

**Customer:** Paul Swan & IRT Project Group  
**Organisation:** Oxfordshire Clinical Commissioning Group

**Report Details:**

This report contains the quantitative evaluation of Integrated Respiratory Team (IRT) Project. It focusses on investigating whether there has been a significant impact on the below outcome measures due to the introduction of the service in the North and Oxford City localities. A difference-in-difference method is presented, with the non-IRT impacted services used as a control group.

Measure	Cohort Included	Values
IRTO-002 - Non Elective Admissions	Updated Focus Cohort	Rate per 1,000 registered population
	Expanded Cohort	
	COPD Cohort	Rate per prevalent patient
	Asthma Cohort	
IRTO-003 - Re-admissions	Updated Focus Cohort	Rate per admission
	Expanded Cohort	
	COPD Cohort	
	Asthma Cohort	
IRTO-005 - Referrals	Target Cohort	Rate per 1,000 registered population
IRTO-005 - Outpatient Follow Ups	Target Cohort	Rate per 1,000 registered population

Supporting documentation

- PR11641 - IRT Populations v2.xlsx** - A review of the populations making up the IRT project
- R\_150 IRT Outcomes Report M12 2019-20.pdf** - The monthly report monitoring IRT Outcomes
- IRT Timeline 20191205.docx** - Further information on IRT Community and Primary Care employment
- PR11641 - Respiratory Outcomes - North and City Split FV02.xlsx** - A review of the outcome measures for the North and City areas compared to the Non-IRT areas

**Data Source:** SUS Inpatient Spells, EMIS  
**Date Period:** April 2015 - February 2020  
**Provider(s):** All  
**Commissioner(s):** Oxfordshire Clinical Commissioning Group

**Methodology/Data Inclusions and Exclusions:**

Please see Data Source and Cohort Definitions tabs.

**If you wish to contact us to discuss this report or its content please use the contact details below:**

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**Date Completed:** 16/06/2020 **Telephone:** 0300 123 5187

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This report contains the results of the quantitative evaluation of the IRT Project and its impact on non-elective admissions, re-admissions, referrals and outpatient follow up attendances. Whilst it is recommended that this report is reviewed in detail, the below summary gives an overview of the methods and key findings of the evaluation.

#### Evaluation Summary

A difference in difference estimation was used to evaluate the impact of the IRT project. The difference between the IRT group and the non-IRT group (control group) was visually displayed for each outcome measure, along with a fitted model for the differences between the two groups. This fitted model was produced using baseline data pre-IRT intervention and modelled using splines (a mathematical technique used to produce a number of curves to best fit the data). The model was then extended past the IRT intervention point to create expected differences. Any change in trend and/or average baseline post the IRT intervention was then observed and evaluated using a Wald test of significance to determine the likelihood of any notable changes in the measure being attributed to the IRT project intervention or natural trend / variation.

Significant results for a change in measure post IRT intervention was found for the below outcomes:

#### **IRTO 002 COPD non-elective admissions per prevalent patient (see tab 002 COPD)**

This measure showed a significant result for an immediate change in the average baseline admission rates post IRT intervention (a change in intersection). The P-value for this test was 0.0396. Non-elective admissions rates for the COPD cohort showed a higher than expected difference between the IRT and the control group. For the IRT group, the observed admission rates for 2019-20 were higher than previous financial years. The Non-IRT area appeared to be increasing at a slower rate than the IRT group for the same time period and this could have also contributed to the increase in the difference in admission rates between the two areas.

#### **IRTO 002 Asthma non-elective admissions per prevalent patient (see tab 002 Asthma)**

This measure showed a significant result for a change in average baseline admission rates and also a change in trend in admission rates post IRT intervention. The P-value for these tests were: change in trend 0.0224, change in baseline average 0.0268. Observing the differences between the IRT and Non-IRT group showed that the trend had shifted from an upwards trend pre IRT intervention to a downward trend post IRT intervention. The actual admission rates did not see a decrease for either the IRT or the Non-IRT areas, but the gap between the two rates appeared to be closing. This could be due to the slight decrease in admissions rates in the IRT cohort, an increase in admission rates for the Non-IRT cohort, or a combination of the two.

#### **IRTO 005 Outpatient referrals per 1,000 registered population (see tab 005 Referrals)**

This measure showed a significant result for a change in average baseline referral rate and also a change in trend in referral rates post IRT intervention. The P-values for these tests were: change in trend 0.0024, change in baseline average 0.0075. Observed differences between the IRT and Non-IRT referral rates were lower than the predicted model post the IRT intervention date, which was an expected outcome of the IRT project as it was anticipated that patients would be diverted away from these clinics and referred to the IRT clinics instead.

#### Conclusion

The IRT Service specifically targeted patients who have COPD and Asthma so it is perhaps not unexpected that these two measures revealed a significant change in the difference between the IRT and the control group post intervention. Although a significant change was detected, for COPD this was not in the desired direction. COPD cohort admissions are at their highest rate for the 2019-20 financial year in the IRT area, so there is a potential that the IRT service has contributed to this increase. For the Asthma cohort, the impact from the IRT service appears to have kept the asthma admission rates at a steady if not slightly decreasing trend, with the Non-IRT area experiencing a natural increase in admissions, this then caused the gap between the two areas to close and the significant change in trend and average baseline to be observed. Referral rates are perhaps the most obviously impacted by the IRT service, with the steep upward trend in the control group not present for that of the IRT area. The service has clearly successfully re-directed patients to the IRT service and away from the outpatient clinics.

The main expected outcome from the IRT intervention was the change in non-elective admissions for the updated focus cohort, of which the IRT project team had predicted a 20% reduction from the previous financial year. This measure showed no significant change post the IRT intervention and so is unlikely to have been impacted by the IRT Intervention, with any changes observed likely associated with natural trend.

The expanded cohort for non-elective admissions, all cohorts for re-admissions, and outpatient follow ups also did not see any significant change post IRT intervention.

A worthy note when reviewing this piece of analysis is that any results found are drawn from the assumption that there is a true control group. By this, we mean that patients in the Non-IRT localities should have had no contact with the IRT service. Throughout the project there has been speculation around whether the Non-IRT area is a true control group. During an IRT project implementation meeting in November 2019, the employment of 2 new community nurses in the non-IRT area was announced, and conversations revealed that nurses cross cover across localities to assist with patient care where required.

Measure	Source	Methodology/Data Inclusions and Exclusions
Non-Elective Admissions	SUS Inpatient Spells	In Expanded cohort Commissioner Oxfordshire CCG NHS Patients only (excludes private patients) Non-elective admissions only Age > 17 [REDACTED]
Re-admissions		OUH Ambulatory Unit activity is included in this report as these are coded within inpatient SUS data. These Ambulatory Unit attendances are coded as admissions (even if the patient did not actually occupy a bed). For the expanded cohort this takes up approximately 4 - 5 % of activity.  Readmissions are defined as patients with a recorded NHS Number having another non-elective admission within 30 days of discharge. The clinical cohort for these patients are defined using the <u>readmission</u> spell coding.
GP Populations	NHS Statistics	Age > 17 Commissioner Oxfordshire CCG [REDACTED]
Asthma Prevalence	EMIS	Age > 17 Patients with an Asthma diagnosis recorded in EMIS Patients who have declined sharing data are excluded [REDACTED]
COPD Prevalence	EMIS	Age > 17 Patients with an COPD diagnosis recorded in EMIS Patients who have declined sharing data are excluded [REDACTED]
Outpatient Referrals	Local Outpatient Referrals (OPREF) submission from OUH	In Target cohort Age > 17 Commissioner Oxfordshire CCG [REDACTED]
Outpatient Follow Up Appointments	SUS Outpatient	Age > 17 Commissioner Oxfordshire CCG [REDACTED] [REDACTED] Follow Up appointments only Attended appointments only NHS Patients only (excludes private patients) Restricted using clinic codes identified in the Target Cohort of the Outpatient Referrals data

**Inpatient Spells - Updated Focus Cohort**

Primary diagnosis of:	AND Secondary diagnosis of:
Respiratory Infection (contains Bronchitis, Pneumonia, Upper Respiratory Tract Infection, Lower Respiratory Tract Infection)	Asthma, Bronchiectasis, Bronchitis, COPD, Emphysema, Interstitial Lung Disease, Sarcoidosis and Wheezing
Sepsis	Asthma, Bronchiectasis, Bronchitis, COPD, Emphysema, Interstitial Lung Disease, Sarcoidosis and Wheezing
Abnormalities of breathing (contains wheezing and cough)	Asthma, Bronchiectasis, Bronchitis, COPD, Emphysema, Interstitial Lung Disease, Sarcoidosis and Wheezing
COPD (contains Emphysema)	Any (no restriction)
Asthma	Any (no restriction)
Bronchiectasis	Any (no restriction)
ILD	Any (no restriction)
Sarcoidosis	Any (no restriction)

**Inpatient Spells - Expanded Cohort**

Primary diagnosis of:	AND Secondary diagnosis of:
Respiratory Infection (contains Bronchitis, Pneumonia, Upper Respiratory Tract Infection, Lower Respiratory Tract Infection)	
COPD (contains Emphysema)	
Asthma	
Bronchiectasis	
ILD	
Sarcoidosis	
Lung Cancer	
Abnormalities of breathing (contains wheezing and cough)	
Sepsis	Asthma, Bronchiectasis, Bronchitis, COPD, Emphysema, Interstitial Lung Disease, Sarcoidosis and Wheezing

**Inpatient Spells - COPD Cohort**

Primary diagnosis of:	OR Secondary diagnosis of:
COPD (contains Emphysema)	COPD (contains Emphysema)

**Inpatient Spells - Asthma Cohort**

Primary diagnosis of:	OR Secondary diagnosis of:
Asthma	Asthma

**Outpatient Referrals - Target Cohort**

Appointment Type:
Respiratory Asthma New
Respiratory Asthma FU
Respiratory Bron New
Respiratory Bron FU
Respiratory COPD New
Respiratory COPD FU
Respiratory Sarcoid New
Respiratory Sarcoid FU
Respiratory General Smith Horton New
Respiratory General Smith Horton FU
Respiratory ILD LFT New
Respiratory ILD LFT FU

The Difference-in-Difference Estimation

This approach looks at the difference between the intervention group and the control group and uses these differences to model the "expected" difference between the two groups. This then allows comparison between the actual difference and the expected difference (the expected difference being what would happen if the IRT project never happened).

There are many benefits of using this approach. One benefit being that rather than looking at the actual change in admission volumes alone for each of the intervention and control group, which are very affected by seasonality, ageing population, and changes in coding practice (to take a few as an example), this approach looks at the difference between the two groups, so negates the need for modelling these factors into the analysis, as both groups are affected by them.

The assumptions and best practice of using this model have been investigated and are outlined below.

Assumptions for Difference-in-Difference Estimation

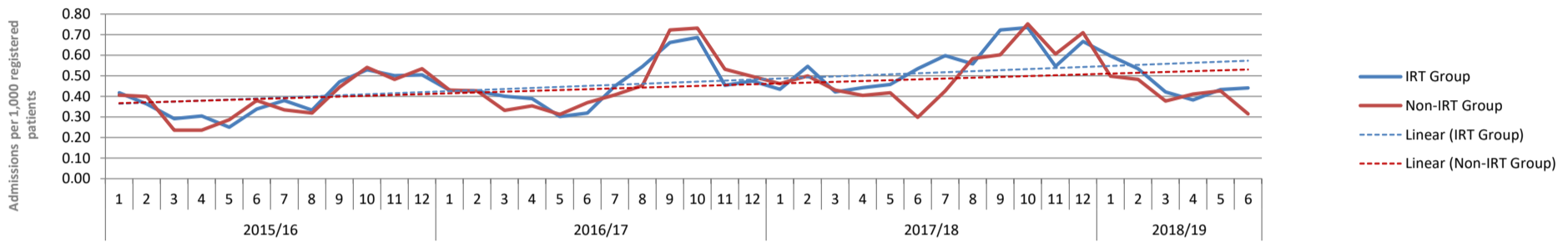
- Intervention unrelated to outcome at baseline (allocation of intervention was not determined by outcome)
- Treatment/intervention and control groups have parallel trends in outcome
- The trend in the control group approximates what would have happened in the treatment group in the absence of the treatment
- Composition of intervention and comparison groups is stable for repeated cross-sectional design
- No spill over effects

Best Practice for Difference-in-Difference Estimation

- Be sure outcome trend did not influence allocation of the treatment/intervention
- Acquire more data points before and after to test parallel trend assumption
- Be sure to examine composition of population in treatment/intervention and control groups before and after intervention
- Use robust standard errors to account for autocorrelation between pre/post in same individual
- Perform sub-analysis to see if intervention had similar/different effect on components of the outcome

note: Treatment/intervention Group = **IRT Group**. Control Group = **Non-IRT Group**

IRTO-002 Updated Focus Cohort Non-Elective Admissions, per 1,000 Registered Population



Comments

- Taking non-elective admissions per 1,000 registered population as an example, we can determine that the intervention and control groups have similar trends. The trend is not parallel, but the two groups do follow a very similar trend and this should be noted.
- The city and north localities were selected for the IRT pilot areas as there was a general impression that there was high activity in these areas.
- Spill over effects were thought to not be an issue as the IRT Group consists of the only patients who have access to the services provided by the IRT Project. As of 14th November 2019, it was explained that 2 new Respiratory nurses have been employed in the control group. This should be taken into account when interpreting the analysis for future months.
- The composition of the IRT and control groups has been investigated as part of the preparation of the analysis. Please see supporting document PR11641 - IRT Populations v2.xlsx

Year	Month	Item	Key Information
18/19	7 Oct	A	01/10/2018 - Respiratory Consultant recruited
	8 Nov		
	9 Dec		
	10 Jan		
	11 Feb	B	01/02/2019 - Specialist Respiratory Nurse Manager (Lead) & Physiotherapist Team Leader recruited 12/02/2019 - Respiratory GP (City) (x2) recruited
	12 Mar	C	18/03/2019 - Respiratory GP (City) recruited
19/20	1 Apr		
	2 May	D	01/05/2019 - Palliative Consultant (City) & Palliative Nurse/Therapist (City) recruited 20/05/2019 - Clinical Pharmacist recruited
	3 Jun	E	03/06/2019 - IRT Administrator recruited 10/06/2019 - Operational Manager recruited
	4 Jul	F	01/07/2019 - Palliative Nurse/Therapist (North) & Palliative Consultant (North) & IAPT Clinical Psychologist/Supervisor recruited 08/07/2019 - Palliative Occupational Therapist recruited 15/07/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited
	5 Aug	G	01/08/2019 - Respiratory GP (North), Health Care Assistant (HCA/SCW) & IAPT Clinical Psychologist/Supervisor recruited 27/08/2019 - Smoking Cessation/Home Assessment Advisor recruited 28/08/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited
	6 Sep	H	01/09/2019 - Respiratory GP (City) left for Maternity leave - no replacement yet
	7 Oct	I	Specialist Respiratory Nurse Manager (Lead) injured and off work for a number of weeks in Oct/Nov 2019.
	8 Nov	J	CCG and SCW informed in IRT Project Implementation Group Meeting that 2 Respiratory nurses have been employed in the control group area
	9 Dec		
	10 Jan	K	First Coronavirus case reported in England
	11 Feb		
	12 Mar		

Note: Above timeline was created using the recruitment tracker for the IRT Project. The CCG clinical lead for the project has added supplementary information on recruitment in the primary and community setting. Please see supplementary document *IRT Timeline 20191205.docx*

Each chart shows the difference between the IRT Group and Non-IRT Group for the measure in hand. For example, difference in non-elective admission rates per 1,000 registered patients.

Where the difference between the IRT and Non-IRT Group is showing as a positive figure this means that the IRT Group had a higher number of the measure than the Non-IRT Group.

Where the difference is negative, the IRT Group had a lower number of the measure than the Non-IRT Group.

This report aims to model the "expected" difference between the 2 cohorts with the difference between the actuals and expected to be further examined.

3 types of statistical modelling were explored in order to display the "expected" differences: Robust Linear Regression, Cubic Regression and Smoothed Spline Regression. All 3 of these models were calculated using a baseline of April 2015 to November 2018. The decision was made to use the Smoothed Spline Model and this is modelled throughout the report (solid blue line on each chart). A smoothed spline model works by taking fixed points in the data and modelling curves between these points to best fit each segment of data.

The smoothed spline model is used to display "expected" (predicted) values for the difference between the IRT Group and the Non-IRT Group and it should be noted that this model is not predicting actual levels of admissions for patients. To aid the understanding of the charts showing the differences between the 2 groups, below these are charts showing the actual values for each group.

Each chart also displays any key information from the project. The dotted red line marked with the letter A (at October 2018 on each chart) signifies the official start date of the intervention (the date the first IRT consultant was recruited). Following on from this, any key information is marked with a subsequent letter.

Each measure will need to be interpreted slightly differently when looking at the differences between the 2 cohorts. This is due to the suspected impact of the IRT project which includes changes to:

- COPD diagnoses (in both Primary and Secondary Care)
- Asthma diagnoses (in both Primary and Secondary Care)
- Non-Elective Admission volumes
- Readmission volumes

Each of the above are used to define particular measures within this report. If we take, for example, the COPD cohort, this measure is showing non-elective admission rates per prevalent patient.

Numerator = no. COPD non-elective admissions (SUS)

Denominator = no. COPD prevalent patients (EMIS)

Both of these figures are suspected to be affected by the IRT Project. It has been noted that the number of admissions is likely to increase due to improved diagnosis rates, but this will also affect the number of prevalent patients. Another outcome expected is a decrease in the number of non-elective admissions due to improved care in the primary setting.

A Wald test for significance was used throughout this report.

This test uses a basis of robust linear regression which is fitted to each of the outcome measures for the difference between the IRT and Non-IRT rates. The test then looks to see if there is any significant change in the slope of the regression (a change in trend of average admissions post IRT intervention) and/or a change in intersection of the regression (a change in the baseline average admissions post IRT intervention).

As we are using a difference in difference approach to approximate trends in the data, it is likely that if there is a significant change found, this is due to the IRT intervention and not an external factor.

Significance tests work by obtaining the probability that the observed values have occurred by chance, given the null hypothesis is true. These probabilities are known as P-values.

P-values were obtained and evaluated for each outcome measure in this report to determine whether the observations post IRT intervention were significantly different to the values we would have expected if there was no intervention. P-values give you an indication of whether to accept or reject the null hypothesis, of which for this test is:

No: *"There is no change in slope or intersection of the linear regression post the IRT intervention point (no impact of IRT intervention on difference in outcome between the IRT and non-IRT groups)".*

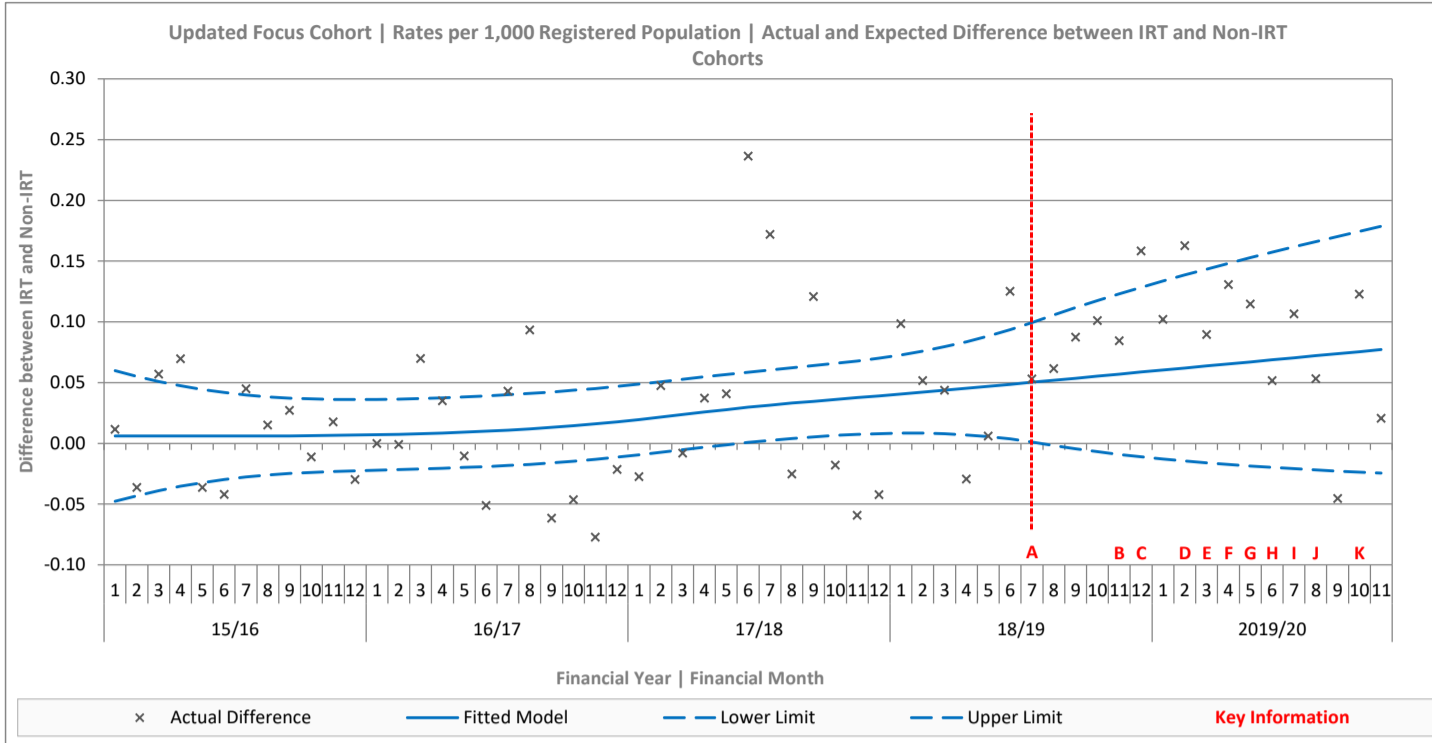
A small P value of much less than 0.05 indicates strong evidence against the null hypothesis. This would mean that we can reject the null hypothesis – there is evidence that IRT has made a difference.

A large P value of greater than 0.05 indicates no evidence against the null hypothesis. This would mean that the null hypothesis cannot be rejected, the trend/average difference between the IRT and Non-IRT groups are consistent, and the IRT intervention is likely to have had no effect.

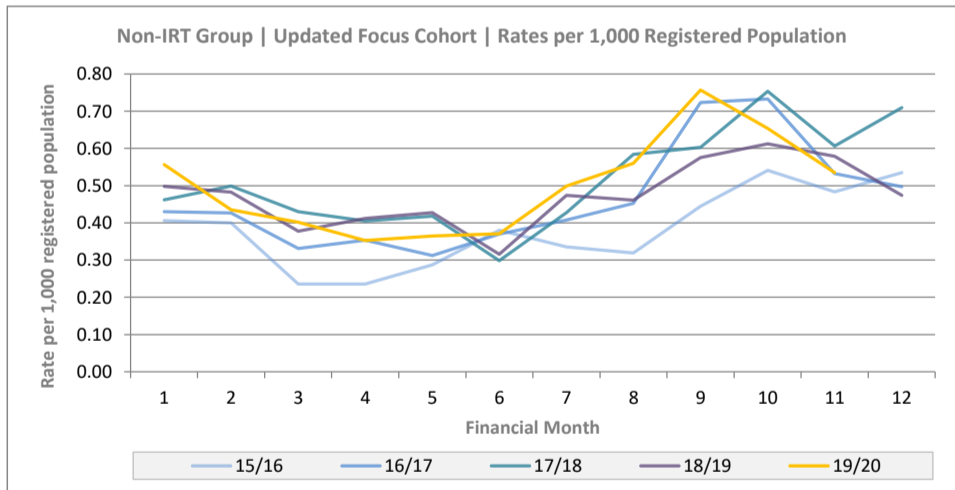
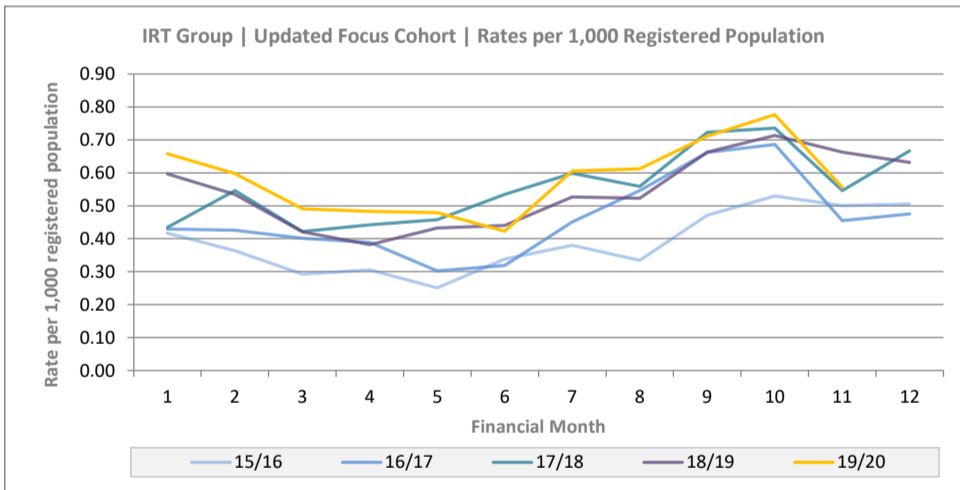
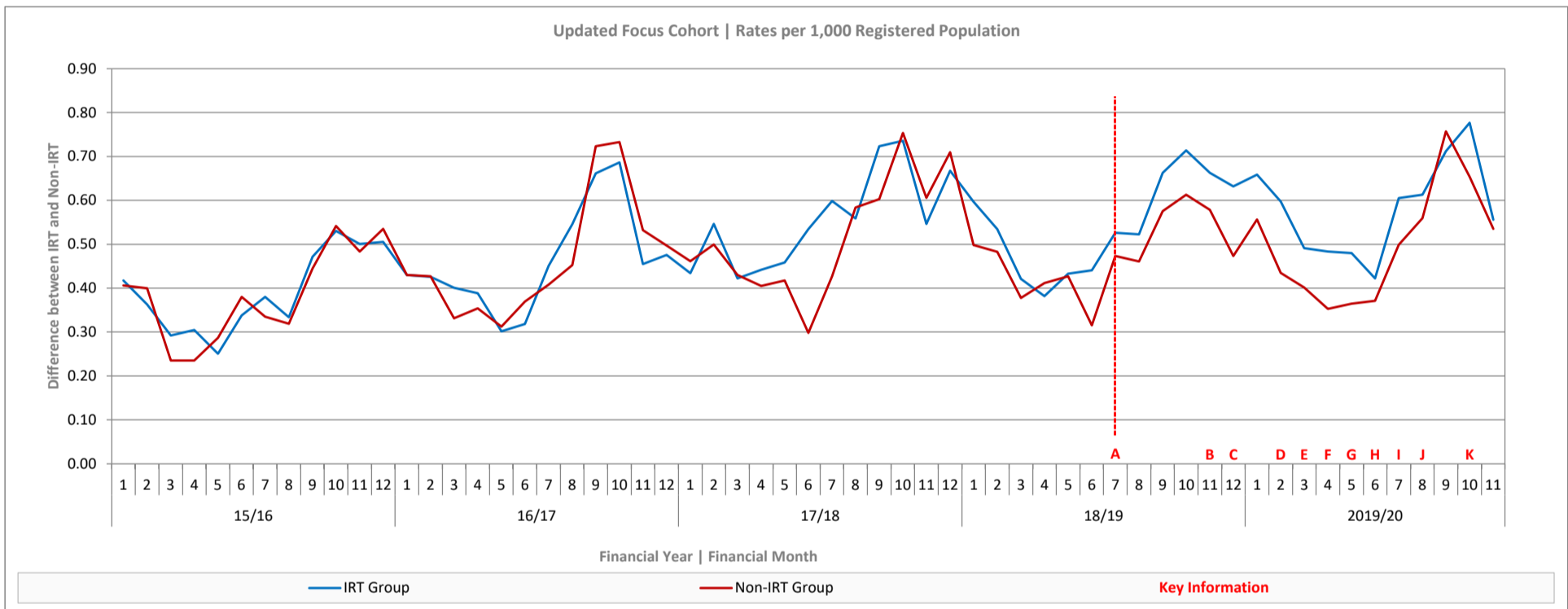
A P value which is very close to 0.05 is considered to have marginal evidence for or against the null hypothesis and produces an inconclusive result.

P-values reported in this evaluation are to 4 decimal places.





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8	Nov	J	
9	Dec		
10	Jan	K	First Coronavirus case reported in England
11	Feb		



**Narrative**

The majority of the differences between the two cohorts, past the red intervention point, are higher than the "expected" blue trend line. This is mainly evident between November 2018 and August 2019. Although this is the case, the majority of these points fall within the upper 95% confidence interval and so one might interpret this as a natural trend not affected by the IRT intervention. In the latter part of 2019 the majority of points are lower than expected, but again most points do not leave the lower 95% confidence interval.

The results for the significance tests for this measure in particular were as follows.

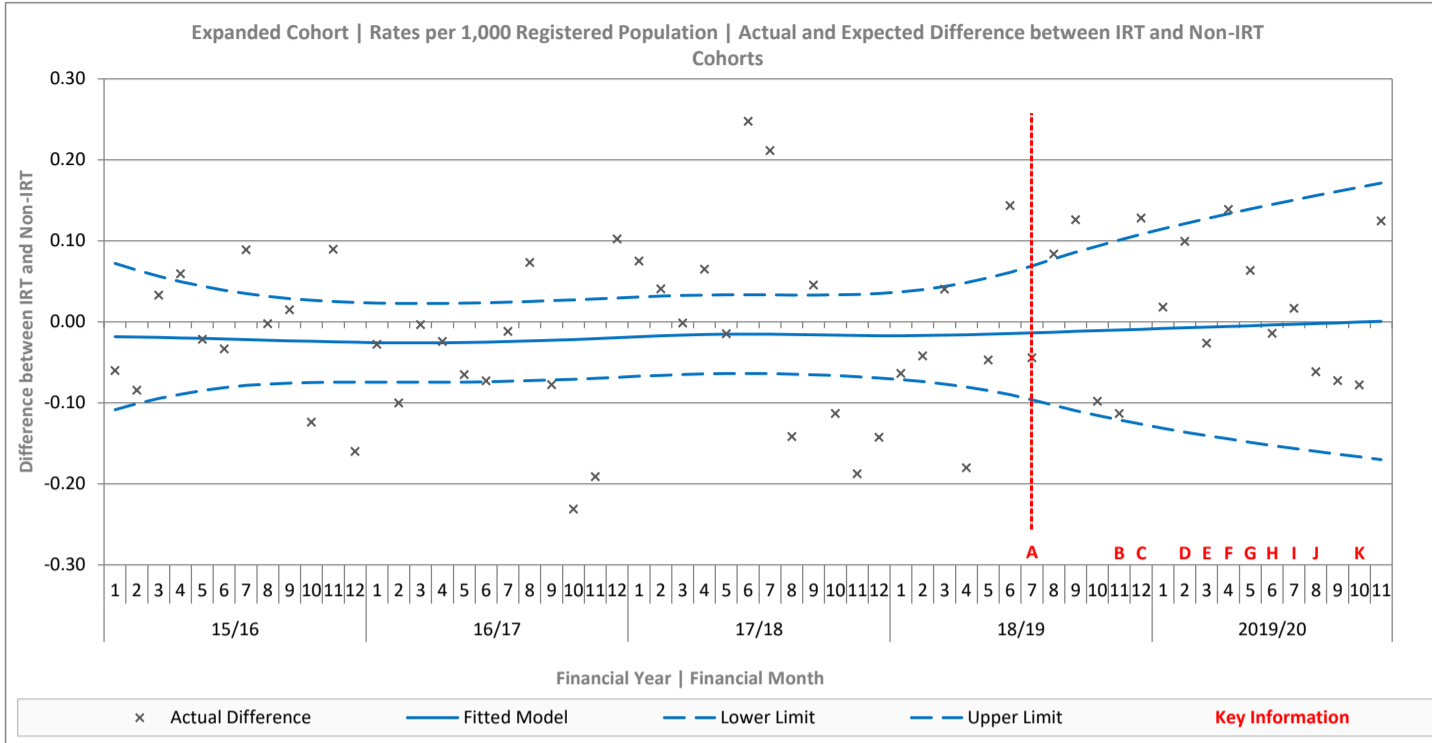
Test for change in slope: **P = 0.0940**

The null hypothesis can not be rejected, the trend in the difference between the IRT and Non-IRT admission rates are consistent, and the IRT intervention is likely to have had no effect.

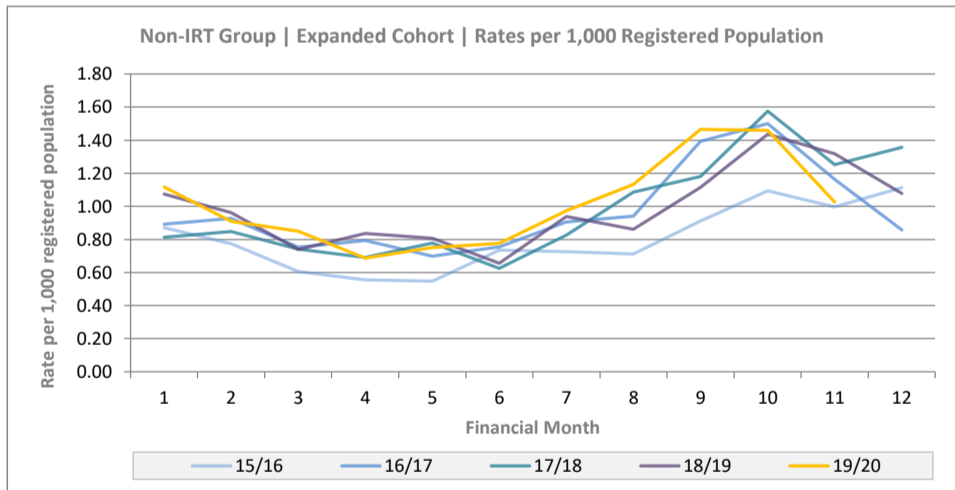
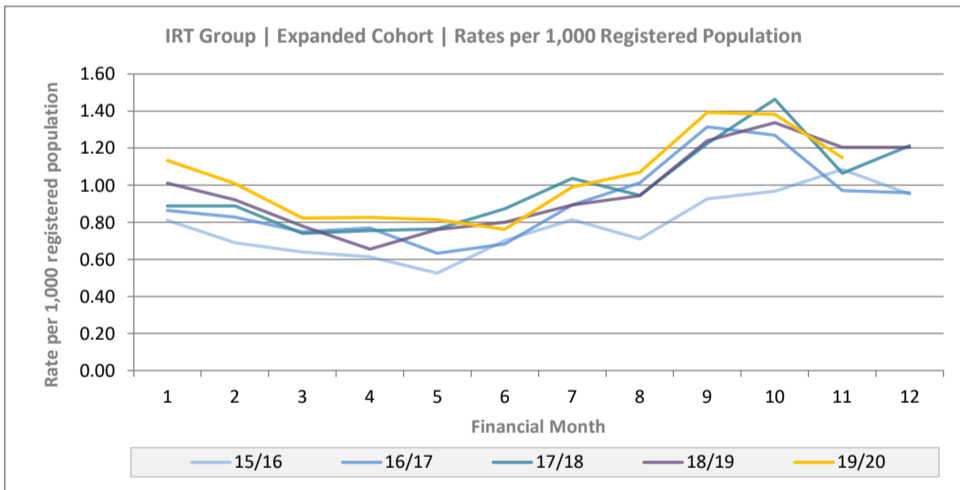
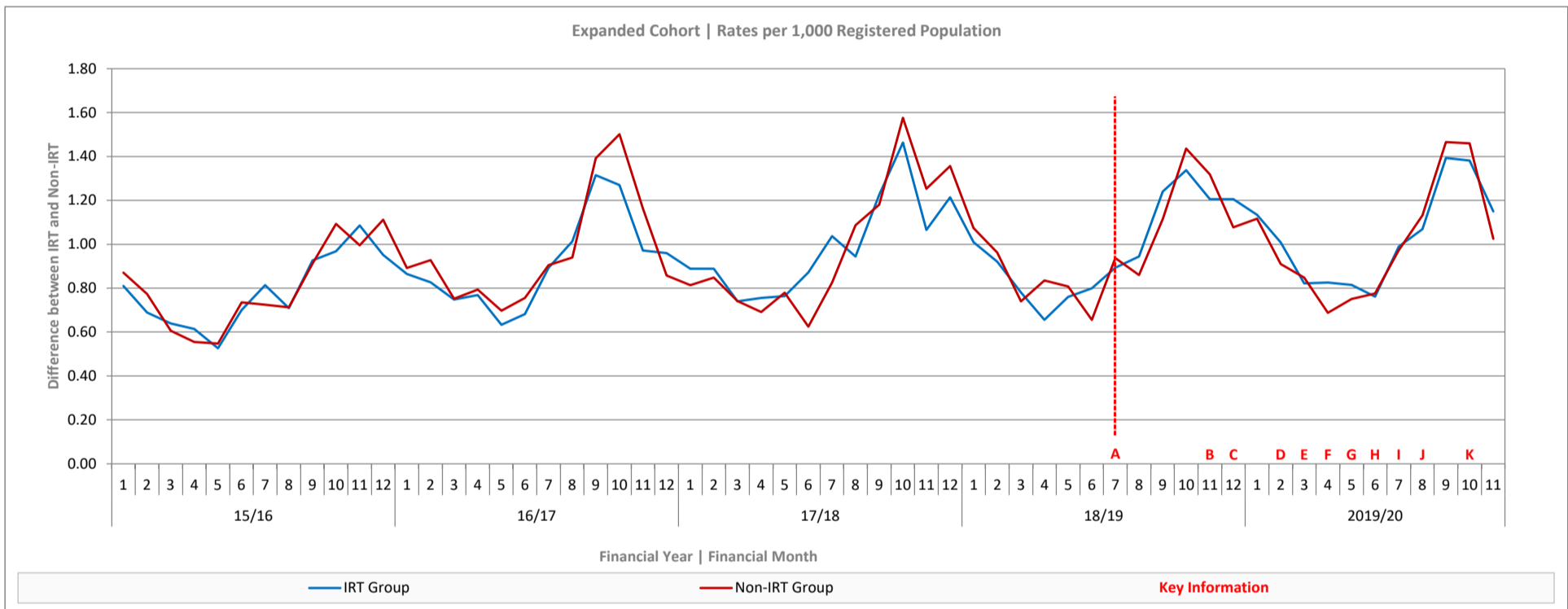
Test for change in intersection: **P = 0.0494**

An inconclusive result. Although the P value is less than 0.05, the value is so close that there is marginal evidence to support or reject the null hypothesis.

Comparing these results to the actual rates of admissions, we can see that the admissions for the focus cohort are the highest they have been in the last 5 years for the IRT Group. For the non-IRT group, admissions are showing rates of admissions of around the same as (if not a bit lower than) the last 2 years for the first half of 2019-20, but in the latter half of the financial year, increase in trend to higher than the previous 5 years (as the IRT area). As the difference between the two cohorts falls within the expected fitted model, and the significance test did not show an indication to reject the null hypothesis, this might suggest that the increase in trend and average baseline admissions for the IRT cohort was a natural increase that would have happened regardless of the intervention (as the differences between the two cohorts are within the expected region), so we can not confidently say that the intervention has made any impact on the admission rates, be it for better or worse.



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**Narrative**

Observing all charts on this page we can see that the IRT and the non-IRT group follow very similar trends, with the difference between the two groups hovering between -0.02 and 0. Although there is a general slight upward trend in admissions this is evident in both groups.

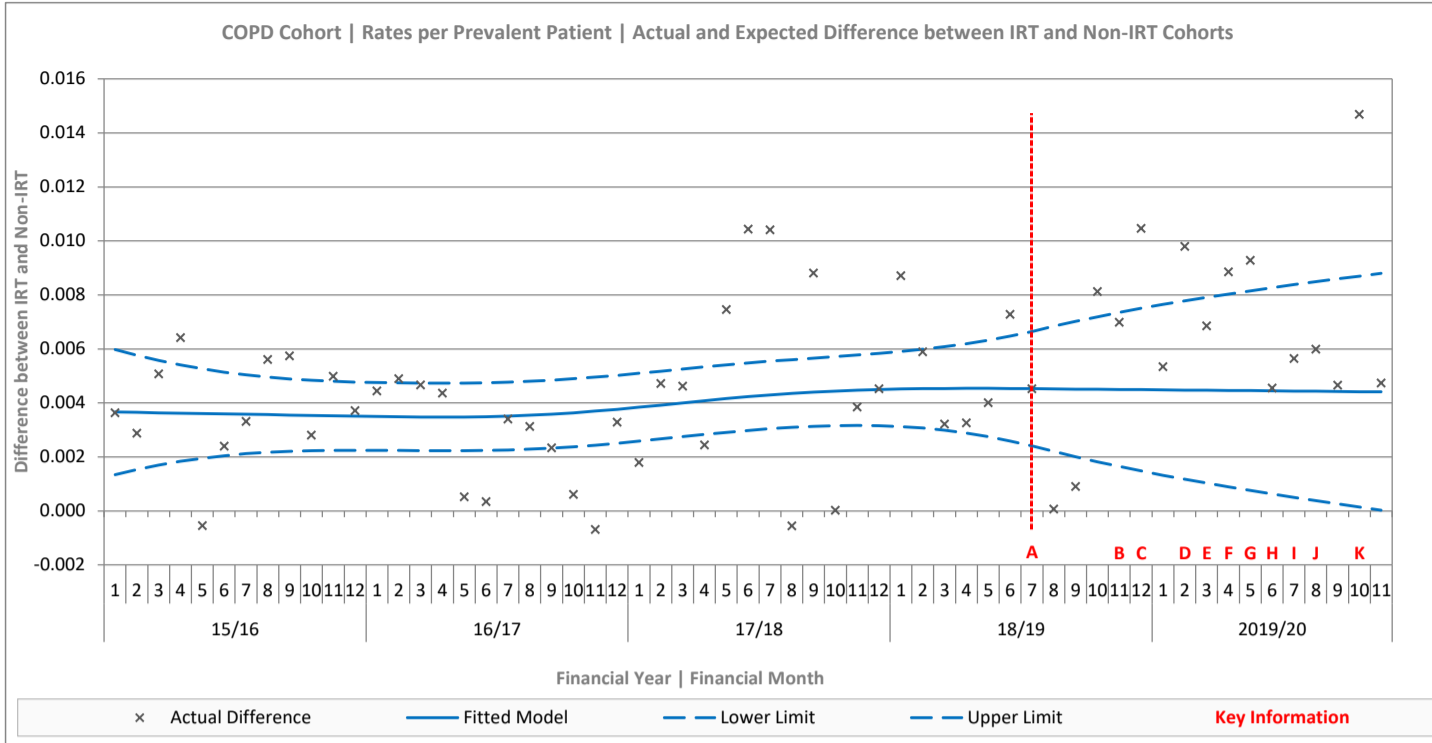
The results for the significance tests for this measure in particular were as follows.

Test for change in slope: **P = 0.7447**

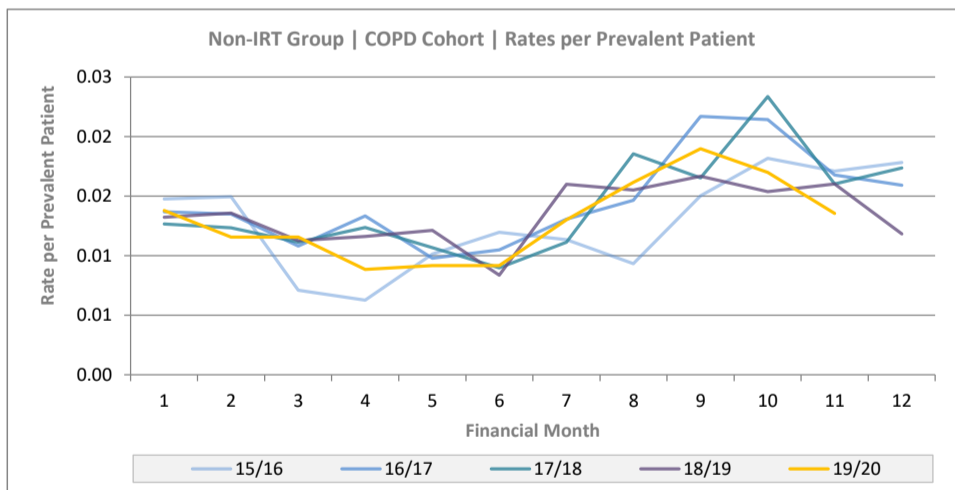
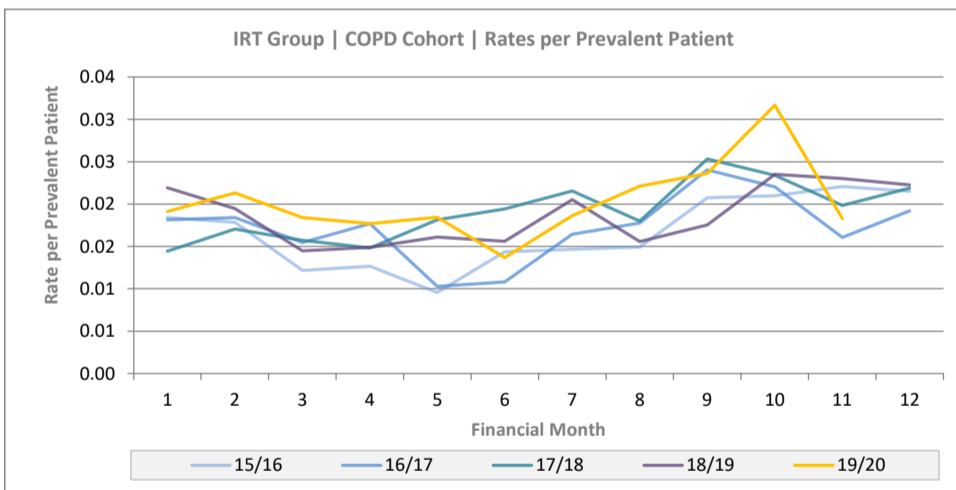
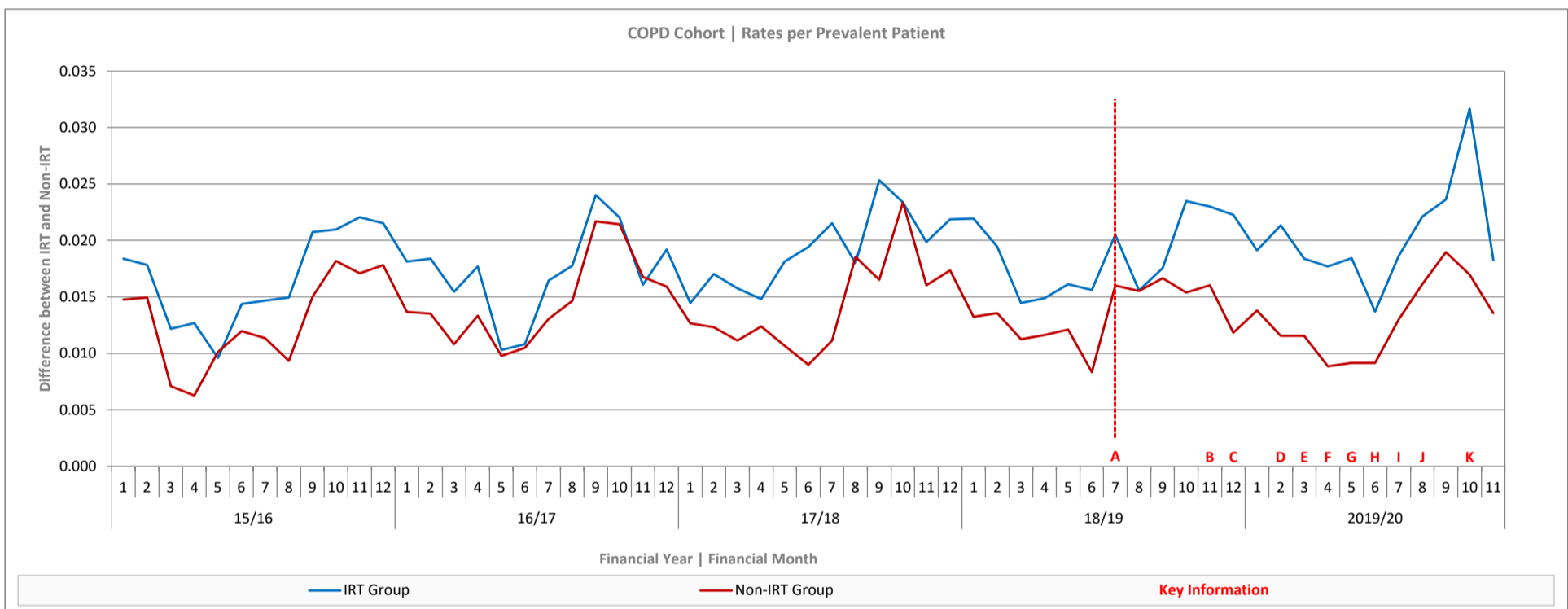
The null hypothesis cannot be rejected, the trend in the difference between the IRT and Non-IRT admission rates are consistent, and the IRT intervention is likely to have had no effect.

Test for change in intersection: **P = 0.6547**

The null hypothesis cannot be rejected, the baseline average in the difference between the IRT and Non-IRT admission rates are consistent, and the IRT intervention is likely to have had no effect.



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	8 Nov	J	15/07/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited
	9 Dec		01/08/2019 - Respiratory GP (North), Health Care Assistant (HCA/SCW) & IAPT Clinical Psychologist/Supervisor recruited
	10 Jan	K	27/08/2019 - Smoking Cessation/Home Assessment Advisor recruited
	11 Feb		28/08/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited
			01/09/2019 - Respiratory GP (City) left for Maternity leave - no replacement yet
			Specialist Respiratory Nurse Manager (Lead) injured and off work for a number of weeks in Oct/Nov CCG and SCW informed in IRT Project Implementation Group Meeting that 2 Respiratory nurses have been employed in the control group
			First Coronavirus case reported in England



**Narrative**

From January 2019, all differences between the two cohorts, are higher than the "expected" blue trend line. 43% of these differences fall outside of the upper confidence interval.

The results for the significance tests for this measure in particular were as follows.

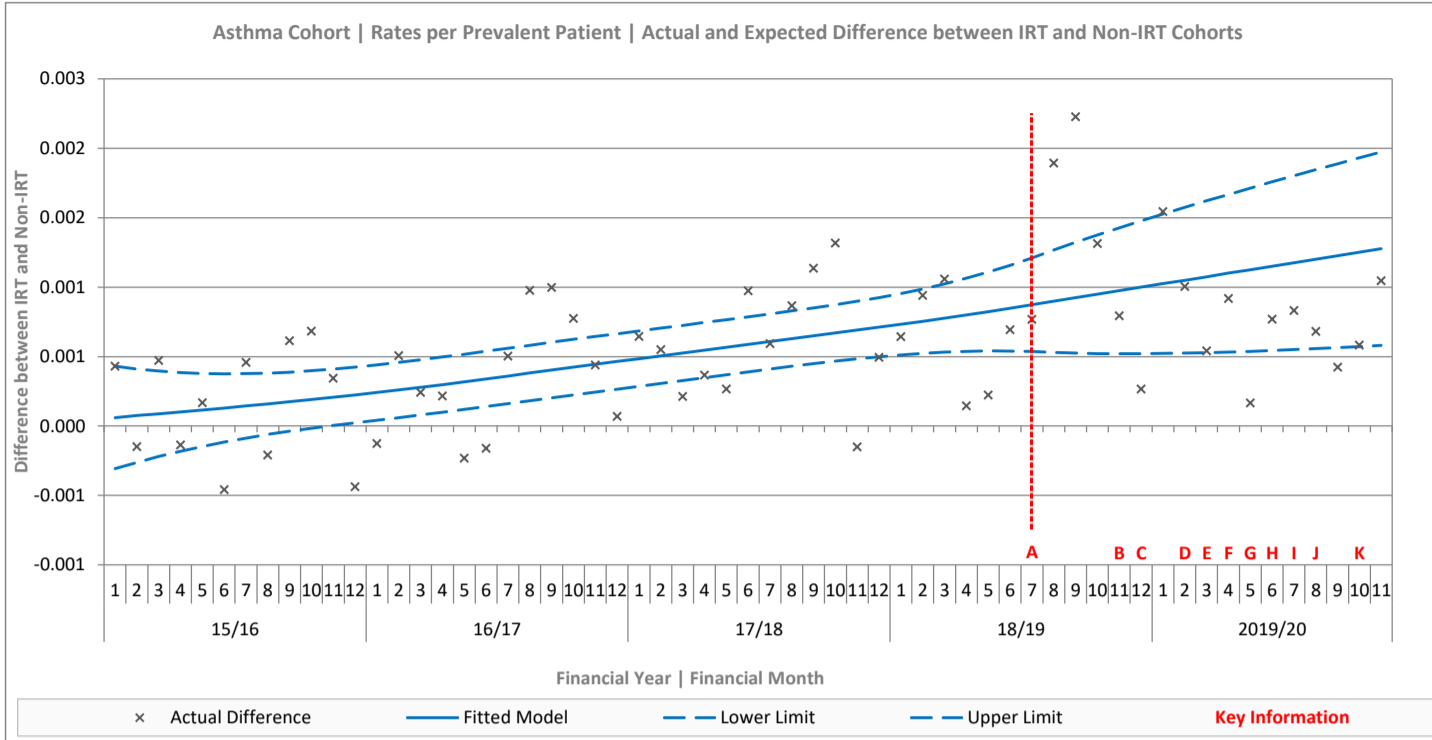
Test for change in slope: **P = 0.5662**

The null hypothesis cannot be rejected, the trend in the difference between the IRT and Non-IRT admission rates are consistent, and the IRT intervention is likely to have had no effect on the trend of average admissions.

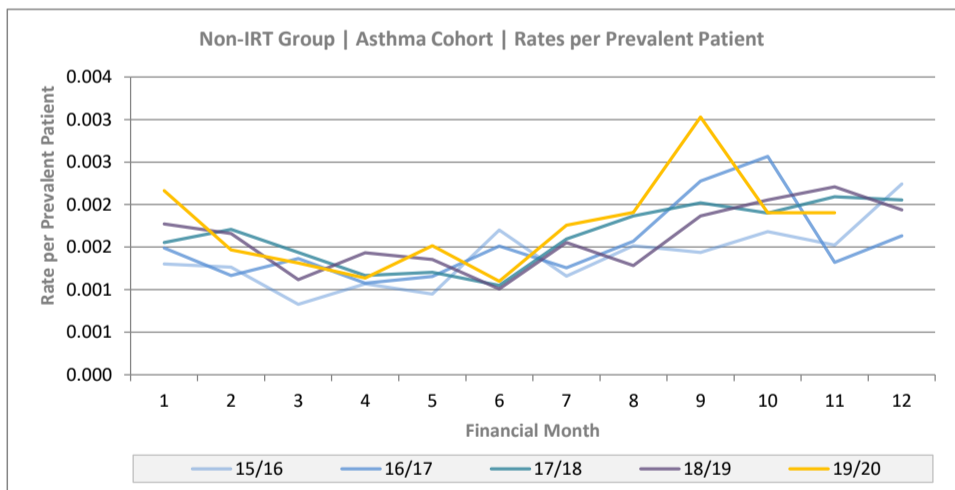
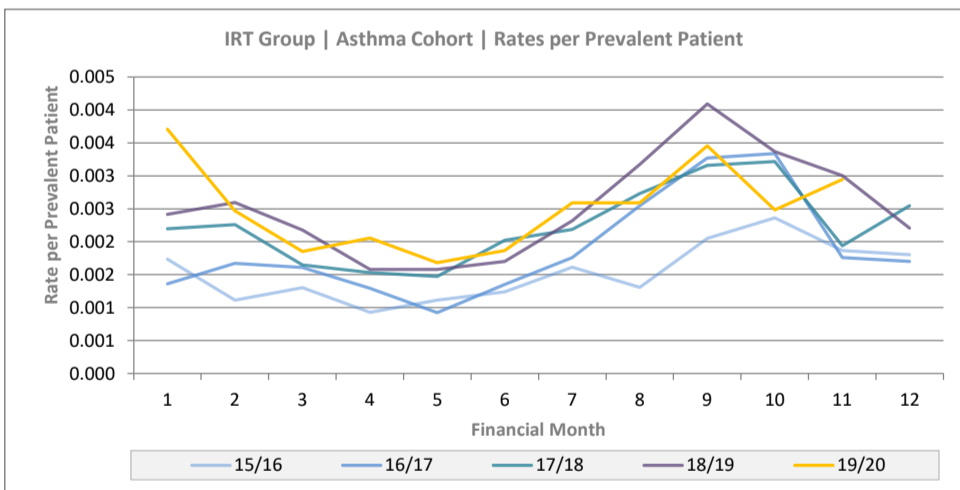
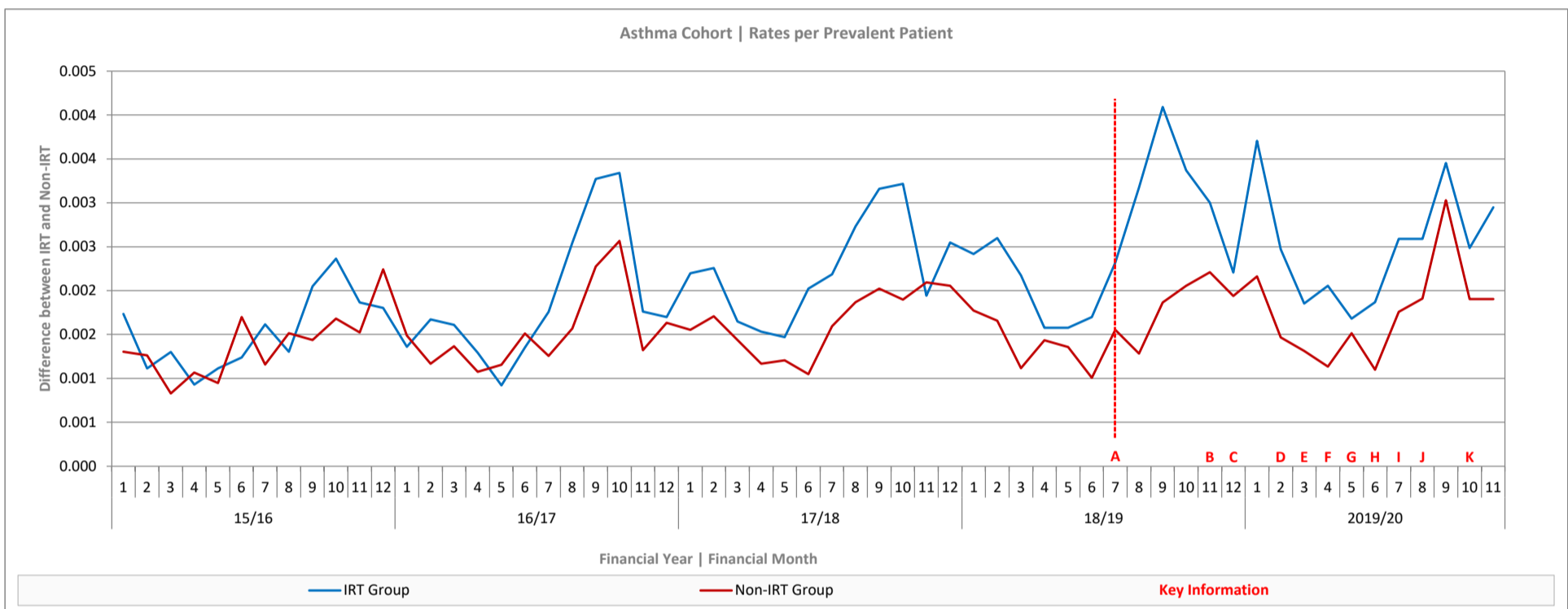
Test for change in intersection: **P = 0.0396**

This P-value is less than 0.05, so the null hypothesis can be rejected, as the P-value indicates significance. The IRT intervention has caused an immediate change in the baseline average of difference of admission rates between the IRT and Non-IRT groups, for the COPD cohort.

Comparing these results to the actual rates of admissions, we can see that the admissions for the COPD cohort, for the IRT group, are the highest they have been in the last 5 years. The overall trend for both the IRT cohort and the Non-IRT cohort has been upwards for the last 5 years, however, the Non-IRT cohort appears to be increasing at a lower rate than the IRT Cohort, seen most obviously post April 2018. Although the difference between the two cohorts has increased, this could be down to a decrease in the Non-IRT area average for a number of months post the IRT Intervention date. This is worth noting in conjunction with the significant result calculated above, as the test for significance indicates that the null hypothesis does not hold (is rejected), but does not indicate why. This evidence suggests that the IRT Intervention has had an impact on the difference between the IRT and Non-IRT groups for the COPD cohort, but how this impact relates to admissions is not tested.



Year	Month	Item	Key Information
18/19	7 Oct	A	01/10/2018 - Respiratory Consultant recruited
	8 Nov		
	9 Dec		
	10 Jan		
	11 Feb	B	01/02/2019 - Specialist Respiratory Nurse Manager (Lead) & Physiotherapist Team Leader recruited
	12 Mar	C	12/02/2019 - Respiratory GP (City) (x2) recruited
	1 Apr		18/03/2019 - Respiratory GP (City) recruited
	2 May	D	01/05/2019 - Palliative Consultant (City) & Palliative Nurse/Therapist (City) recruited
	3 Jun	E	20/05/2019 - Clinical Pharmacist recruited
			03/06/2019 - IRT Administrator recruited
			10/06/2019 - Operational Manager recruited
			01/07/2019 - Palliative Nurse/Therapist (North) & Palliative Consultant (North) & IAPT Clinical Psychologist/Supervisor recruited
			08/07/2019 - Palliative Occupational Therapist recruited
	4 Jul	F	15/07/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited
19/20			01/08/2019 - Respiratory GP (North), Health Care Assistant (HCA/SCW) & IAPT Clinical Psychologist/Supervisor recruited
			27/08/2019 - Smoking Cessation/Home Assessment Advisor recruited
	5 Aug	G	28/08/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited
	6 Sep	H	01/09/2019 - Respiratory GP (City) left for Maternity leave - no replacement yet
	7 Oct	I	Specialist Respiratory Nurse Manager (Lead) injured and off work for a number of weeks in Oct/Nov CCG and SCW informed in IRT Project Implementation Group Meeting that 2 Respiratory nurses have been employed in the control group
	8 Nov	J	
	9 Dec		
	10 Jan	K	First Coronavirus case reported in England
	11 Feb		



**Narrative**

For the Asthma Cohort, the majority of the differences between the two cohorts, past the red intervention point, are lower than the "expected" blue trend line. There are a number of differences which escape the 95% confidence interval, but this happens both for the upper limit and the lower limit. The trend of the observed differences past the intervention point is downwards, whereas pre-IRT the opposite could be observed.

The results for the significance tests for this measure in particular were as follows.

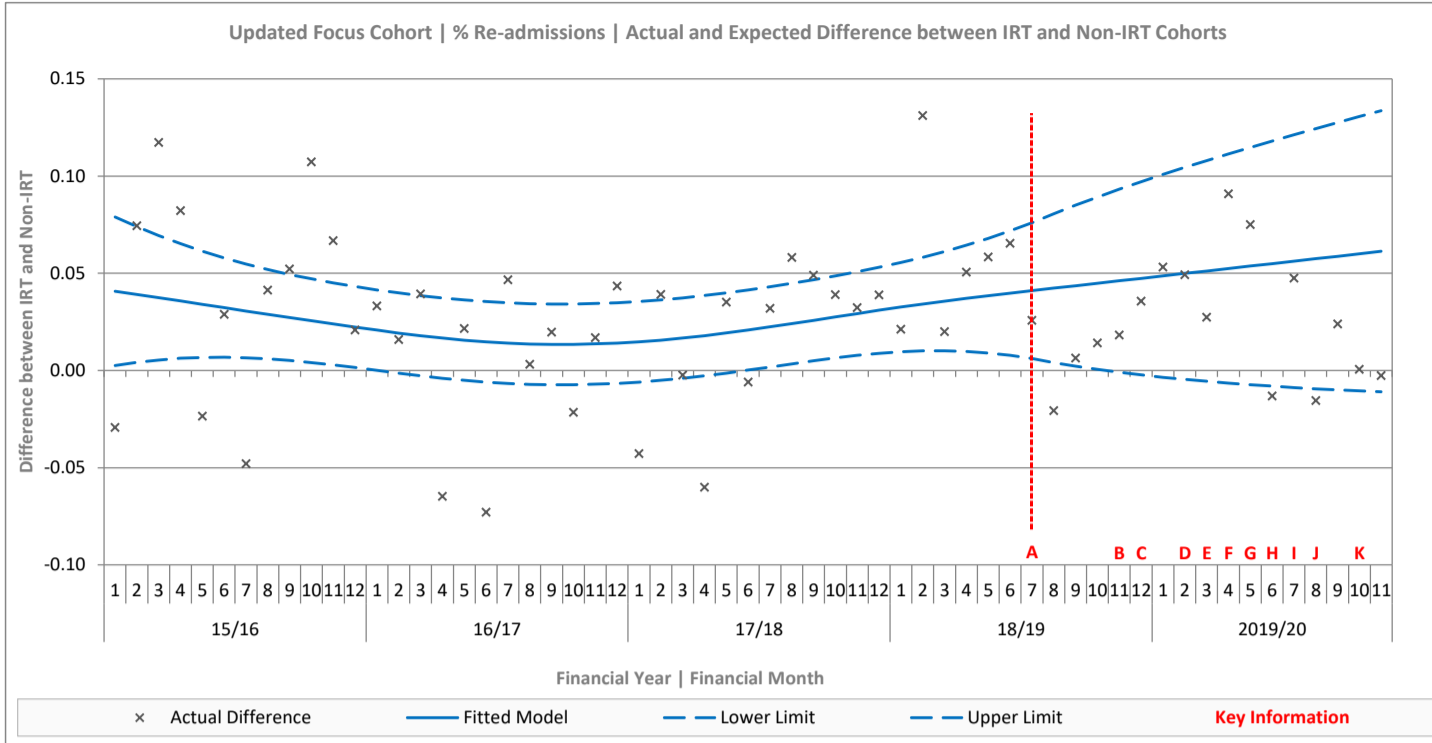
Test for change in slope: **P = 0.0224**

This P-value is less than 0.05, so the null hypothesis can be rejected, as the P-value indicates significance. The IRT intervention has caused a change in the trend of average difference of admission rates between the IRT and Non-IRT groups, for the Asthma cohort.

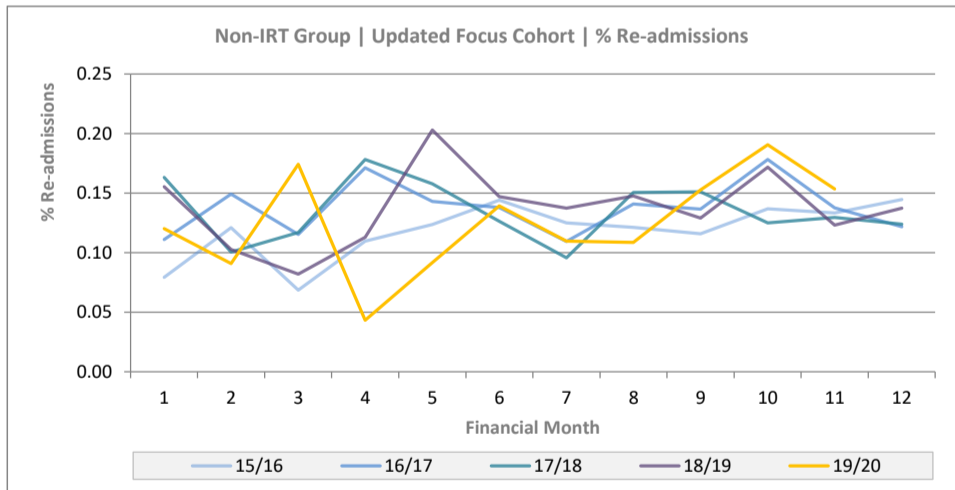
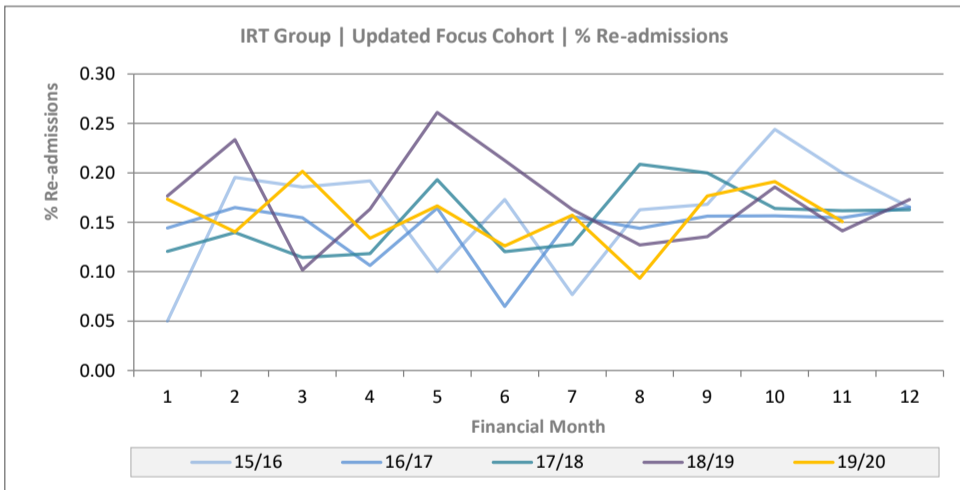
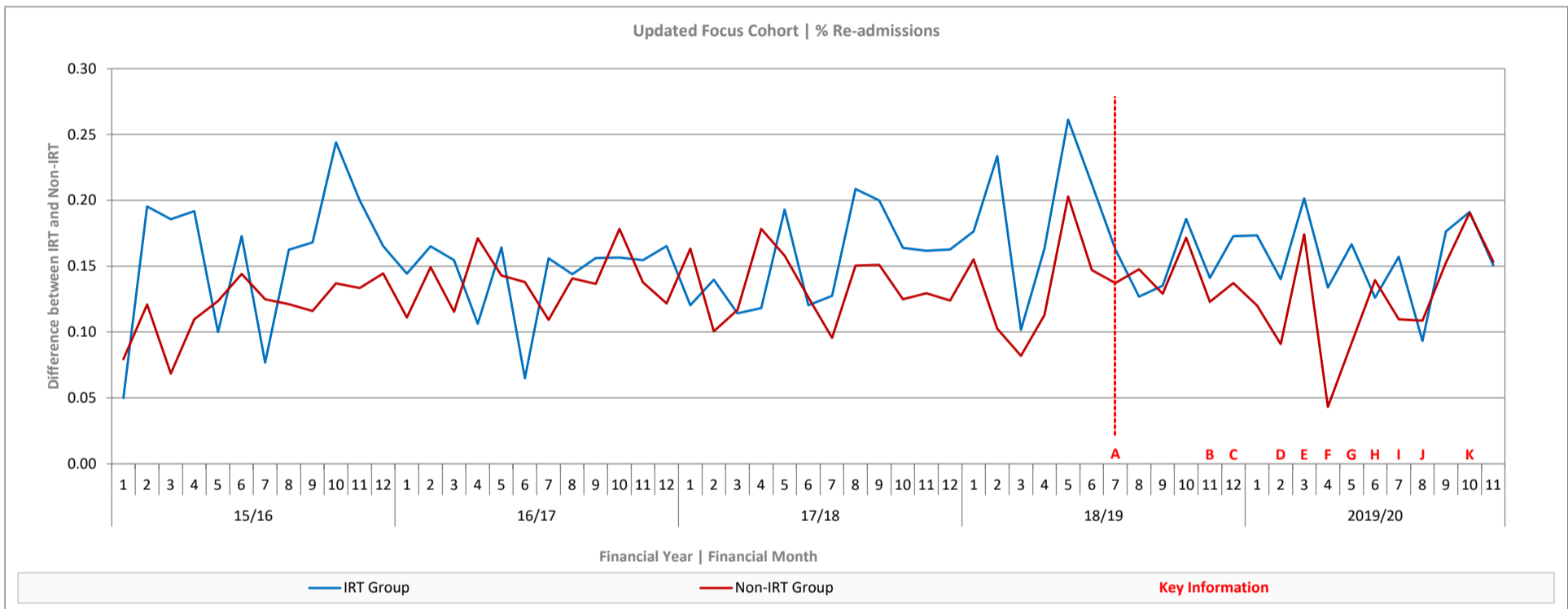
Test for change in intersection: **P = 0.0268**

This P-value is less than 0.05, so the null hypothesis can be rejected, as the P-value indicates significance. The IRT intervention has caused an immediate change in the baseline average of difference of admission rates between the IRT and Non-IRT groups, for the Asthma cohort.

Observing the actual rates of admissions for each cohort we can see that from April 2015 to September 2016 the rates for the IRT and Non-IRT cohorts followed a very similar path. The picture then changed past this point with the gap between the two groups increasing. Past the intervention point, and more obviously post April 2019, the gap between the two groups seems to decrease with the rates of admissions for the two groups becoming more in line, as was observed in the earlier years. Considering these observations along with the results of the significance test we can say that the IRT intervention may have had an impact on the closure of this gap between the two areas. It is worth noting that although the gap between the two areas is closing this looks to be a combination of the IRT area admission rates remaining steadily at a higher rate than the Non-IRT area, whilst slightly decreasing, with the Non-IRT area increasing in admission rates with a peak in December 2019.



Year	Month	Item	Key Information
18/19	7 Oct	A	01/10/2018 - Respiratory Consultant recruited
	8 Nov		
	9 Dec		
	10 Jan		
	11 Feb	B	01/02/2019 - Specialist Respiratory Nurse Manager (Lead) & Physiotherapist Team Leader recruited
	12 Mar	C	12/02/2019 - Respiratory GP (City) (x2) recruited
	1 Apr		18/03/2019 - Respiratory GP (City) recruited
	2 May	D	01/05/2019 - Palliative Consultant (City) & Palliative Nurse/Therapist (City) recruited
	3 Jun	E	20/05/2019 - Clinical Pharmacist recruited
	4 Jul	F	03/06/2019 - IRT Administrator recruited
	5 Aug	G	10/06/2019 - Operational Manager recruited
	6 Sep	H	01/07/2019 - Palliative Nurse/Therapist (North) & Palliative Consultant (North) & IAPT Clinical Psychologist/Supervisor recruited
	7 Oct	I	08/07/2019 - Palliative Occupational Therapist recruited
	8 Nov	J	15/07/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited
	9 Dec		01/08/2019 - Respiratory GP (North), Health Care Assistant (HCA/SCW) & IAPT Clinical Psychologist/Supervisor recruited
	10 Jan	K	27/08/2019 - Smoking Cessation/Home Assessment Advisor recruited
	11 Feb		28/08/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited
			01/09/2019 - Respiratory GP (City) left for Maternity leave - no replacement yet
			Specialist Respiratory Nurse Manager (Lead) injured and off work for a number of weeks in Oct/Nov CCG and SCW informed in IRT Project Implementation Group Meeting that 2 Respiratory nurses have been employed in the control group
			First Coronavirus case reported in England



**Narrative**

The majority of the differences between the two cohorts, past the red intervention point, are lower than the "expected" blue trend line. Although this is the case, the majority of these points fall within the lower 95% confidence interval and so one might interpret this as a natural trend not affected by the IRT intervention.

The results for the significance tests for this measure in particular were as follows.

Test for change in slope: **P = 0.5079**

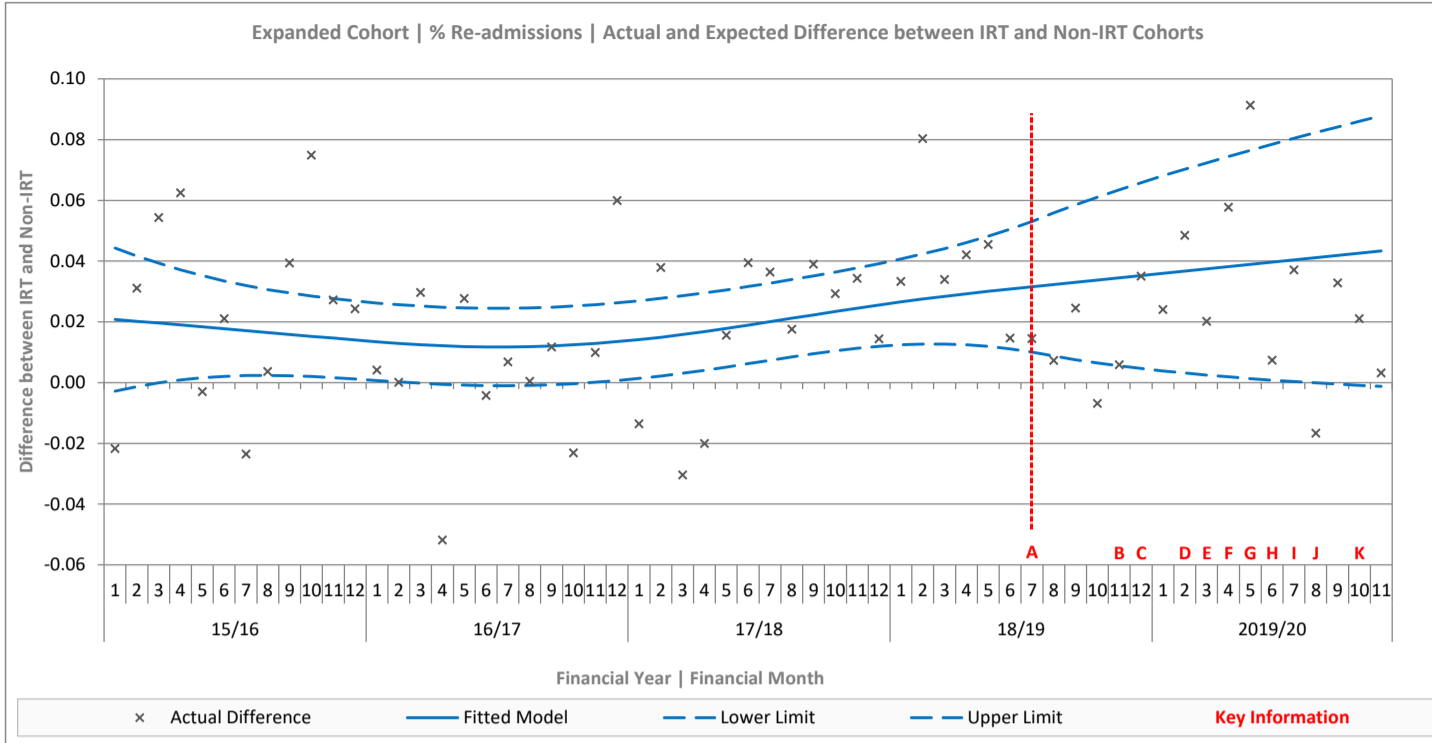
The null hypothesis cannot be rejected, the trend in the difference between the IRT and Non-IRT re-admission rates are consistent, and the IRT intervention is likely to have had no effect.

Test for change in intersection: **P = 0.5263**

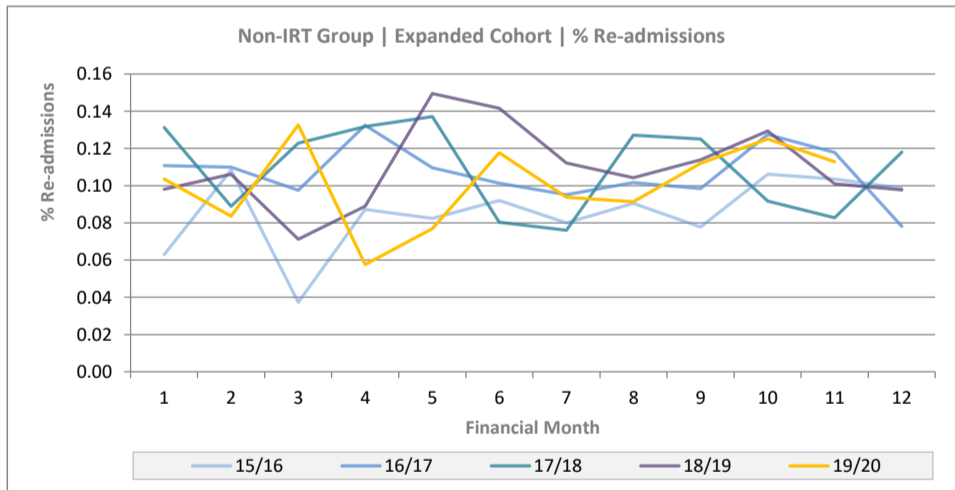
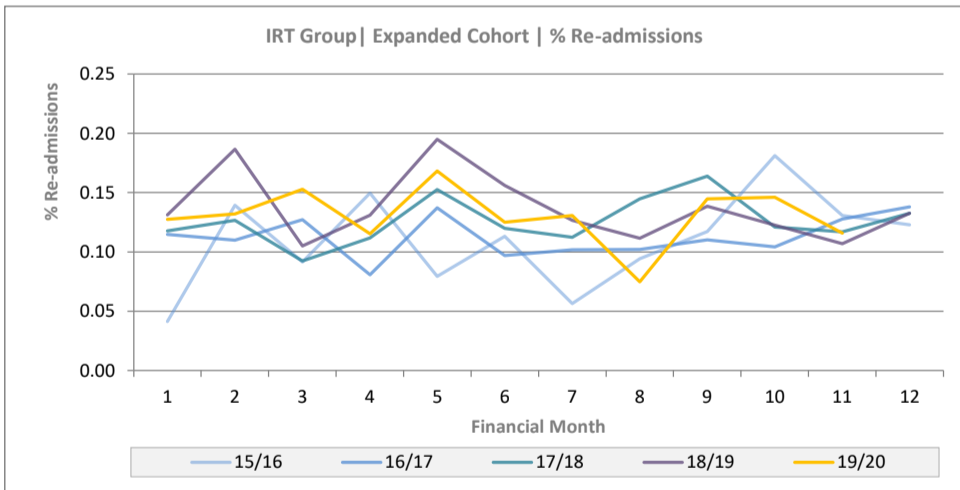
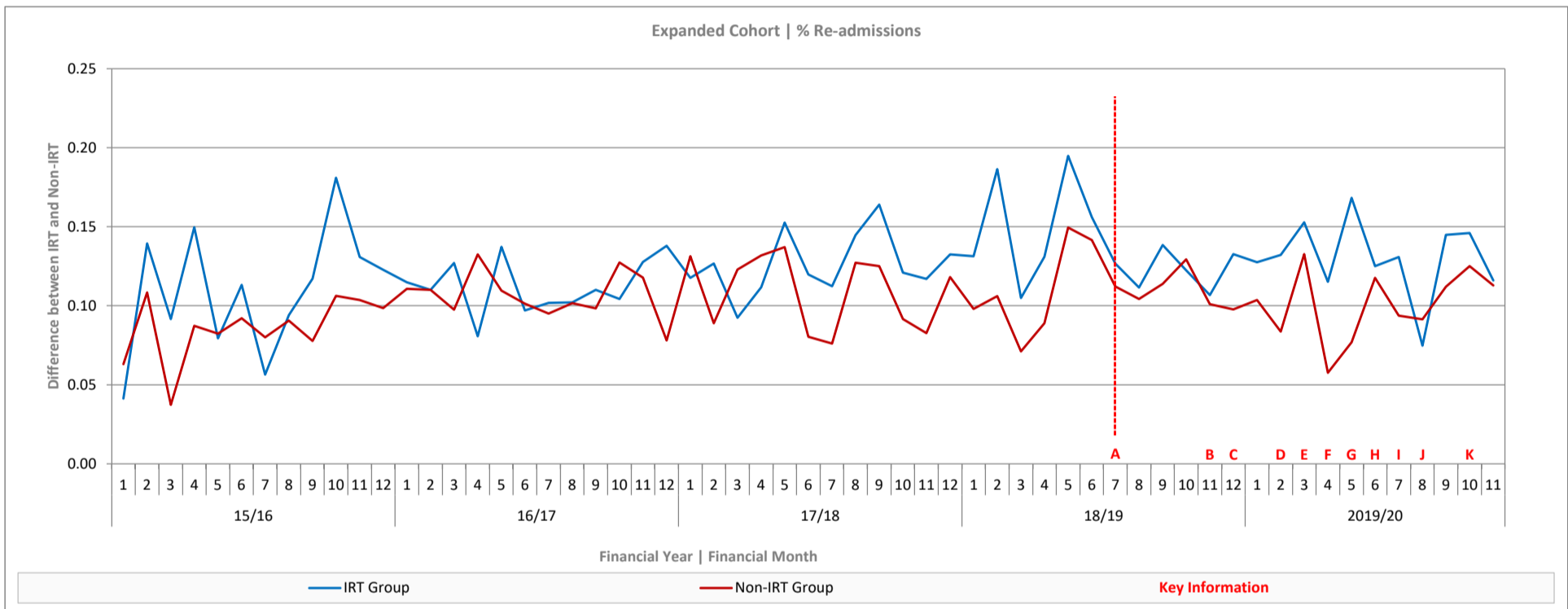
The null hypothesis cannot be rejected, the baseline average in the difference between the IRT and Non-IRT re-admission rates are consistent, and the IRT intervention is likely to have had no effect.

Comparing these results to the actual rates of admissions, we can see that the re-admissions follow a very similar pattern for both the IRT and Non-IRT groups. The trend in re-admissions for both cohorts seems to be fairly stable with no obvious change in trend or jump in rate of re-admissions following the IRT intervention point. This is confirmed via the test for significance which indicated the null hypothesis cannot be rejected.





Year	Month	Item	Key Information
18/19	7 Oct	A	01/10/2018 - Respiratory Consultant recruited
	8 Nov		
	9 Dec		
	10 Jan		
	11 Feb	B	01/02/2019 - Specialist Respiratory Nurse Manager (Lead) & Physiotherapist Team Leader recruited
	12 Mar	C	12/02/2019 - Respiratory GP (City) (x2) recruited
	1 Apr		18/03/2019 - Respiratory GP (City) recruited
	2 May	D	01/05/2019 - Palliative Consultant (City) & Palliative Nurse/Therapist (City) recruited
	3 Jun	E	20/05/2019 - Clinical Pharmacist recruited
			03/06/2019 - IRT Administrator recruited
			10/06/2019 - Operational Manager recruited
			01/07/2019 - Palliative Nurse/Therapist (North) & Palliative Consultant (North) & IAPT Clinical Psychologist/Supervisor recruited
			08/07/2019 - Palliative Occupational Therapist recruited
	4 Jul	F	15/07/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited
			01/08/2019 - Respiratory GP (North), Health Care Assistant (HCA/SCW) & IAPT Clinical Psychologist/Supervisor recruited
			27/08/2019 - Smoking Cessation/Home Assessment Advisor recruited
	5 Aug	G	28/08/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited
	6 Sep	H	01/09/2019 - Respiratory GP (City) left for Maternity leave - no replacement yet
	7 Oct	I	Specialist Respiratory Nurse Manager (Lead) injured and off work for a number of weeks in Oct/Nov CCG and SCW informed in IRT Project Implementation Group Meeting that 2 Respiratory nurses have been employed in the control group
	8 Nov	J	
	9 Dec		
	10 Jan	K	First Coronavirus case reported in England
	11 Feb		



**Narrative**

Re-admissions for the Expanded cohort had been on an upward trend for both the IRT and Non-IRT group from April 2015 to the Intervention point. After the IRT Intervention point the re-admissions seem to level out and the difference in difference chart shows that the observed differences are less than the expected fitted model. The observed differences are within the 95% confidence intervals and so the observations which fall below the expected fitted model could be within the natural trend.

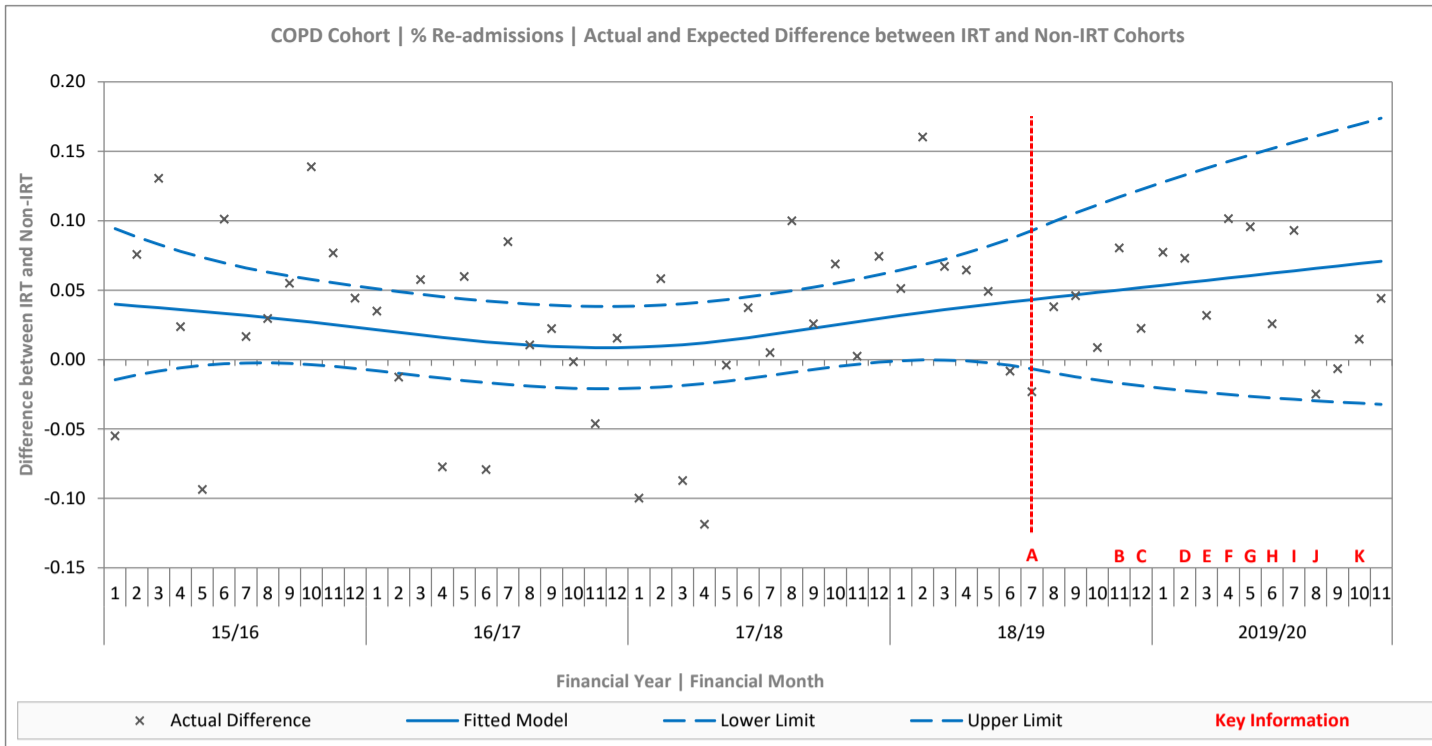
The results for the significance tests for this measure in particular were as follows.

Test for change in slope: **P = 0.7799**

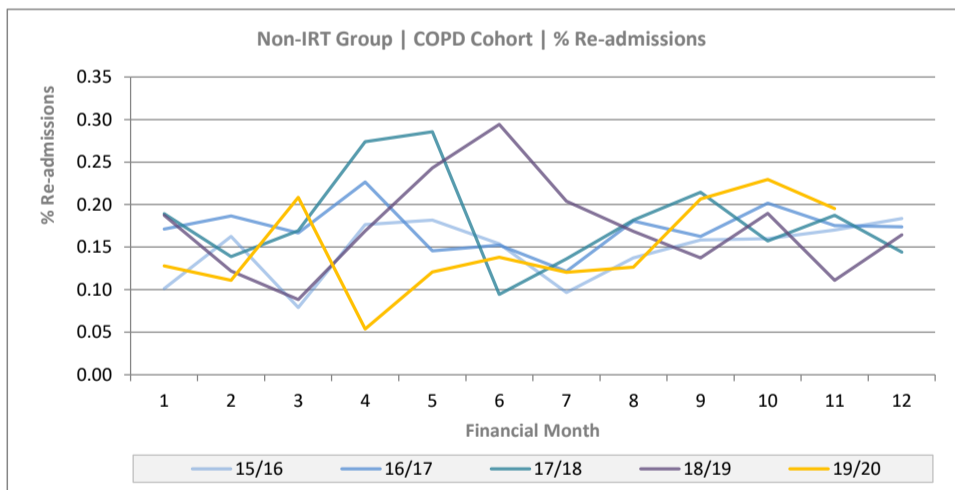
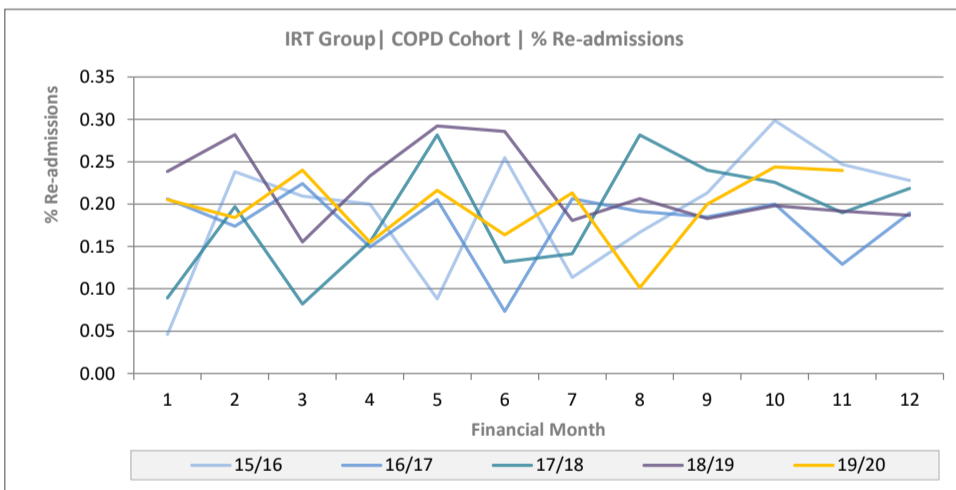
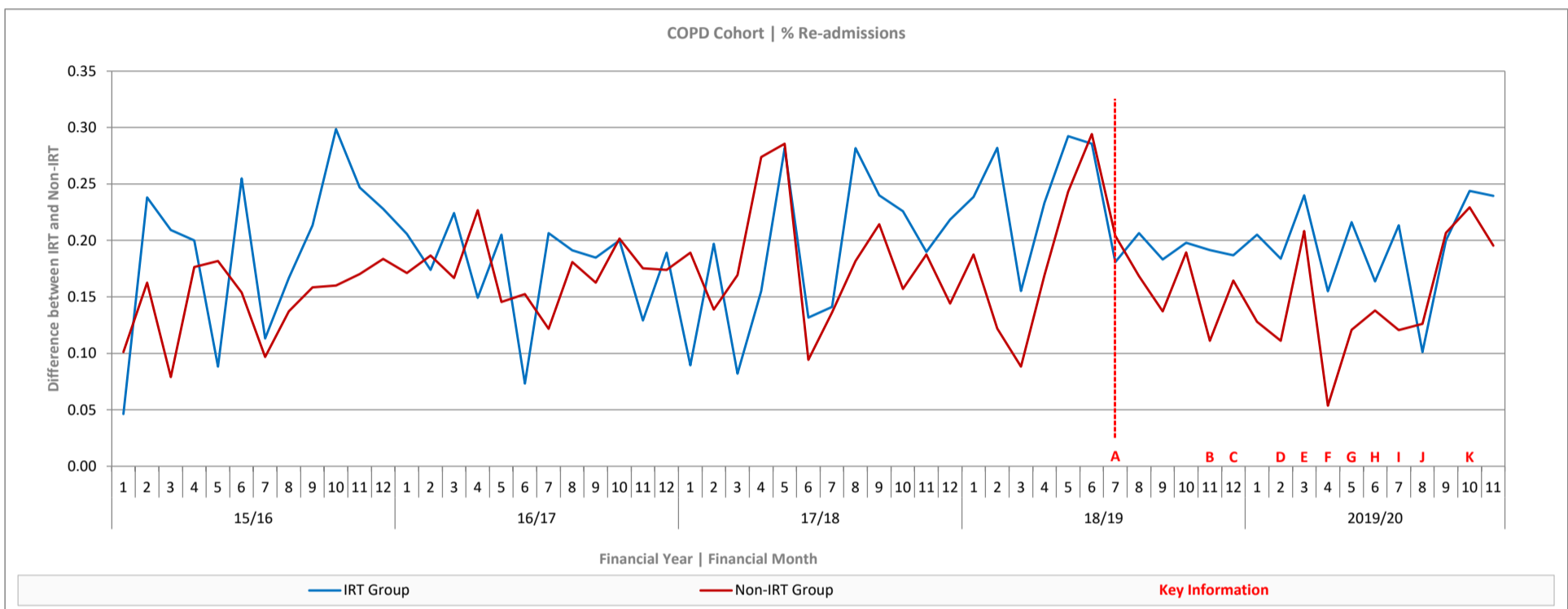
The null hypothesis cannot be rejected, the trend in the difference between the IRT and Non-IRT re-admission rates are consistent, and the IRT intervention is likely to have had no effect.

Test for change in intersection: **P = 0.8292**

The null hypothesis cannot be rejected, the baseline average in the difference between the IRT and Non-IRT re-admission rates are consistent, and the IRT intervention is likely to have had no effect.



Year	Month	Item	Key Information
18/19	7 Oct	A	01/10/2018 - Respiratory Consultant recruited
	8 Nov		
	9 Dec		
19/20	10 Jan		
	11 Feb	B	01/02/2019 - Specialist Respiratory Nurse Manager (Lead) & Physiotherapist Team Leader recruited
	12 Mar	C	12/02/2019 - Respiratory GP (City) (x2) recruited
	1 Apr		18/03/2019 - Respiratory GP (City) recruited
	2 May	D	01/05/2019 - Palliative Consultant (City) & Palliative Nurse/Therapist (City) recruited
	3 Jun	E	20/05/2019 - Clinical Pharmacist recruited
			03/06/2019 - IRT Administrator recruited
			10/06/2019 - Operational Manager recruited
			01/07/2019 - Palliative Nurse/Therapist (North) & Palliative Consultant (North) & IAPT Clinical Psychologist/Supervisor recruited
			08/07/2019 - Palliative Occupational Therapist recruited
			15/07/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited
	4 Jul	F	01/08/2019 - Respiratory GP (North), Health Care Assistant (HCA/SCW) & IAPT Clinical Psychologist/Supervisor recruited
5 Aug	G	27/08/2019 - Smoking Cessation/Home Assessment Advisor recruited	
6 Sep	H	28/08/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited	
7 Oct	I	01/09/2019 - Respiratory GP (City) left for Maternity leave - no replacement yet	
8 Nov	J	Specialist Respiratory Nurse Manager (Lead) injured and off work for a number of weeks in Oct/Nov CCG and SCW informed in IRT Project Implementation Group Meeting that 2 Respiratory nurses have been employed in the control group	
9 Dec			
10 Jan	K		
11 Feb			



**Narrative**

Re-admissions for the COPD cohort follow a fairly steady trend for both the IRT and the Non-IRT cohorts. The observed differences between the two groups fluctuate above and below the expected fitted model for the differences and remain within the upper and lower 95% confidence intervals.

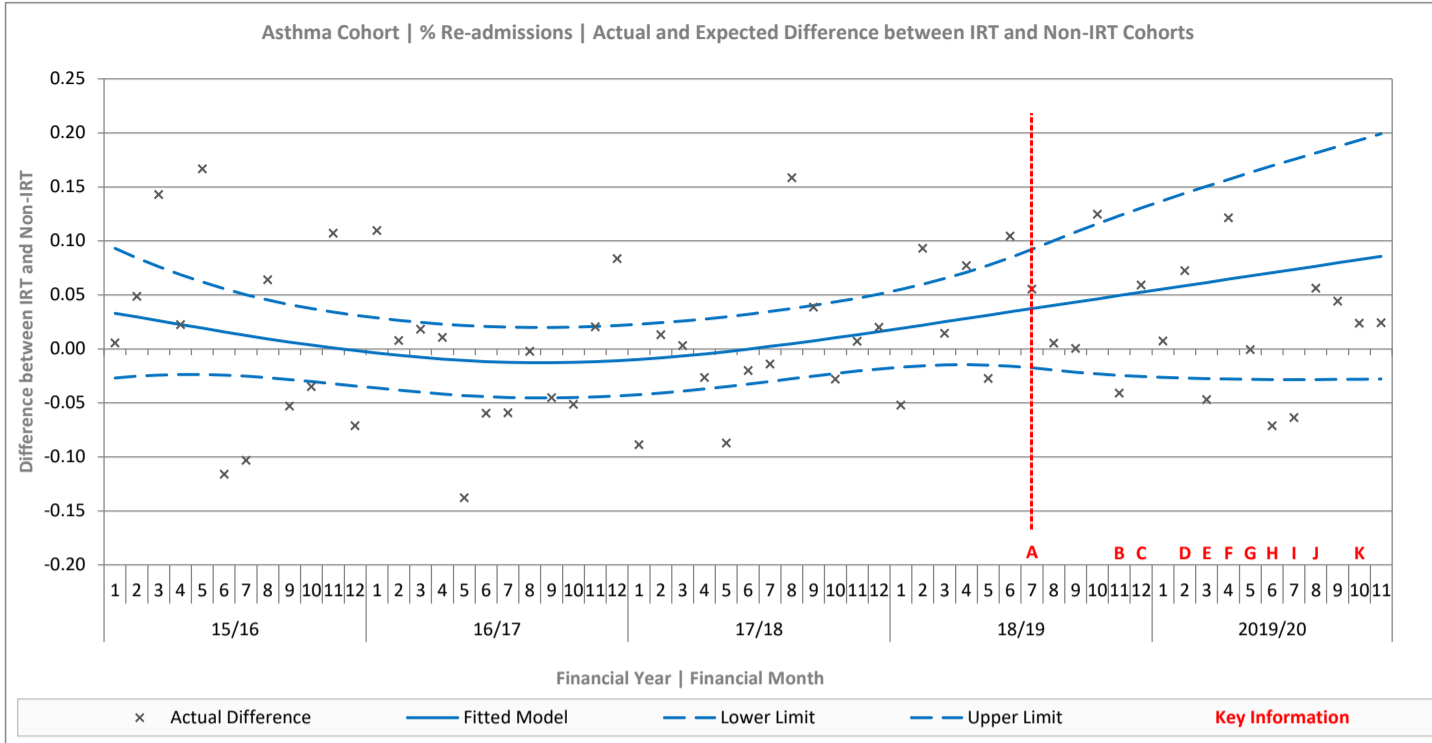
The results for the significance tests for this measure in particular were as follows.

Test for change in slope: **P = 0.5467**

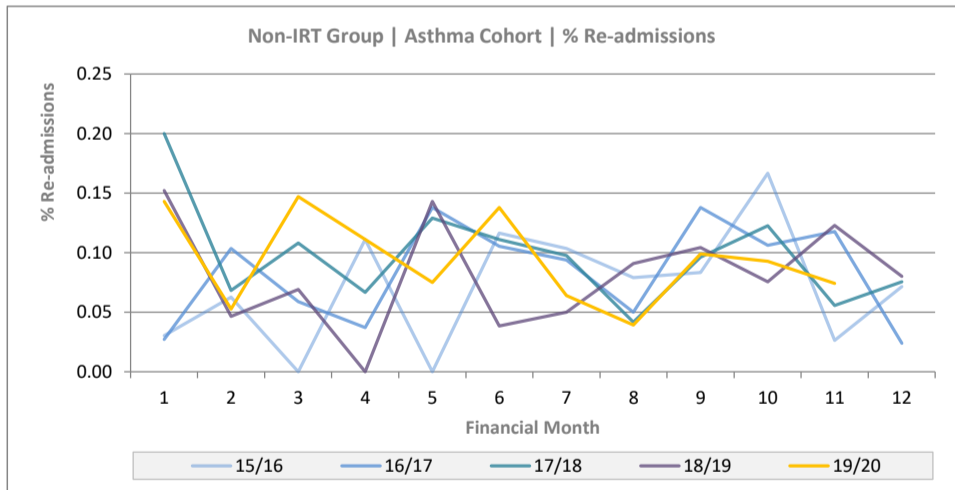
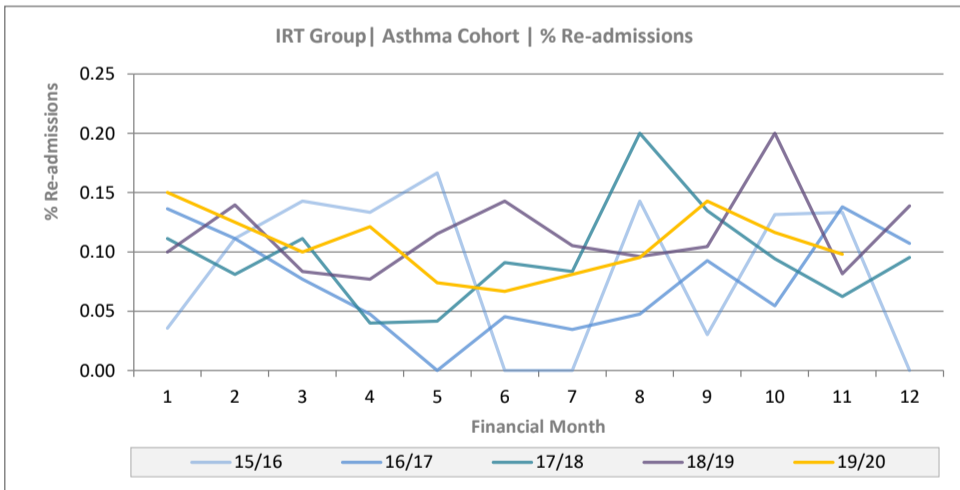
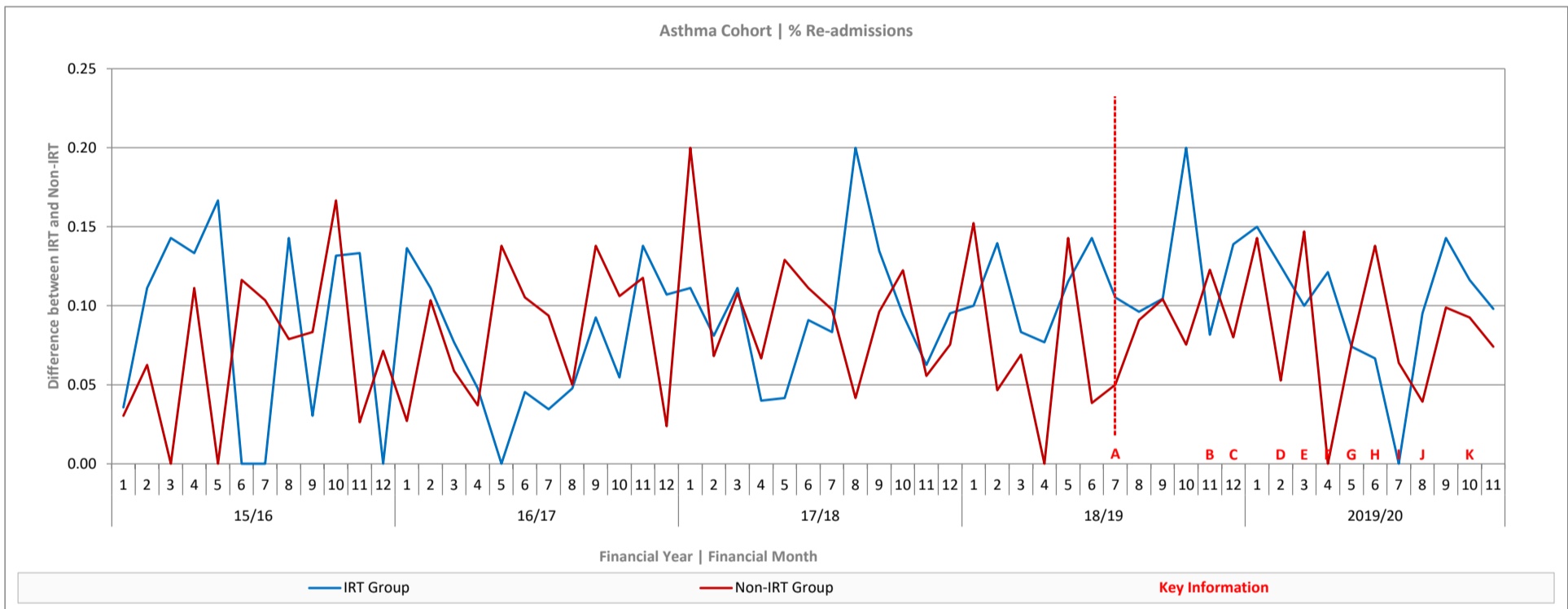
The null hypothesis cannot be rejected, the trend in the difference between the IRT and Non-IRT re-admission rates are consistent, and the IRT intervention is likely to have had no effect.

Test for change in intersection: **P = 0.4751**

The null hypothesis cannot be rejected, the baseline average in the difference between the IRT and Non-IRT re-admission rates are consistent, and the IRT intervention is likely to have had no effect.



Year	Month	Item	Key Information
18/19	7 Oct	A	01/10/2018 - Respiratory Consultant recruited
	8 Nov		
	9 Dec		
	10 Jan		
	11 Feb	B	01/02/2019 - Specialist Respiratory Nurse Manager (Lead) & Physiotherapist Team Leader recruited
	12 Mar	C	12/02/2019 - Respiratory GP (City) (x2) recruited
	1 Apr		18/03/2019 - Respiratory GP (City) recruited
	2 May	D	01/05/2019 - Palliative Consultant (City) & Palliative Nurse/Therapist (City) recruited
	3 Jun	E	20/05/2019 - Clinical Pharmacist recruited
			03/06/2019 - IRT Administrator recruited
			10/06/2019 - Operational Manager recruited
			01/07/2019 - Palliative Nurse/Therapist (North) & Palliative Consultant (North) & IAPT Clinical Psychologist/Supervisor recruited
			08/07/2019 - Palliative Occupational Therapist recruited
	4 Jul	F	15/07/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited
19/20			01/08/2019 - Respiratory GP (North), Health Care Assistant (HCA/SCW) & IAPT Clinical Psychologist/Supervisor recruited
			27/08/2019 - Smoking Cessation/Home Assessment Advisor recruited
	5 Aug	G	28/08/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited
	6 Sep	H	01/09/2019 - Respiratory GP (City) left for Maternity leave - no replacement yet
	7 Oct	I	Specialist Respiratory Nurse Manager (Lead) injured and off work for a number of weeks in Oct/Nov CCG and SCW informed in IRT Project Implementation Group Meeting that 2 Respiratory nurses have been employed in the control group
	8 Nov	J	
	9 Dec		
	10 Jan	K	First Coronavirus case reported in England
	11 Feb		



**Narrative**

Re-admissions for the Asthma cohort fluctuate between 0 and 0.2 for both the IRT and the Non-IRT cohorts, and for each are rather sporadic. The observed differences between the two groups fluctuate above and below the expected fitted model, with the majority of points falling below the fitted model post IRT intervention. A small number of these fall below the 95% lower confidence interval.

The results for the significance tests for this measure in particular were as follows.

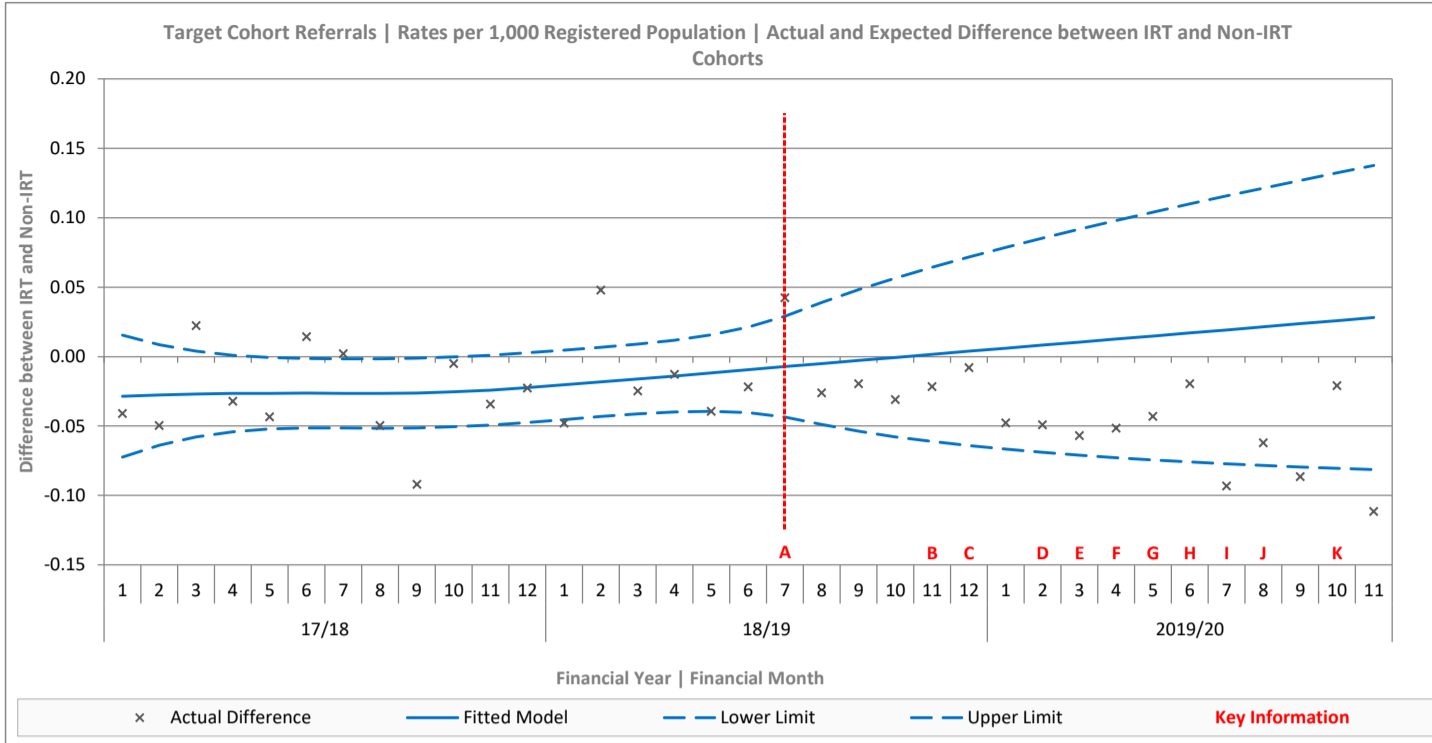
Test for change in slope: **P = 0.6187**

The null hypothesis cannot be rejected, the trend in the difference between the IRT and Non-IRT re-admission rates are consistent, and the IRT intervention is likely to have had no effect.

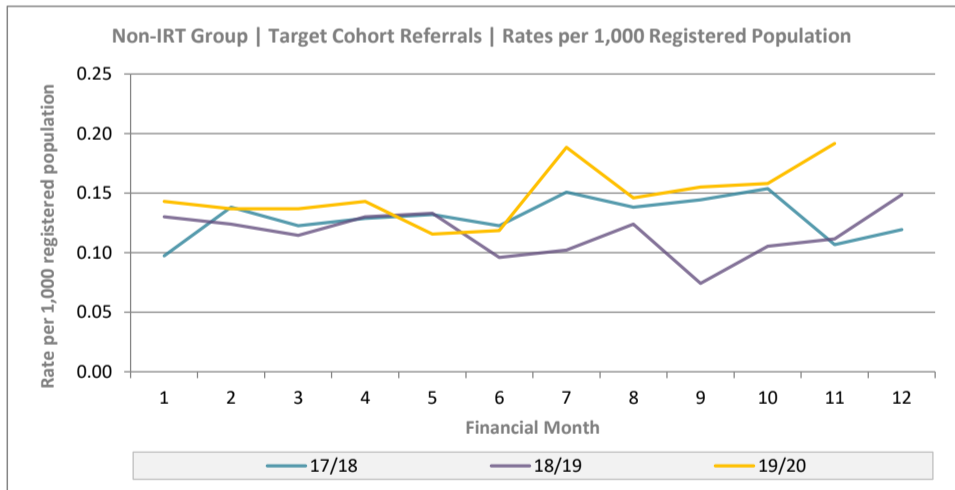
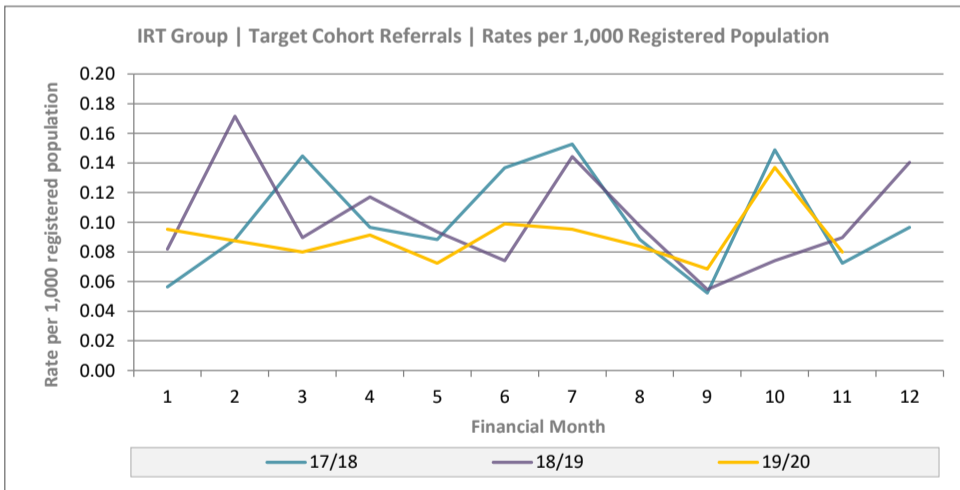
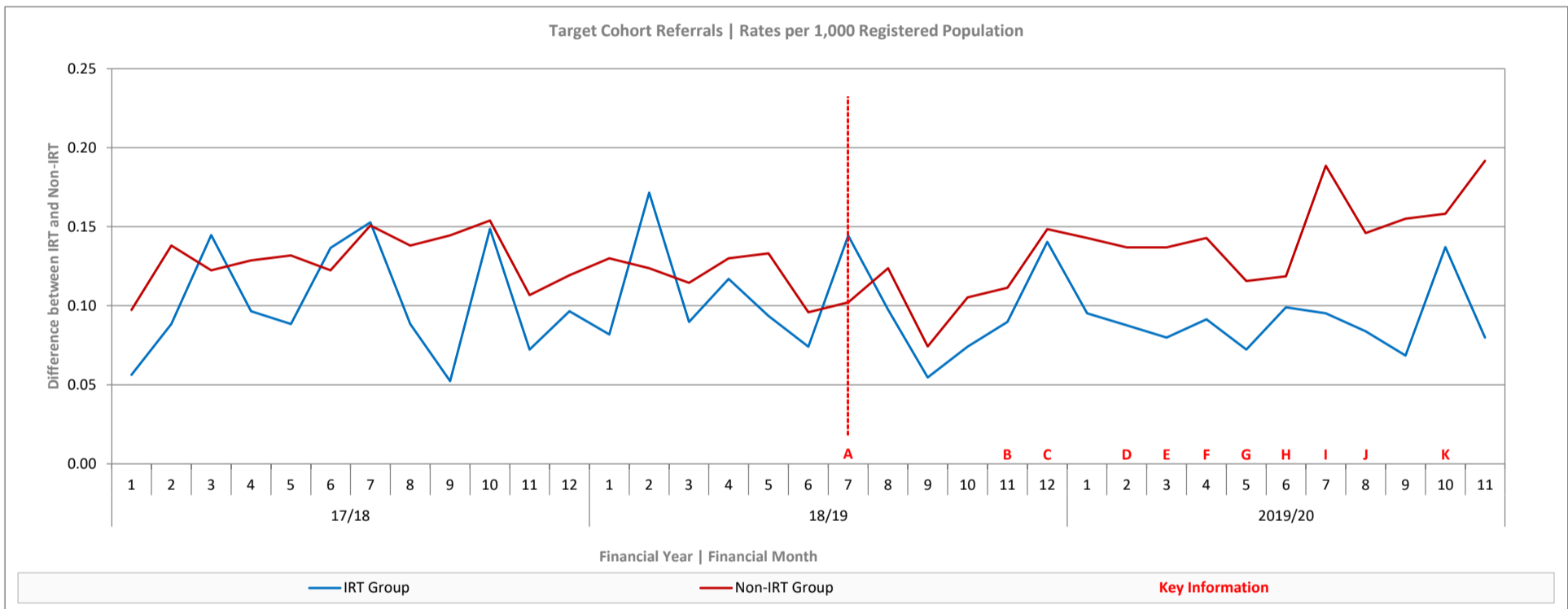
Test for change in intersection: **P = 0.6103**

The null hypothesis cannot be rejected, the baseline average in the difference between the IRT and Non-IRT re-admission rates are consistent, and the IRT intervention is likely to have had no effect.





Year	Month	Item	Key Information
7	Oct	A	01/10/2018 - Respiratory Consultant recruited
8	Nov		
9	Dec		
10	Jan		
18/19			
11	Feb	B	01/02/2019 - Specialist Respiratory Nurse Manager (Lead) & Physiotherapist Team Leader recruited
12	Mar	C	12/02/2019 - Respiratory GP (City) (x2) recruited
			18/03/2019 - Respiratory GP (City) recruited
1	Apr		
2	May	D	01/05/2019 - Palliative Consultant (City) & Palliative Nurse/Therapist (City) recruited
			20/05/2019 - Clinical Pharmacist recruited
3	Jun	E	03/06/2019 - IRT Administrator recruited
			10/06/2019 - Operational Manager recruited
			01/07/2019 - Palliative Nurse/Therapist (North) & Palliative Consultant (North) & IAPT Clinical Psychologist/Supervisor recruited
			08/07/2019 - Palliative Occupational Therapist recruited
4	Jul	F	15/07/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited
19/20			
			01/08/2019 - Respiratory GP (North), Health Care Assistant (HCA/SCW) & IAPT Clinical Psychologist/Supervisor recruited
			27/08/2019 - Smoking Cessation/Home Assessment Advisor recruited
5	Aug	G	28/08/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited
6	Sep	H	01/09/2019 - Respiratory GP (City) left for Maternity leave - no replacement yet
7	Oct	I	Specialist Respiratory Nurse Manager (Lead) injured and off work for a number of weeks in Oct/Nov CCG and SCW informed in IRT Project Implementation Group Meeting that 2 Respiratory nurses have been employed in the control group
8	Nov	J	
9	Dec		
10	Jan	K	First Coronavirus case reported in England
11	Feb		



**Narrative**

The expected trend for the difference in referral rates between the IRT and Non-IRT groups was modelled using a baseline of April 2017 to November 2018. It should be noted that this differs from all other models in this report which calculate the expected rates using data from April 2015 to November 2018.

For this measure we see a divergence from the expected trend which was modelled to increase if the intervention was not put in place (the IRT group expected to diverge further from the non-IRT group in the positive direction). When observing the actual differences between the two groups, the difference is lower than expected past the intervention point and more notably so past month 12 2018-19, with 3 points falling outside the lower confidence limit and the differences appearing to trend away from the fitted model in the negative direction. Comparing this to the actual rates per 1,000 population for the same time period, the Non-IRT rates have remained at a higher level and are trending upwards, whereas the IRT Group have reduced and are remaining at a lower rate.

The results for the significance tests for this measure in particular were as follows.

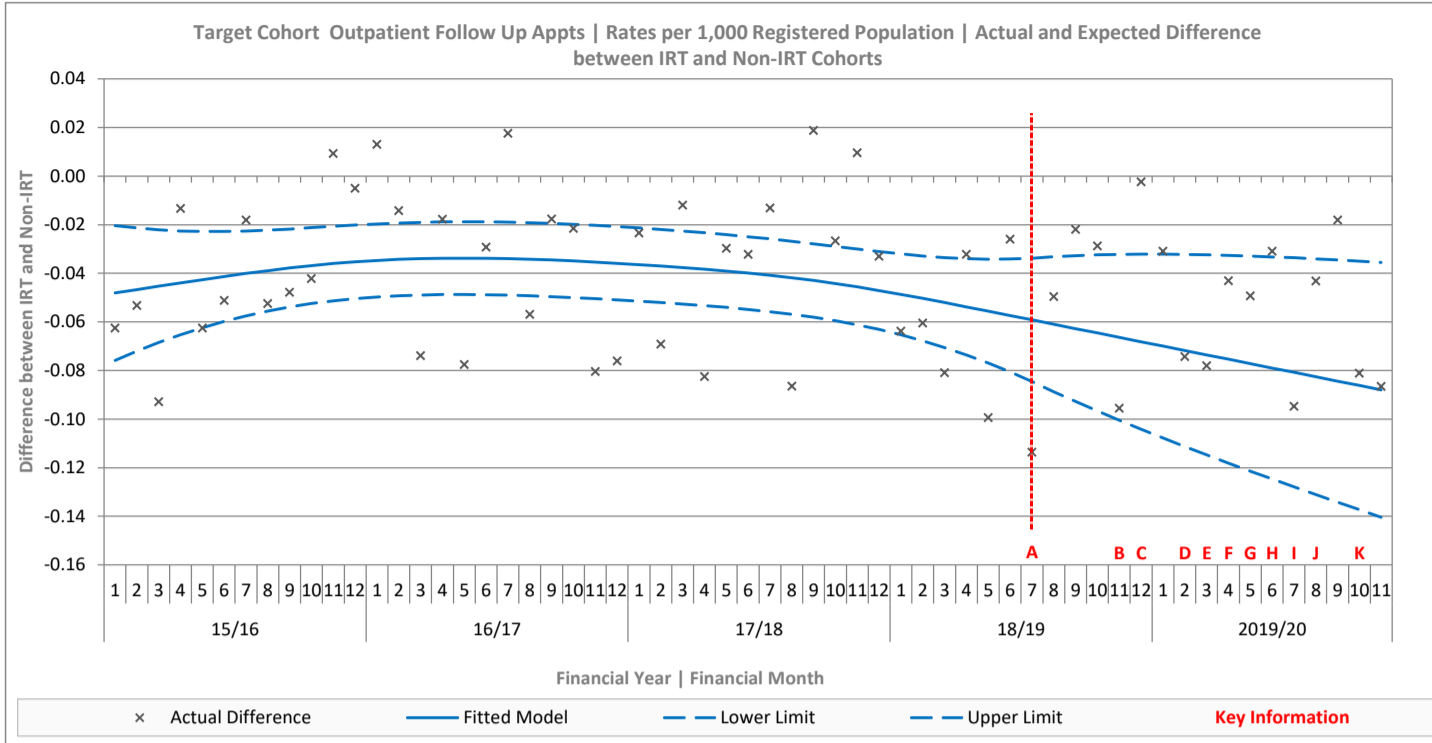
Test for change in slope: **P = 0.0024**

This P-value is much less than 0.05, so the null hypothesis can be rejected, as the P-value indicates significance. The IRT intervention has caused a change in the trend of average difference of referral rates between the IRT and Non-IRT groups, for the target cohort.

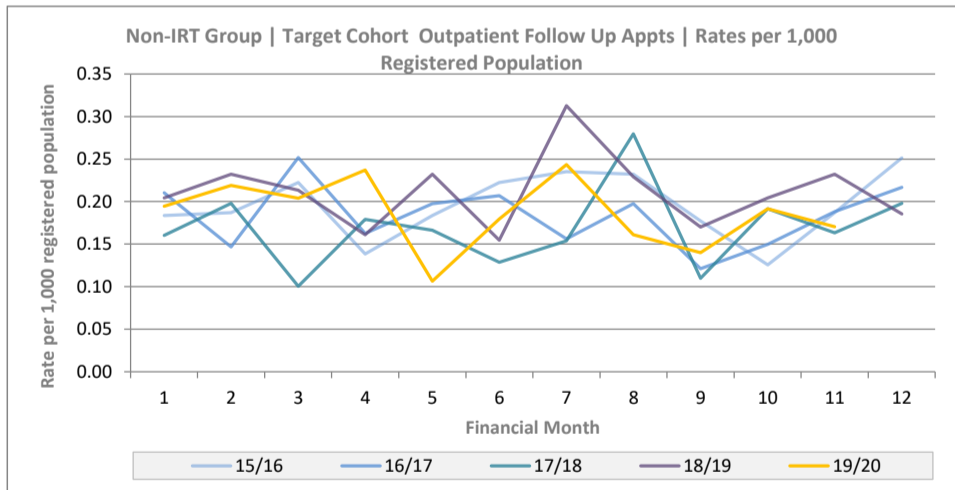
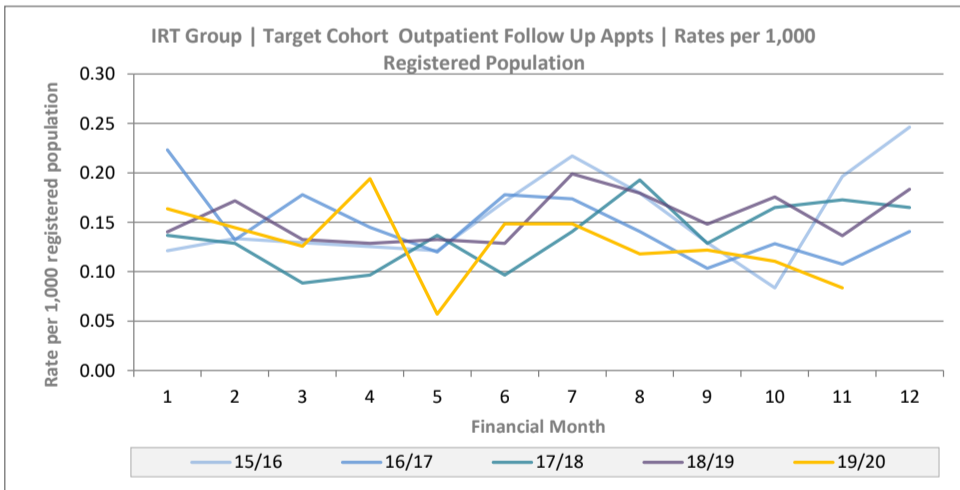
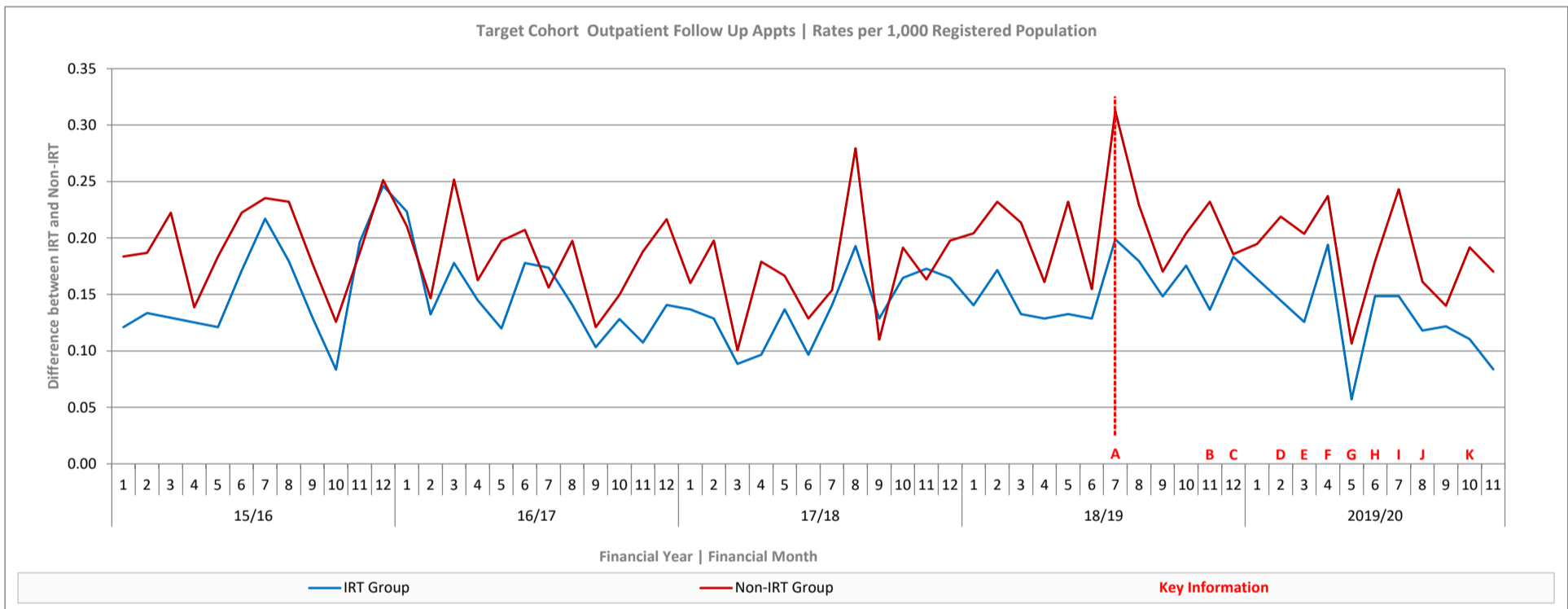
Test for change in intersection: **P = 0.0075**

This P-value is much less than 0.05, so the null hypothesis can be rejected, as the P-value indicates significance. The IRT intervention has caused an immediate change in the baseline average of difference in referral rates between the IRT and Non-IRT groups, for the target cohort.

The expected impact of the IRT Project is that patients would be diverted away from the clinics in question and referred to the IRT community clinics instead. This appears to be the case when evaluating the OUH clinic referral rates.



Year	Month	Item	Key Information
18/19	7 Oct	A	01/10/2018 - Respiratory Consultant recruited
	8 Nov		
	9 Dec		
	10 Jan		
	11 Feb	B	01/02/2019 - Specialist Respiratory Nurse Manager (Lead) & Physiotherapist Team Leader recruited
	12 Mar	C	12/02/2019 - Respiratory GP (City) (x2) recruited
	1 Apr		18/03/2019 - Respiratory GP (City) recruited
	2 May	D	01/05/2019 - Palliative Consultant (City) & Palliative Nurse/Therapist (City) recruited
	3 Jun	E	20/05/2019 - Clinical Pharmacist recruited
	4 Jul	F	03/06/2019 - IRT Administrator recruited
	5 Aug	G	10/06/2019 - Operational Manager recruited
	6 Sep	H	01/07/2019 - Palliative Nurse/Therapist (North) & Palliative Consultant (North) & IAPT Clinical Psychologist/Supervisor recruited
	7 Oct	I	08/07/2019 - Palliative Occupational Therapist recruited
	8 Nov	J	15/07/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited
	9 Dec		01/08/2019 - Respiratory GP (North), Health Care Assistant (HCA/SCW) & IAPT Clinical Psychologist/Supervisor recruited
	10 Jan	K	27/08/2019 - Smoking Cessation/Home Assessment Advisor recruited
	11 Feb		28/08/2019 - Specialist Respiratory Practitioner (Nurse/Physio) recruited
			01/09/2019 - Respiratory GP (City) left for Maternity leave - no replacement yet
			Specialist Respiratory Nurse Manager (Lead) injured and off work for a number of weeks in Oct/Nov CCG and SCW informed in IRT Project Implementation Group Meeting that 2 Respiratory nurses have been employed in the control group
			First Coronavirus case reported in England



**Narrative**

For this measure the fitted model predicted a natural decrease in trend of the difference in the rate of follow ups between the IRT and Non-IRT groups. The observed differences in follow up rates post the IRT intervention date are mainly above the fitted model with 6 points falling outside the upper 95% confidence interval. Observing the actual rates of follow up attendances, the trend for the IRT and Non-IRT groups appear to be fairly consistent, although rates for both are trending downwards past the IRT intervention point.

The results for the significance tests for this measure in particular were as follows.

Test for change in slope: **P = 0.3537**

The null hypothesis cannot be rejected, the trend in the difference between the IRT and Non-IRT follow up rates are consistent, and the IRT intervention is likely to have had no effect.

Test for change in intersection: **P = 0.349**

The null hypothesis cannot be rejected, the baseline average in the difference between the IRT and Non-IRT follow up rates are consistent, and the IRT intervention is likely to have had no effect.