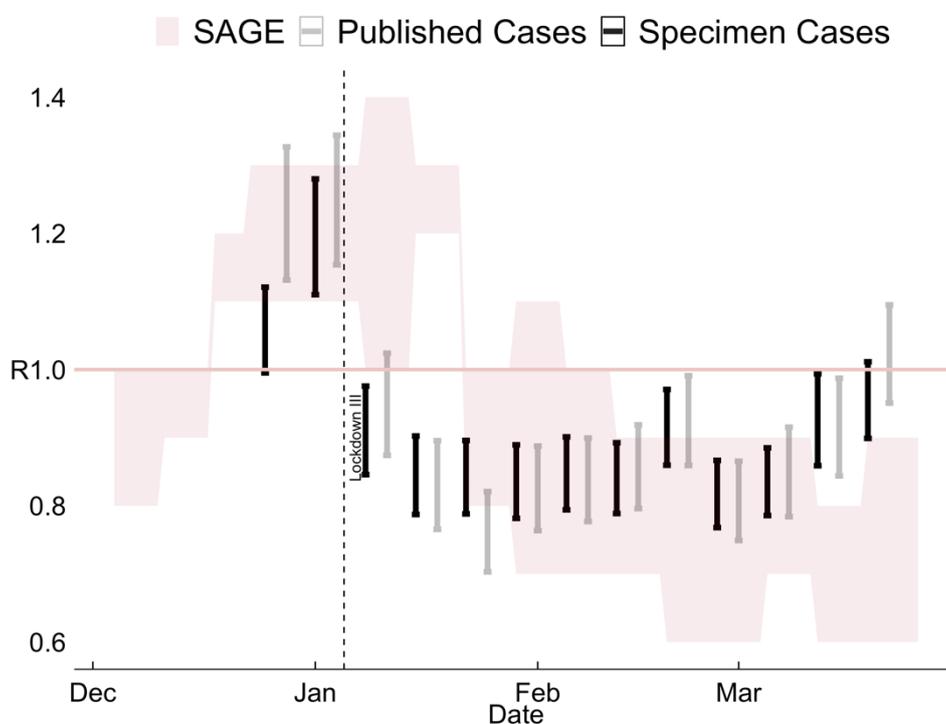## Reproduction Number (R) and Forecasts of New Cases: New cases still decreasing but R number on the rise

Figure 1 - UK R – NIESR controlling for enhanced testing in schools and SAGE

Shaded pink area is SAGE upper and lower bounds (www.gov.uk/guidance/the-r-number-in-the-uk)
NIESR estimates of R show ± 1 standard deviation confidence intervals estimated on
published and specimen cases. For specimen cases we discard the last 3 days data.

Main points

- We produce timely estimates of the R number and report forecasts for new cases of Covid-19, hospital admissions and deaths due to Covid-19 using publicly available data on 23rd March 2021.

- Following government definitions data on cases can be represented by specimen date or by published date. Specimen cases refer to cases by the date when the sample was taken from the person being tested and published cases refer to cases by the first date when they are included in the published numbers. At the present time we regard the specimen date data as a more reliable

- indicator of the trend in new cases as the model based on specimen dated observations has better captured the sharp increase in testing on the day that schools reopened.

- Figure 1 shows that the Reproduction number, R, which is the average number of secondary infections currently generated by an infected individual, estimated using the specimen date data, had **moved up to 0.9 – 1.0 by 19th March** which is again higher than SAGE's estimates. This estimate was obtained after controlling for enhanced testing in schools that started when they reopened on the 8th of March. If enhanced testing in schools is not controlled for, the R estimate would be in the range 0.9 – 1.05.

- Based on our model, by 12th April when non-essential retail is scheduled to reopen, we expect the trend value of daily cases to be around 3,800; admissions to be around 100, and deaths to stay below 50 (Figures 3-5). Our forecasts for admissions and deaths are unchanged relative to last week, but our forecast for cases is higher by 900. If enhanced testing in schools is not controlled for, the number of cases would be 4,300.

- To the extent that each stage of re-opening increases transmission these numbers may increase. At the same time, expansion of the vaccination programme can be expected to reduce transmission. The trajectory that nets out these opposing trends will become evident in the weeks to come.

- Figure 5 shows that regional R number estimates have increased. Currently, the London has the lowest R number while Yorkshire and the Humber has the highest.

"Based on the latest data on new cases, our estimate of the R number for the UK lies in the range 0.9 – 1.0, taking it above the range it was last week. This estimate is based on data up to 23rd March 2021, just over 2 weeks after the schools were reopened on the 8th of March. After controlling for increased testing in schools our model indicates that increased transmissions are pushing the estimate of the R number ever closer to 1 at which point daily cases would again start to rise. Reassuringly, hospital admissions and deaths due to Covid-19 continue their steady decline."

Dr Craig Thamotheram
Senior Economist - Macroeconomic Modelling and Forecasting
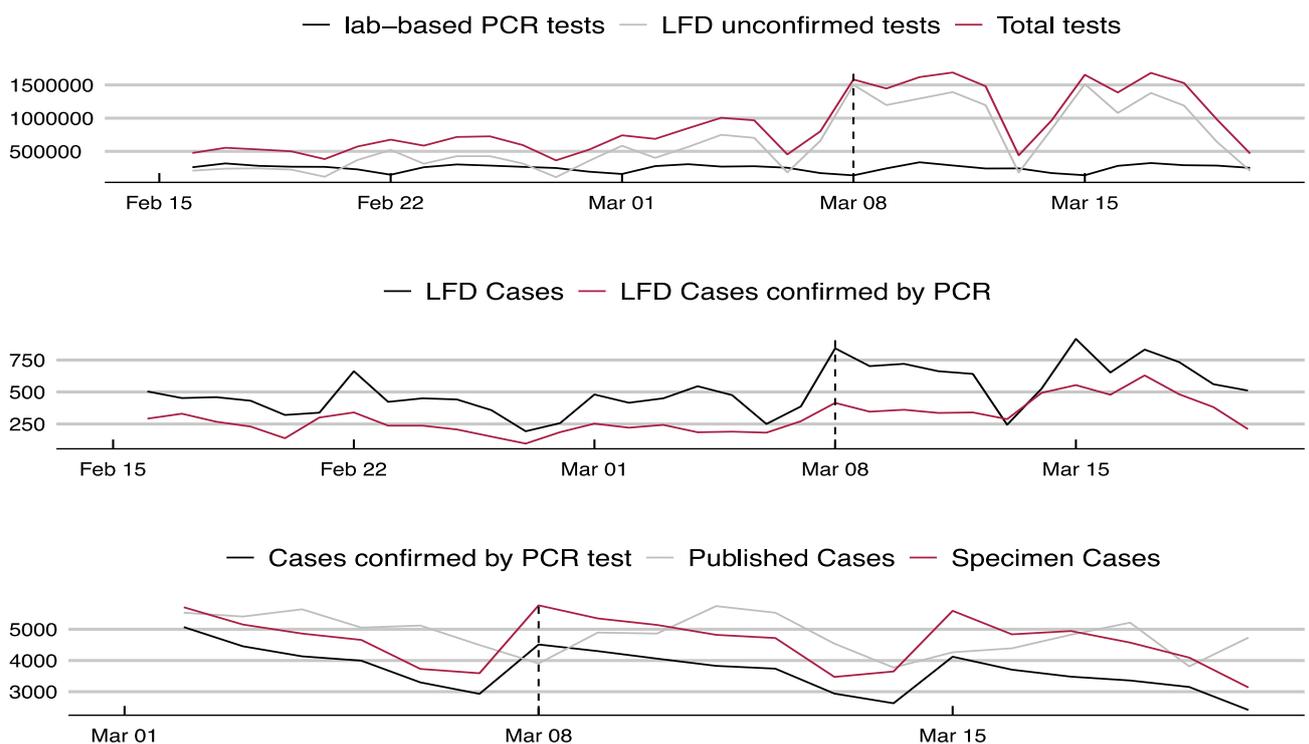
Results

From 10th March, data on cases identified by test type has become available for England. That is, the number of people with at least one positive COVID-19 test result is available by the type of test used in their first positive test. There are three types of tests:

1. Lab-based polymerase chain reaction (PCR).
2. Lateral flow device (LFD) confirmed by a PCR test taken within 3 days.
3. LFD that are unconfirmed by PCR.

Note, specimen cases are the sum of all three types of tests.

Figure 2 - England cases and tests by type

Vertical dashed line on 8th March. The test types are:
  – lab–based polymerase chain reaction (PCR)
  – lateral flow device (LFD) confirmed (this means the LFD result has been verified
   with a positive PCR result taken within 3 days)
 *– LFD unconfirmed (no positive PCR result taken within 3 days).*

- The top panel of Figure 2 shows that the number of PCR tests remained approximately the same after schools reopened while the number of LFD tests increased significantly.

- The middle panel of Figure 2 shows that this translated into an increase in LFD cases on the 8th March.
- The bottom panel of Figure 2 shows that this fed through into published cases on the 9th March and specimen cases immediately, on the 8th March.

Figure 3 provides forecasts of daily cases of Covid-19 for the period until mid-April and highlights the underlying trend value of new cases to be expected on the key dates in the Government's roadmap: outdoor association on the 29th March and non-essential retail reopening on the 12th April. Projections include a correction for the increased testing due to the reopening of schools.

- Trend values of daily cases are forecast to be around 4,500 by the 29th of March and 3,800 by 12th of April. That represents increases of 700 and 900 respectively from last week.
- If enhanced testing in schools is not controlled for, the number of cases would be 4,800 by the 29th of March and 4,300 by 12th of April.

Figure 3 - UK forecast of new COVID-19 cases
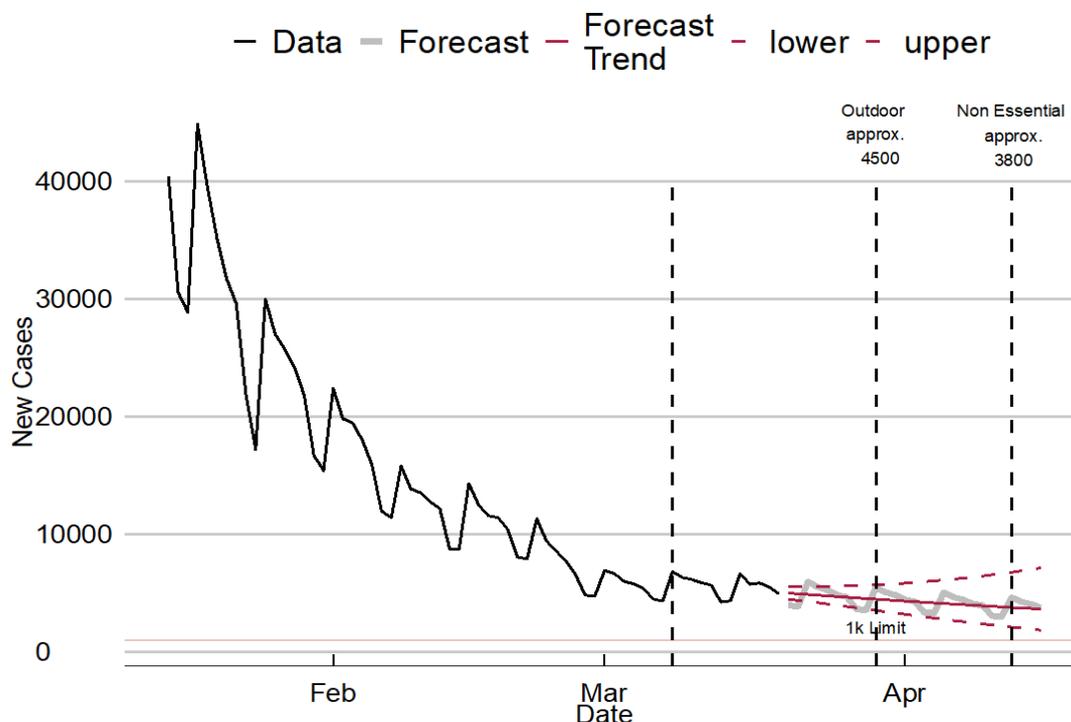
Vertical dashed lines show trend new cases on 8th March, 29th March and 12th April rounded to nearest 100.
Specimen case data available on 23 March 2021. The last 3 days data are discarded so the estimation sample ends on 19 March 2021.

Figure 4 provides forecasts of daily hospital admissions for Covid-19 until mid-April and highlights the underlying number of new admissions to be expected on the key dates in the Government's roadmap: outdoor association on the 29th March and non-essential retail reopening on the 12th April.

- Hospital admissions are forecast to be around 300 by 29th of March and 200 by the 12th of April, up from 200 last week.

Figure 4 – UK forecast of daily Covid-19 hospital admissions

Vertical dashed lines show trend Admissions on 8th March,
29th March and 12th April rounded to nearest 100.
Admissions data avaiable on 23 March 2021, there is a 5 to 7 day lag
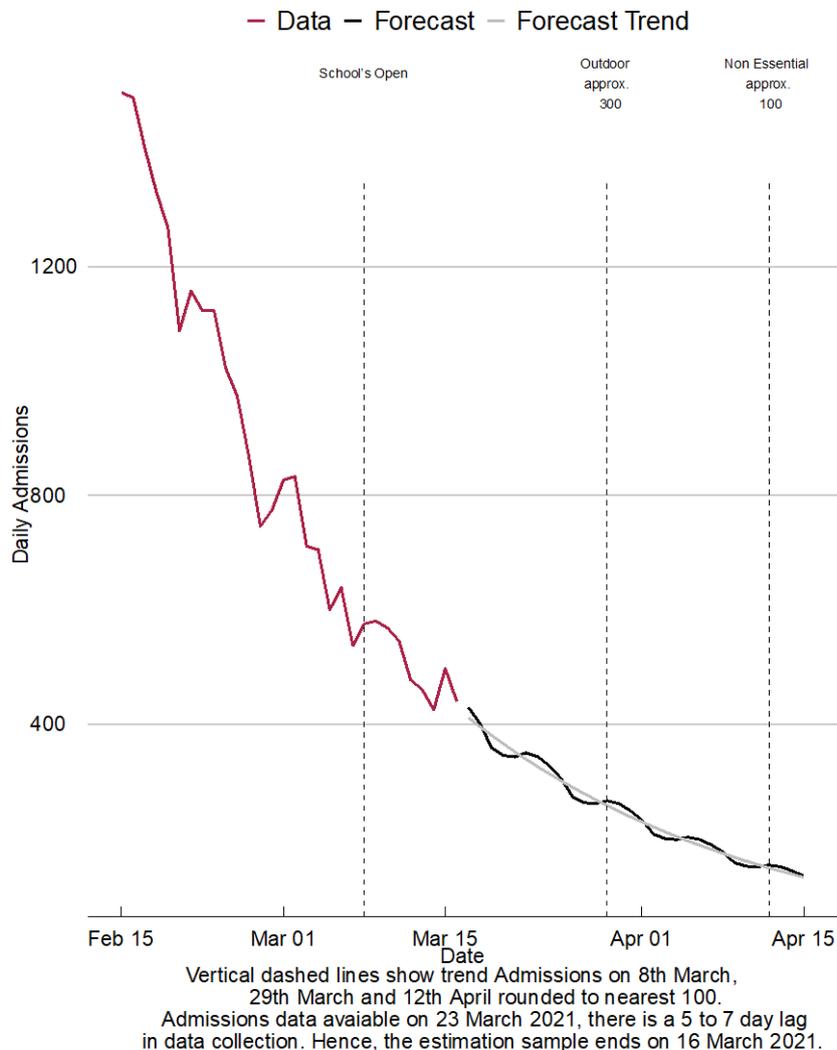in data collection. Hence, the estimation sample ends on 16 March 2021.

Figure 5 provides forecasts of daily deaths due to Covid-19 until mid-April and highlights the underlying number of daily deaths to be expected on the key dates in the Government's roadmap: outdoor association on the 29th of March and non-essential retail reopening on the 12th April.

- By 12th April when non-essential retail is expected to restart, daily deaths are forecast to be below 50.

Figure 5 – UK forecast of daily Covid-19 deaths
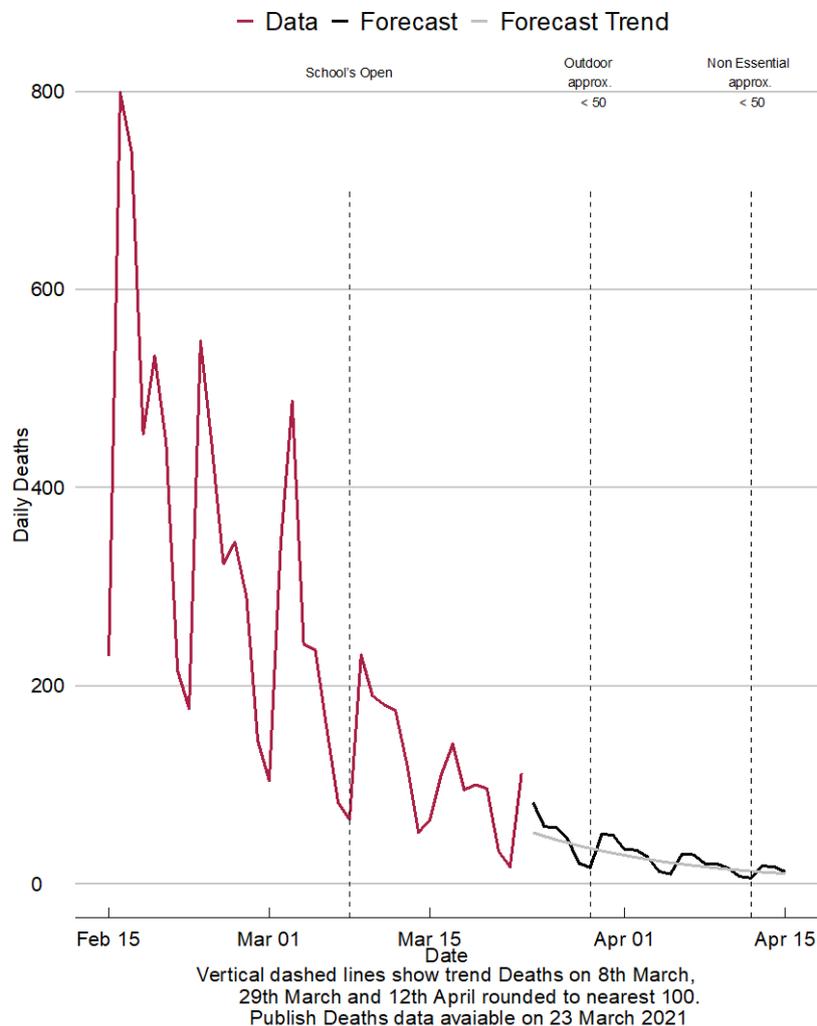
- Figure 6 provides regional R number estimates based on specimen date data series released on 23rd March 2021, controlling for increased testing due to schools reopening. We discard the last 3 days data due to data revisions in that time window. Thus, at the end of our estimation sample on the 19th of March 2021, regional R number estimates have increased with all now lying above 0.9.
- Among nations of the UK, Scotland has the largest R number (0.96), and Northern Ireland has the lowest (0.91).
- Among regions of England, Yorkshire and Humber has the highest R number (1.00) and the London has the lowest (0.91).

Figure 6 - UK Regional R
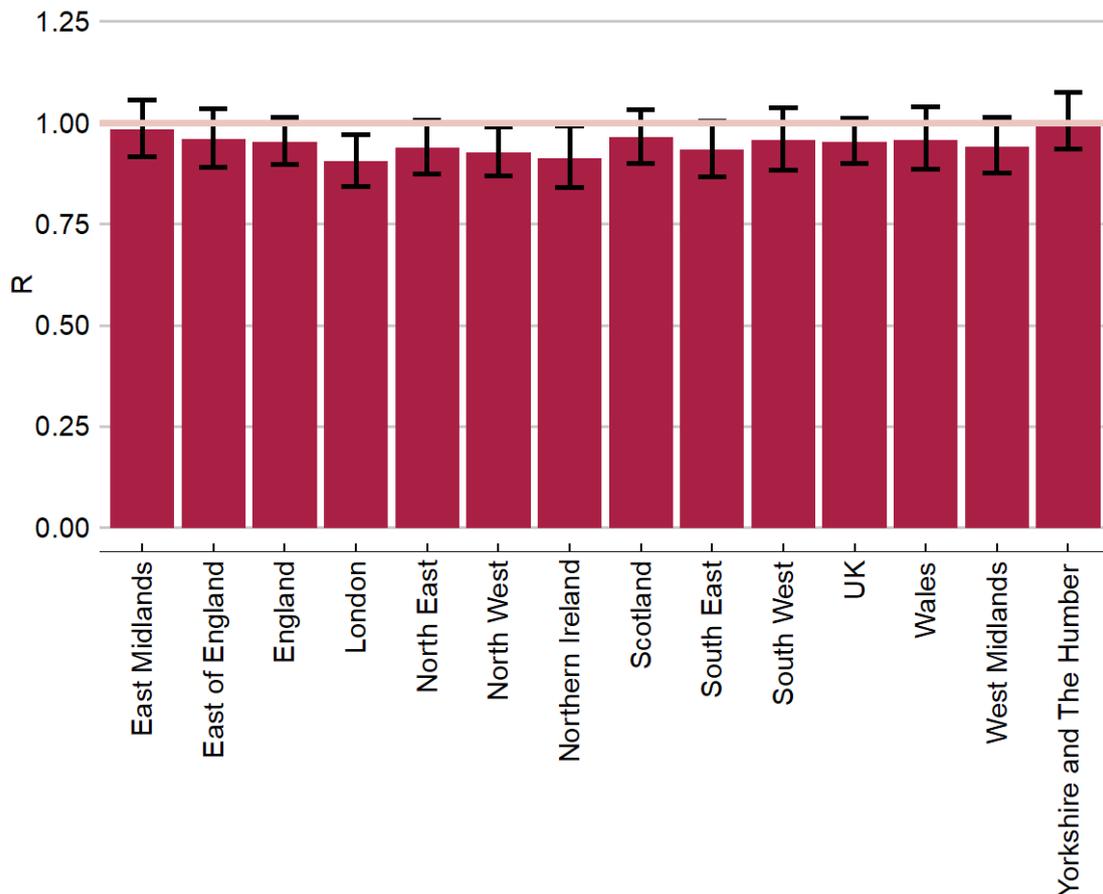
Bar chart shows point estimates of R and the ± 1 standard deviation confidence intervals

Background

NIESR aims to set out projections of the future path of the Covid-19 epidemic in the United Kingdom, its constituent nations and the regions of England, based on current policies.

NIESR will be producing weekly updates on Thursdays, projecting new cases and estimating the R number using a class of time series models developed by Prof. Andrew Harvey and Dr. Paul Kattuman of Cambridge University; see Harvey and Kattuman (2020a). The models generate forecasts by extracting changing trends from historical data. They are relatively simple and transparent, and their specifications can be assessed by standard statistical test procedures. The advantage of the time series approach is that it can adapt very quickly to the most recent information and hence produce timely estimates. This flexibility enables the effects of changes in policy, virus mutations and human behaviour to be tracked. The models are data driven and so are different from the structural models used by epidemiologists which rely on assumptions about transmission and behaviour; see Avery et al (2020).

A description of the methods used to produce these estimates and an evaluation of their forecasting performance can be found in Harvey, Kattuman, and Thamotheram (2021).

Data

Data: COVID-19 confirmed cases and deaths data are sourced from https://coronavirus.data.gov.uk

Caveat

The model relies on historical data and does not incorporate future outlined changes in the underlying environment. Thus, it is important to read the forecasts in this context. For example, the current forecasts make no assumptions about the effect of reopening the schools on increasing transmissions. On the other hand, the effect of the vaccine program will be in the opposite direction.

Authors

Professor Andrew Harvey is Emeritus Professor of Econometrics at the University of Cambridge and a Fellow of Corpus Christi College. He has published over 100 articles and is the author of four books: *The Econometric Analysis of Time Series* (1981), *Time Series Models* (1981), *Forecasting. Structural Time Series Models and the Kalman Filter* (1989) and *Dynamic models for Volatility and Heavy Tails* (2013). He is a Fellow of the British Academy and the Econometric Society.

Dr Paul Kattuman is a reader in Economics at Cambridge University. He has been a Senior Research Fellow at the University of Cambridge Department of Applied Economics, and a lecturer in economics at Durham. He has held Visiting Professorships at Université Paris 12 and Paris-Est Créteil and was appointed Grupo Santander Visiting Professor at Universidad Complutense de Madrid. He was visiting Faculty Scholar at the Kennedy School of Government, and at the Department of Statistics, both at Harvard University.

Dr Craig Thamotheram is a Senior Economist at NIESR. Prior to joining NIESR, he studied Engineering at Imperial and obtained a PhD in Economics at Warwick. He has work experience as a post-doc in macro and financial econometrics.

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Notes for editors

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