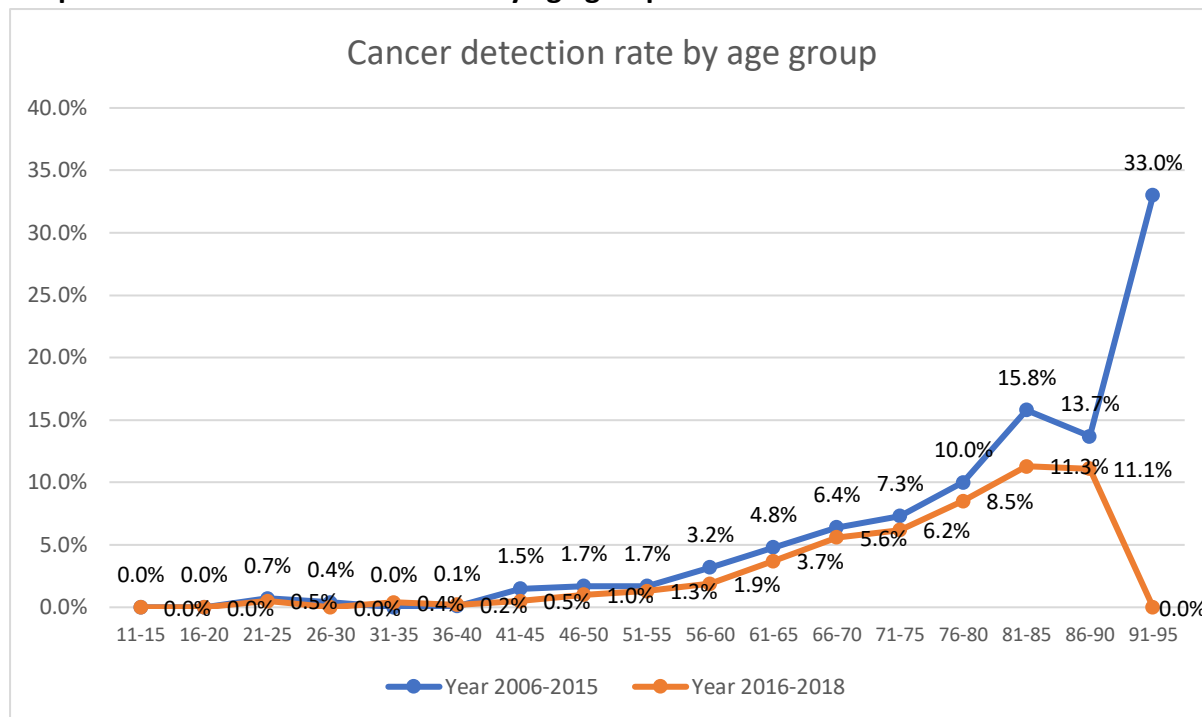
The age group with the highest cancer detection rate is “age 81-85”, with 11.3% patients spotted cancer. Followed by “age 86-90” and “age 76-80”, with 11.1% and 8.5% respectively. However, cancer can occur at a younger age, our data showed 5 patients with cancer at 21-40 years old, in which one has cancer detected at age of 22.

Compare with the previous result, the cancer detection rate dropped for all age groups older than “age 41-45”.

Table 3.7.1.4 Cancer detection rate by age group (N=16604)

Age group	No Cancer spotted		Cancer Spotted		Cancer Spotted (2006-2015)	Difference
	No. of procedure	Percentage	No. of procedure	Percentage	Percentage	Percentage
age 11 - 15	2	100.0%	0	0.0%	0.0%	0.0%
age 16 - 20	50	100.0%	0	0.0%	0.0%	0.0%
age 21 - 25	188	99.5%	1	0.5%	0.7%	-0.2%
age 26 - 30	397	100.0%	0	0.0%	0.4%	-0.4%
age 31 - 35	533	99.6%	2	0.4%	0.0%	0.4%
age 36 - 40	845	99.8%	2	0.2%	0.1%	0.1%
age 41 - 45	1233	99.5%	6	0.5%	1.5%	-1.0%
age 46 - 50	1740	99.0%	18	1.0%	1.7%	-0.7%
age 51 - 55	2788	98.7%	37	1.3%	1.7%	-0.4%
age 56 - 60	2877	98.1%	55	1.9%	3.2%	-1.3%
age 61 - 65	2440	96.3%	93	3.7%	4.8%	-1.1%
age 66 - 70	1923	94.4%	115	5.6%	6.4%	-0.8%
age 71 - 75	742	93.8%	49	6.2%	7.3%	-1.1%
age 76 - 80	322	91.5%	30	8.5%	10.0%	-1.5%
age 81 - 85	86	88.7%	11	11.3%	15.8%	-4.5%
age 86 - 90	16	88.9%	2	11.1%	13.7%	-2.6%
age 91 - 95	1	100.0%	0	0.0%	33.3%	-33.3%
Total	16183	97.5%	421	2.5%	3.2%	N/A

Graph 3.7.1.2 Cancer detection rate by age group



3.7.2. Cancer location

From the 421 patients with cancer detected during the endoscopy process, in which 8 patients have two synchronous cancers, a total of 429 cancer sites were identified. A majority of 42.4% of cancer was detected at the rectum, followed by 31.7% of the cancer was detected at the sigmoid colon.

Table 3.7.2.1 Cancer location (N=429)

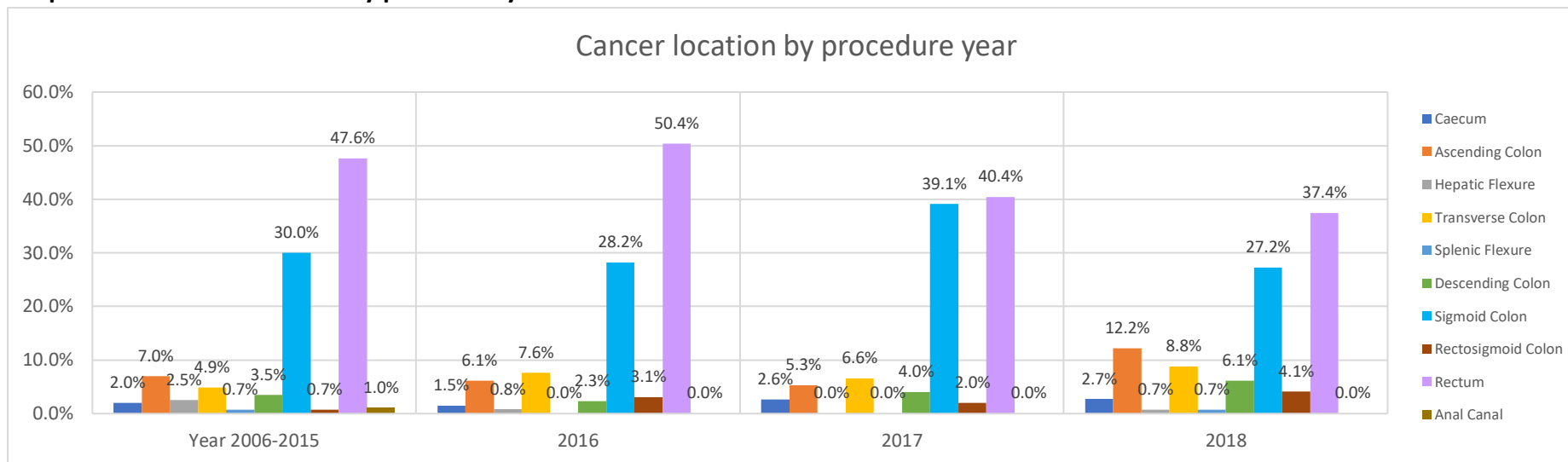
	No. of cancer site	Percentage
Caecum	10	2.3%
Ascending Colon	34	7.9%
Hepatic Flexure	2	0.5%
Transverse Colon	33	7.7%
Splenic Flexure	1	0.2%
Descending Colon	18	4.2%
Sigmoid Colon	136	31.7%
Rectosigmoid Colon	13	3.0%
Rectum	182	42.4%
Total	429	100.0%

Remark: One patient may have more than one cancer site

Table 3.7.2.2 Cancer location by procedure year (N=429)

	2016		2017		2018	
	No. of cancer site	Percentage	No. of cancer site	Percentage	No. of cancer site	Percentage
Caecum	2	1.5%	4	2.6%	4	2.7%
Ascending Colon	8	6.1%	8	5.3%	18	12.2%
Hepatic Flexure	1	0.8%	0	0.0%	1	0.7%
Transverse Colon	10	7.6%	10	6.6%	13	8.8%
Splenic Flexure	0	0.0%	0	0.0%	1	0.7%
Descending Colon	3	2.3%	6	4.0%	9	6.1%
Sigmoid Colon	37	28.2%	59	39.1%	40	27.2%
Rectosigmoid Colon	4	3.1%	3	2.0%	6	4.1%
Rectum	66	50.4%	61	40.4%	55	37.4%
Total	131	100.0%	151	100.0%	147	100.0%

Graph 3.7.2.1 Cancer location by procedure year



4. Discussion and conclusion

4.1. Discussion and conclusion

Our present audit showed that our colonoscopy performance in various parameters including bowel preparation, caecal intubation rate, ileal intubation rate, ADR, morbidity and mortality was kept up to the level of our last audit result and the guideline of International standards from American Society for Gastrointestinal Endoscopy (ASGE)³ and European Society for Gastrointestinal Endoscopy (ESGE)⁴.

The bowel preparation result showed our nursing staff had been doing satisfactory work on following bowel preparation program and on conveying information to our patients. During this period some new endoscopists joined our service and Dr. F leave our service early in this audit period, the performance of all our present endoscopists was similarly satisfactory. ADR as the main indicator of our colonoscopy service performance was contributed by multiple factors including the incidence of adenoma in our population, age, gender, attitude and culture of endoscopists and assisting staff, and technological improvement. Our ADR kept at a high level of 58 % that mostly because of the high frequency of adenoma in our patients. Another factor we considered paramount to maintain the level of ADR is attitude and culture of endoscopists and assisting nursing staff on thorough scrutiny and removal all adenoma as possible. Technology improvement of endoscopy and instrument also play a role in improving ADR.

Morbidity and mortality was acceptably low in this audit. Training and credentialing of medical staff, equipment and its maintenance, resuscitation, infective control were factors that we need to consider in our management to further reduce morbidity and mortality.

To sum up with service performance in our present audit, our clinical performance was up to standard. All our present endoscopists performed similarly satisfactorily. Areas need improvement included time slot arrangement in high variability in length of procedure in view of the increasing demand of polypectomy and further reduction of post-polypectomy bleeding rate.

³ ASGE.(2014). Quality indicators for GI endoscopic procedures - complete set. https://www.asge.org/docs/default-source/education/practice_guidelines/doc-2014_quality_in_endoscopy_set.pdf

⁴ ESGE.(2019). Performance measures for small-bowel endoscopy: a European Society of Gastrointestinal Endoscopy (ESGE) Quality Improvement Initiative. <https://www.esge.com/performance-measures-for-small-bowel-endoscopy/>

Table 4.1.1 Result comparison with international standards

Quality Indicator	ASGE (2014)	ESGE (2019)	TSSEC result (2006 - 2015)	TSSEC result (2016 - 2018)
Rate of appropriate bowel preparation	> 85%	> 95%	99.7%	99.6%
Caecal intubation rate	> 90%	> 90%	99.5%	99.3%
Perforation rate	< 0.1%	Not mentioned	0.0095%	0%
Post-polypectomy bleeding rate	< 1%	Not mentioned	0.40%	0.24%
Adenoma detection rate	> 25%	> 25%	54.8%	58.1%

In our audit data, we pick up some important findings of our patient colorectal health that may need to be noticed.

From the last audit data, there was a rising trend of ADR from 2006 to 2014 with a peak of 64.5% in 2014. The trend seems to plateau off in our present audit at about 58%. This level was still considered as alarmingly high, which may reflect the incidence of adenoma in our population was similarly high. However, our data did not separate symptomatic patient from the asymptomatic screening patient, which may not be able to imply directly to the population.

The overall cancer rate was also shown to be decreased in the present audit (graph 3.7.1.1).

There was a trend of right shift in ADR that frequency of adenoma was increasing in ascending colon. This may imply coming increasing frequency of ascending colon cancer. Though there was no obvious change in our last audit, an increasing trend in ascending colon cancer from 7.0% (2006-2015)/ 6.1% (2015) to 12% (2018) was noted. It may represent a right shift of colorectal cancer occurrence or just a transient variation. Because of both adenoma and cancer frequencies at ascending colon were increased, together with difficulty to spot adenoma in the deep folding in ascending colon, more attention to ascending colon scrutiny may need to be exercised.