

**Evolution of poor reporting and inadequate methods over time within and across
journals in 21,000 randomised controlled trials included in Cochrane reviews**

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Abstract (336 words)

Objective: Poor reporting and inadequate methods are common in randomised controlled trials (RCTs) representing an important source of waste. We aimed to examine the evolution of poor reporting and inadequate methods for key methodological features in RCTs within and across journals.

Design: Mapping of trials included in recent Cochrane reviews.

Data Sources: Data from RCTs included in all Cochrane reviews published between March 2011 and September 2014 reporting an evaluation of the Cochrane risk of bias (RoB) items: sequence generation, allocation concealment, blinding and incomplete outcome data.

Data Extraction: For each RCT, we extracted consensus on risk of bias made by the review authors and identified the primary reference (ie, the reference reporting the main results) to extract publication year and journal. We matched journal names with the Journal Citation Reports to obtain 2014 impact factors (IFs).

Main Outcomes measures: We considered the proportions of trials rated by review authors at unclear and high risk of bias as surrogates for poor reporting and inadequate methods, respectively.

Results: We analysed 20,920 RCTs (from 2,001 reviews) published in 3,136 journals. The proportion of trials with unclear RoB was 49% for sequence generation and 58% for allocation concealment, with 4% and 7% of trials at high risk, respectively. For blinding and incomplete outcome data, 31% and 25% of trials were at unclear risk and 33% and 17% were at high risk, respectively. For all items, higher journal IF was associated with a lower proportion of trials at unclear and high risk of bias. The proportion of trials at unclear RoB decreased over time, especially for sequence generation, from 69% in 1986-1990 to 31% in 2011-2014, and for allocation concealment, from 70% to 45%. After excluding trials at

unclear RoB, inadequate methods also decreased over time: from 15% to 5% for sequence generation and from 33% to 12% for allocation concealment.

Conclusions: Poor reporting and inadequate methods have decreased over time, especially for sequence generation and allocation concealment. However, there is room for improvement, especially in lower impact factor journals.

“What this study adds” box

What is already known on this subject

- Poor reporting and inadequate methods are common in randomised controlled trials (RCTs)
- Many methodological studies have evaluated the quality of reporting and risk of bias in RCTs but they are limited in terms of number of trials evaluated, most focusing on specific diseases, journals or time periods.

What this study adds

- We took advantage of the amount and quality of data included in Cochrane reviews to map the evolution of poor reporting and inadequate methods within and across journals
- From nearly 21,000 RCTs published in 3,136 journals over 3 decades, our results show a decrease over time of poor reporting and inadequate methods especially for sequence generation and allocation concealment
- We found a lower proportion of RCTs with poor reporting and inadequate methods in higher IF journals. In contrast, our results raise concerns about journals with no IF because of the prevalence of poor reporting and inadequate methods
- The next step would be to provide feedback to journals and to evaluate whether this type of audit has an impact by using Cochrane data as a live observatory to monitor changes over time.

INTRODUCTION

The public has a right to expect that information about the efficacy and safety of health interventions is complete, transparent, reliable and that research investments are not wasted¹⁻⁷.

Although randomised controlled trials (RCTs) are considered the reference standard for assessing the efficacy of interventions, how they are planned, conducted and reported raises important concerns^{5,6}. Despite empirical evidence of biased intervention effects with inadequate methods to generate randomisation sequence, lack of allocation concealment or blinding and exclusion of patients from analysis⁸⁻¹², half of trials fail to take adequate steps to reduce such bias^{3,7,13}. Poor reporting of methods is another common problem in RCTs^{3,5}.

Although poor reporting does not necessarily mean poor methods^{14,15}, it prevents readers from adequately assessing whether the methods are reliable and whether the results and conclusions of RCTs can be trusted, also limiting the possibility of reproducibility¹⁶. RCTs affected by inadequate methods or that are poorly reported may not contribute to the evidence base, which represents a waste of resources that could have been otherwise used. This waste affects not only RCTs but also systematic reviews that include them.

Many methodological studies have evaluated the quality of reporting and risk of bias in RCTs¹⁷⁻³⁰. However, most focus on small numbers of trials, specific diseases, journals or time periods. Moreover, these studies used various criteria for their assessments, which were frequently not defined¹⁷. Therefore, we lack a global picture of the amount and evolution of poor reporting and inadequate methods in RCTs. Such a comprehensive picture of the quality of research would be an essential tool to assess whether this waste is decreasing over time and to better understand disparities between journals in order to propose practical ways of improvement with interventions dedicated to certain groups of journals.

Cochrane reviews are uniquely placed to serve as an observatory of the quality of research.

They synthesize findings from RCTs and are considered a reference to aid decision-making

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3 and development of practice guidelines^{31 32}. Risk of bias of each included study is
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5 systematically assessed in duplicate by trained reviewers with consensus and use of a tool
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7 called the Risk of Bias (RoB) tool that assess a few methodological items considered crucial
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9 to evaluate the validity of a RCT^{33 34}.
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11 In this study, we aimed to examine the evolution of poor reporting and inadequate methods
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13 over time within and across journals for the last three decades by taking advantage of the
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15 amount and quality of data included in Cochrane reviews.
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METHODS

This is a mapping of poor reporting and inadequate methods in RCTs over time within and across journals based on all RCTs included in Cochrane reviews. We used the proportion of trials considered by the review authors at unclear and high risk of bias as surrogates for poor reporting and inadequate methods, respectively. We focused on the following key items of the RoB tool: sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessors, and incomplete outcome data (Box 1) because they are associated with intervention effect estimates in meta-epidemiological studies^{33 35 36}.

Data sources

On September 2014, we obtained data from all Cochrane reviews published between March 2011 and September 2014. We chose March 2011 because it corresponded to the last update of the RoB tool³⁴. Data were provided as one xml file per review consisting of all data entered by the review authors in RevMan, the software used for preparing and maintaining Cochrane reviews³⁷. Each file contained information for all studies included in the review, including methods summary, references and consensus on RoB assessment between the reviewers. The RoB assessment is systematically performed by two authors who compare their classification and reach consensus on the final classification³⁴.

We downloaded the Web of Science and PubMed databases for the list of indexed journals as well as the Journal Citation Reports (JCR) database for the list of journals with their medical categories and 2014 journal impact factor (IF).

Constitution of a unique database

Using R v3.2.2 with the xml package, we combined all individual xml files in a single database including methods summary, references, and consensus on risk of bias assessment for all included studies. Because the exact wording concerning risk of bias items (e.g., allocation concealment, allocation concealment [selection bias], sequence concealment) varied across reviews, we first standardized these items. To do so, we sorted all wording corresponding to RoB assessment in the reviews and two of us (AD, LT) manually classified them in a standardized set of items of risk of bias. All disagreements were resolved by discussion.

Selection of eligible Cochrane reviews

In cases where reviews had been updated within the time-frame, we considered the most recent Cochrane review. We excluded withdrawn reviews and “empty” reviews (i.e., those not including any study). We focused on reviews of RCTs only and excluded those of observational or non-randomised studies. To identify observational or non-randomised studies, two of us (AD, LT) developed a list of keywords that could correspond to observational studies (e.g., “observational”, “cohort”, case-control”) that were automatically searched in the free-text description of the methods summary. We also identified risk of bias items that could correspond to observational studies (e.g., potential confounding factors taken into account). We excluded reviews reporting these keywords or risk of bias items. Then, we identified and included reviews with an assessment of the risk of bias for the following key items: sequence generation, allocation concealment, blinding (whatever the type of blinding item), and incomplete outcome data. Although we selected reviews from the last update of the RoB tool, in some reviews, blinding was assessed overall (according to the previous version of the RoB tool), with no distinction between blinding of participants and personnel and

blinding of outcome assessors. This is why we considered reviews eligible if they reported at least one item concerning blinding (i.e., blinding overall, blinding of participants and personnel, blinding of outcome assessors).

Selection of eligible RCTs and identification of corresponding primary reference

We excluded RCTs if trial results were not reported in at least one journal article published after 1985, and those for which no primary reference was reported. We excluded RCT journal articles published prior to 1986 (corresponding to the 10th percentile of trial year of publication) to focus on contemporary trials. To do this, we first extracted the references for all RCTs included in the eligible Cochrane reviews, including the reference type (i.e., journal article, book section or conference proceedings). We excluded RCTs without a reference corresponding to a journal article. Second, we used a matching algorithm³⁸ and manual validation to identify duplicate references and excluded trials appearing in more than one review. Third, for RCTs referencing more than one journal article, we selected the ‘primary reference’ as reported by the review authors. In the few cases there were several ‘primary references’ reported, we manually identified the reference corresponding to reporting of the main results. We excluded RCTs for which no primary reference was reported. We also excluded RCTs reported in abstract format only (reported as such in the characteristics of included studies). We extracted the year of publication and journal names of the primary reference for all selected RCTs.

Matching of journal names with the Web of Science, PubMed and JCR

To standardise journal names and obtain the 2014 journal IF, we used the Web of Science and PubMed databases. We matched journal names to journal names and abbreviations of journals indexed in Web of Science and PubMed databases. One of us manually reviewed journal

names that could not be matched to verify whether they corresponded to existing but not-indexed journals. This step also allowed us to identify variations in journal names (e.g., Critical care, Critical care London, Critical Care London England) that we corrected to have a consistent journal name with the Web of Science or PubMed databases. We excluded RCTs with journal names corresponding to non-existing journals. Finally, we extracted the 2014 Journal IF, medical category, average percentile across medical categories, countries and language from JCR. For journals not included in the JCR, we manually evaluated the main medical category and the language.

Extraction of risk of bias assessment

For all included RCTs, we extracted from Cochrane reviews the RoB judgment in terms of “low”, “high” or “unclear” risk assigned to each of the five key RoB items considered in this work (i.e., sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessors and incomplete outcome data). When a Cochrane review assigned more than one judgment of RoB to the same item (e.g., the item “blinding of outcome assessors” may have been assessed for each outcome or type of outcome), we considered the risk of bias judgment corresponding to subjective outcomes (because for objective outcomes, the item “blinding of outcome assessors” should be at low risk of bias even if no blinding is reported). For trials included in reviews assessing blinding overall with no distinction between blinding of participants and personnel and blinding of outcome assessors, we considered the risk of bias for blinding overall for both blinding of participants and personnel and blinding of outcome assessors. For trials appearing in more than one Cochrane reviews, we extracted the RoB assessment for the most recent Cochrane review.

Summary of data available for each included RCT

- *Publication characteristics*: year of publication, journal name, whether the journal was indexed in Web of Science and PubMed databases as well as JCR, medical category and language. For RCTs published in a journal indexed in JCR, we also had the journal 2014 IF.
- *Risk of bias assessment*: Final risk of bias judgment, which corresponds to the consensus of the judgment by two trained reviewers for each of the following five key RoB items: sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessors and incomplete outcome data.

Assessment of poor reporting and inadequate methods

According to the Cochrane Handbook, RoB should be considered unclear in cases of insufficient information to permit judgement of low risk or high risk^{33 34}. Therefore, an item classified as at unclear risk of bias can be considered poorly reported. A judgement of high risk should be given when inadequate methods or conduct could result in a bias of sufficient magnitude to have a notable impact on the results or conclusions of the trial³⁴. In this study, we used the proportion of trials considered by the review authors as at unclear and high risk of bias for the key items of the RoB tool as surrogates for poor reporting and inadequate methods, respectively.

Analysis

The analysis was descriptive. We first conducted an overall description of the amount of poor reporting and inadequate methods for each RoB item in included RCTs by assessing the overall proportion of trials at unclear and high risk of bias, respectively. Then, we assessed the evolution of poor reporting and inadequate methods over time. To do so, we ordered all

RCTs by increasing publication year (i.e., starting at 1986) and assessed the evolution over time of the proportion of trials at unclear and high risk of bias for each item. Because inadequate methods can only be assessed when reporting is adequate, we performed two analyses for the evolution of inadequate methods: one based on all trials and one based on only trials that were not at unclear risk of bias for the item.

We predefined subgroup analyses based on the following characteristics:

- Journal IF
 - o ≥ 10 , 5-10, < 5 , no IF
 - o $\geq 90^{\text{th}}$ percentiles of journals with the highest IF, 70-90th, $< 70^{\text{th}}$ percentile, no IF
- Medical subject category according to the JCR with a comparison between general journals (category “Medicine, general and internal”) and specialty journals (other categories)
- Separately for each of the 10 journals with the most RCTs
- Language: English only or Other languages. This analysis was suggested by a reviewer.

The constitution of the database and all statistical analyses involved use of R v3.2.2 (R Core Team (2015). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.)

Patient involvement

Patients were not involved in any aspect of the study design, conduct, or in the development of the research question or outcome measures. This study is a meta-epidemiological assessment of existing published research and therefore there was no active patient recruitment for data collection.

RESULTS

Selection and general characteristics

The selection process is reported in eAppendix 1. Briefly, we included data from 2,001 systematic reviews. These reviews included 20,920 unique articles (median year of publication 2003 [Q1-Q3: 1997-2008]) published in 3,136 journals. Of these, 19,551 (93%) pertained to 2,390 journals indexed in Web of Science or PubMed and 17,944 (86%) to 1,706 journals indexed in JCR. The median IF for the journals was 3.4 (Q1-Q3: 2.0-5.5) (Table 1). Most RCTs were published in journals with IF <5 or IF between 5 and 10 (12,496 [60%] and 3,134 [15%], respectively). Of the journals indexed in JCR, 165 (10%) were non-English and included 584 RCTs (3% of RCTs published in journals with IF). There were 2,976 RCTs published in 1430 journals with no IF (14%).

Eighty percent of RCTs were published in 24% of the journals. The 10 journals with the most RCTs included 2,386 trials representing 11% of all RCTs and consisted of 4 general journals (*New England Journal of Medicine*, *The Lancet*, *The BMJ* and *Journal of the American Medical Association*) and 6 specialist journals (*American Journal of Obstetrics and Gynecology*, *Obstetrics and Gynecology*, *BJOG: An International Journal of Obstetrics and Gynaecology*, *Pediatrics*, *Journal of Pediatrics* and *Journal of Clinical Oncology* [Table 1]).

Characteristics of journals with no IF

Among the 1,430 journals with no IF, 743 (52%) were non-English and included 1511 RCTs (51% of RCTs published in journals with no IF). The most common medical categories were integrative and complementary medicine and medicine, general & internal with 521 RCTs for both. We identified 12 journals (including 29 RCTs) that had not yet an IF in 2014 but had

one in 2015 and 102 journals (including 287 RCTs) that had previously (before 2014) an impact factor.

Overall assessment of poor reporting and inadequate methods

The proportion of trials at unclear RoB was high for sequence generation and allocation concealment (49% and 58%, respectively) and lower for blinding of participants and personnel and incomplete outcome data (31% and 25%, respectively) (Figure 1). The proportion of trials at high RoB was 4% and 7% of all trials for sequence generation and allocation concealment, respectively, but was 33% and 23% for blinding of participants and personnel and blinding of outcome assessors, respectively, and 17% for incomplete outcome data (Figure 1).

For all five RoB items, we found a lower proportion of trials at unclear and high risk of bias in journals with high IF as compared to those with low and no IF (Figure 2). For example, for allocation concealment, 38% of trials published in journals with $IF \geq 10$ were at unclear risk of bias as compared with 73% in journals with no IF. The same finding was also observed when grouping the journals by percentiles of IF (46% vs 73% of unclear allocation concealment for trials published in journals with percentile in [90-100] vs no IF, respectively) and by medical category. The proportion of trials at high and unclear risk of bias was lower for journals in the “Medicine, general and internal” category than other categories and those not indexed (Figure 2). Risk of bias for the 10 main medical categories is described in eAppendix 2.

There was a lower proportion of trials at unclear and high risk of bias in English than in non-English journals (eAppendix 3). For example for allocation concealment, 56% and 7% of RCTs were at unclear and high risk of bias for English journals versus 74% and 12%, respectively for non-English journals.

Evolution of poor reporting and inadequate methods over time

Evolution of poor reporting

The proportion of trials at unclear RoB decreased over time, especially for sequence generation, decreasing from 69% in 1986-1990 to 31% in 2011-2014, and for allocation concealment, decreasing from 70% to 45%, respectively (Figure 3).

The reduced proportion of trials at unclear risk of bias over time observed for sequence generation and allocation concealment was consistent across all types of journals but seemed more marked for journals with higher IF (Figure 4). The difference in proportion of trial articles assessed at unclear RoB over time also seemed more marked for general than specialist journals (eAppendix 4).

eAppendix 5 represents the evolution of poor reporting for the 10 journals with most of the RCTs. All journals showed an improvement over time (i.e., reduced proportion of trials at unclear risk of bias) but with important differences between journals.

Evolution of inadequate methods

Evolution of inadequate methods over time is shown in Figure 5. When considering all trials, including those considered at unclear risk of bias, the change appears minimal. For sequence generation, the proportion of trials at high RoB changed from 5% for the years 1986-1990 to 3% for 2011-2014 and for allocation concealment from 10% to 6%, respectively. When excluding trials at unclear risk of bias, the decrease was greater: from 15% to 5% and from 33% to 12%, respectively. We found a slight decrease for blinding of outcome assessors and incomplete outcome data, from 24% to 20% and from 20% to 15%, respectively, when considering all trials, and from 42% to 31% and from 28% to 19% when excluding trials at unclear risk of bias. In contrast, the proportion of trials at high risk of bias for blinding of participants and personnel slightly increased from 31% to 36% for all trials and from 47% to

49% when excluding trials at unclear risk of bias. We found no clear difference in evolution over time by journal IF (eAppendix 6).

DISCUSSION

This extensive mapping of existing research included in recent Cochrane reviews shows a decrease of poor reporting over time especially for sequence generation and allocation concealment. The proportion of trials with inadequate methods has also decreased slightly for these items. However, we found important differences among journals according to their IF, and between general and specialist journals. Our results particularly raise concerns about trials published in journals with no IF in light of their high number (2976 trials; 14% of our sample) and the prevalence of poor reporting and inadequate methods.

Strengths and weaknesses

In this study, we took advantage of all recent Cochrane reviews to build a comprehensive database of primary research (RCTs) by compiling a large amount of data routinely collected for another purpose for systematic reviews. These data are of good quality³⁹, relatively standardized and available in an electronic format. Using these data, we identified more than 20,000 RCTs and the corresponding RoB assessment, which was collected in duplicate by trained Cochrane reviewers. Although RCTs included in Cochrane reviews do not represent all RCTs, they cover a large and important body of evidence^{31 32}. We believe research on such a large group of trials would not have been possible otherwise.

Our study has several limitations. We relied on Cochrane reviewers' assessment of risk of bias. Although reviewers should be trained in use of the RoB tool, there could be variability in this assessment which is likely to be at random. For RCTs included in more than one review, we relied on the risk of bias assessment in the most recent Cochrane review. Nevertheless, we compared this assessment with previous reviews for 1,065 RCTs sharing the same primary reference and found agreement in 83% (n=881) and 75% (n=802) of RCTs for sequence generation and allocation concealment, respectively. Most disagreements concerned the

distinction between low and unclear risk of bias. These disagreements might be explained because some Cochrane reviewers may contact study authors for clarification and to obtain additional information for some methodological elements that were not clearly reported in study reports. This variability seems to be at random and does not seem to be correlated with the time of conduct of the review. Reviewers may have excluded some trials because of inadequate methods. Thus, we may have underestimated the number of studies with poor reporting and inadequate methods in publications. We cannot exclude the possibility that a classification bias may explain the results concerning the differences by IF. Cochrane reviewers might be influenced by the IF of the journal when assessing the risk of bias, with attribution of better scores to journals with the highest IF. We believe that this situation is more likely to affect mainly the extreme categories (IF ≥ 10 and no IF), and we observed a clear trend for all categories. We relied on the 2014 IF from the JCR, which could differ from that in the year the trial was published. Finally, we focused on inadequate methods and poor reporting and did not consider other important sources of waste in RCTs such as addressing questions not relevant to patients or their physicians or failure to report trial results^{3 7}.

Comparison with other studies

This study goes beyond the previous literature on the topic by the amount and quality of data included, allowing assessment of changes over time and comparisons between journals. Our results highlight the importance of poor reporting in RCTs included in all recent Cochrane reviews with around half of these considered as unclear risk of bias by the review authors for sequence generation and allocation concealment, which agrees with previous findings^{13 40 41}. However, we noted an improvement in reporting for these items with the proportion of trials at unclear risk of bias being halved over 3 decades which is consistent with results found in a

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3 study of variation in risk of bias over time from a sample of 1,732 RCTs included in 97
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5 systematic reviews published in 2012⁴⁰.
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7 We found important differences in findings by journal IF with lower proportion of RCTs with
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9 poor reporting and inadequate methods in higher IF journals. Similarly, general medical
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11 journals appeared to be associated with lower risk of bias and better reporting compared to
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13 specialist journals but this may be explained by the higher IF of general medical journals.
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15 Journal IF may represent a surrogate for other factors. Previous studies showed that trials
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17 published in journals with a high IF were more likely to report methodological safeguards
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19 against bias^{42 43} and to adhere to reporting guidelines^{43 44}. Higher technical resources in high
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21 IF journals may help ensure adherence to reporting guidelines by checking submission of the
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23 checklist or may detect selective reporting of outcomes by checking information from clinical
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25 trial registries. In addition, some high IF journals may be more engaged in a quality
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27 improvement process with involvement of methodologists during peer review. Finally, the
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29 selection of trials may be more stringent in high IF journals. However, while there are
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31 studies⁴²⁻⁴⁴ that support a relationship between IF and quality, there are other studies showing
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33 no such relationship⁴⁵ and its use is controversial^{46 47}. As previously mentioned⁴², publication
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35 in a journal with a high IF does not ensure that an RCT is at low risk of bias.
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40 Trials published in a journal with no IF represented 14% of all trials included in Cochrane
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42 reviews we examined. Poor reporting and inadequate methods were particularly common in
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44 these trials, with limited improvement over time. While IF should not be assumed to represent
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46 journal quality, those journals without an IF are likely to be different in some way from those
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48 with one. From our sample, we identified 1,430 journals with no IF and 52% were non-
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50 English journals (as compared to 10% for journals with IF).
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Implications

Although the improvements over time that we observed are rather encouraging, there is still a room for improvement. Most of the waste related to poor reporting or inadequate methods could be avoided. We previously showed that half of the waste related to inadequate methods could be limited at the planning stage of the trial with simple and inexpensive methodological adjustments¹³. Waste related to poor reporting could be completely avoided with a better reporting of all important items in publications. Although use of reporting guidelines such as the CONSORT Statement is associated with more complete reporting^{48 49}, their implementation varies across journals^{44 50-52} with many journals having no particular policy or just mentioning the existence of the CONSORT Statement in the instructions to authors^{44 50-52}. We need to promote more active implementation, such as submission of the checklist with the manuscript, as it was shown to be associated with better reporting⁵¹.

It is also crucial that research investigators and other stakeholders act responsibly to report clear, transparent and reliable research findings⁶. This responsibility can be communicated through education and training starting at university and continuing through residency, fellowship, and the various stages of a career (e.g., through professional societies, departments). Investigators should also be encouraged to work with methodologists from the planning stage of their trial to increase the likelihood of adequate study design and quality of reporting⁵³. When access to methodologists as co-investigators is not possible, writing aid tools may be particularly useful⁵⁴.

Our study has implications for Cochrane reviews in that our data provide an overview of the quality of evidence in Cochrane reviews. Poor reporting and inadequate methods are common in RCTs included in Cochrane reviews and may affect their results and conclusions, as was shown with meta-epidemiological studies⁸⁻¹². Our results highlight the importance of assessing risk of bias and of incorporating this assessment in evidence synthesis.

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3 Improvements at the trial level are necessary to improve the quality of evidence provided by
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5 systematic reviews.
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7 This study is part of a larger project whose next step will be to engage journals either alone or
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9 perhaps grouped by content area⁵⁵ as to whether this type of audit and feedback is useful to
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11 their journal practice. Similarly, when examined over time, such data can serve as an
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13 important monitoring function to examine incremental changes in quality over time. If such
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15 assessments can be automated this could be a powerful tool for funding agencies and others
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17 interested in assessing the value of their research investments^{1 5-7 56}. Cochrane is uniquely
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19 placed to partner in such a program as their data are routinely collected with excellent quality
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21 assurance.
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27 **Conclusions**

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29 This extensive mapping of trials shows a decrease in waste related to poor reporting and
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31 inadequate methods over time but with important differences among items and between
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33 journals. Our approach, based on the use of already-collected data from Cochrane reviews,
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35 has important advantages and may be a first step in the development of a live observatory to
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37 monitor the quality of research over time.
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Authors' contributions:

Agnes Dechartres participated in the design of the study, selection and acquisition of data, interpreted the data and wrote the manuscript

Ludovic Trinquart participated in the design of the study, selection and acquisition of data, interpreted the data and critically reviewed the manuscript

Ignacio Atal was involved in the selection and acquisition and management of data, statistical analysis and critically reviewed the manuscript

David Moher interpreted the data and critically reviewed the manuscript

Kay Dickersin interpreted the data and critically reviewed the manuscript

Isabelle Boutron interpreted the data and critically reviewed the manuscript

Elodie Perrodeau conducted the statistical analysis

Douglas G. Altman interpreted the data and critically reviewed the manuscript

Philippe Ravaud generated the idea, participated in the design of the study, interpretation of data and writing of the manuscript

Agnes Dechartres is the guarantor. She had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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5 **Competing interests:**
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7 David Moher is a member of the Cochrane Library Oversight Committee and a member of the
8
9 Cochrane Bias Methods Group. He received funding from the Cochrane Collaboration for an
10
11 unrelated project.
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13
14 Isabelle Boutron and Douglas G. Altman are also members of the Cochrane Bias Methods
15
16 Group. Douglas G. Altman is supported by Cancer Research UK (C5529).
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18 Kay Dickersin is the director of the US Cochrane Center.
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20 Philippe Ravaud is the director of Cochrane France.
21

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26

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32
33

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38
39

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42 Raw data and analysis available on request from the authors
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FIGURE LEGENDS

Figure 1: Risk of bias for each key methodological item in 20,920 trial articles

Figure 2: Risk of bias for each key methodological item in 20,920 trial articles by journal impact factor and medical category

Figure 3: Evolution of poor reporting over time in 20,920 trial articles

Legend: The proportion of trials at unclear risk of bias is represented as a surrogate for poor reporting. Data are proportions and 95% confidence intervals.

Figure 4: Evolution of poor reporting over time in 20,920 trial articles by journal impact factor

Legend: The proportion of trials at unclear risk of bias is represented as a surrogate for poor reporting.

Figure 5: Evolution of inadequate methods over time for A) all trials and B) trials not at unclear risk of bias for the item considered

Legend: The proportion of trials at high risk of bias is represented as a surrogate for inadequate methods. Data are proportions and 95% confidence intervals.

eAppendix 1: Flow chart of the selection process. RoB, Cochrane Risk of Bias tool; RCT, randomised controlled trial

Legend: * For 1,528 RCTs, the reference was not a journal article but book (n=138), conference proceeding (n=274), unpublished (n= 248), other (n=855), correspondence (n=11),

reference from a previous Cochrane review (n=2). For 48 RCTs, the reference corresponded to a journal article but no information was entered.

eAppendix 2: Risk of bias for each key methodological item in 20,920 trial articles by main medical categories according to Journal Citation Reports (JCR)

Legend: green indicates low risk of bias; yellow, unclear risk and red, high risk

eAppendix 3: Risk of bias for each key methodological item in 20,920 trial articles by language (English only vs Other languages)

Legend: green indicates low risk of bias; yellow, unclear risk and red, high risk

eAppendix 4: Evolution of poor reporting over time in 20,920 trial articles by journal medical category

Legend: The proportion of trials at unclear risk of bias is represented as a surrogate for poor reporting

eAppendix 5: Evolution of poor reporting for the 10 journals with most RCTs in the sample.

Legend: The proportion of trials at unclear risk of bias is represented as a surrogate for poor reporting

eAppendix 6: Evolution of inadequate methods over time in trials not at unclear risk of bias for the item considered by journal impact factor

Legend: The proportion of trials at high risk of bias is represented as a surrogate for inadequate methods

Box 1: Details on the items included in the Cochrane Risk of Bias tool considered in this study

Items	Support for judgment	Review authors' judgment assessed as low, high or unclear
Sequence generation	Method used to generate the allocation sequence reported in sufficient detail to allow an assessment of whether it should produce comparable groups	Selection bias (biased allocation to interventions) due to inadequate generation of a randomised sequence
Allocation concealment	Method used to conceal the allocation sequence reported in sufficient detail to determine whether intervention allocations could have been foreseen in advance of, or during, enrolment	Selection bias (biased allocation to interventions) due to inadequate concealment of allocations before assignment
Blinding of participants and personnel	Measures used, if any, to blind study participants and personnel from knowledge of which intervention a participant received	Performance bias due to knowledge of the allocated interventions by participants and personnel during the study
Blinding of outcome assessors	Measures used, if any, to blind outcome assessors from knowledge of which intervention a participant received.	Detection bias due to knowledge of the allocated interventions by outcome assessment
Incomplete outcome data	Evaluation of the completeness of outcome data for each main outcome, including attrition and amount of exclusions from the analysis.	Attrition bias due to amount, nature, or handling of incomplete outcome data

Sources: Cochrane Handbook³⁴ (<http://handbook.cochrane.org/>) and Higgins JP, Altman DG, Gotzsche PC, Juni P, Moher D, Oxman AD, et al. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. BMJ. 2011; **343**: d5928³³.

**Table 1: General characteristics of included articles of randomised controlled trials
(N=20,920)**

Characteristics	N=20,920
Publication year, median (Q1-Q3), min-max	2003 (1997-2008), 1986-2014
Journal indexed in PubMed or Web of Science, n (%)	19,551 (93)
Journal category according to JCR, n (% among RCTs published in journals included in JCR)*	
Medicine, general and internal	2,204 (12)
Obstetrics and gynecology	2,000 (11)
Pediatrics	1,347 (8)
Surgery	1,337 (7)
Clinical Neurology	1,234 (7)
Psychiatry	1,161 (6)
Pharmacology and pharmacy	897 (5)
Anesthesiology	796 (4)
Oncology	775 (4)
Respiratory system	711 (4)
Other	6,732 (38)
Journal IF	
Has impact factor, n (%)	17,944 (86)
Median, (Q1-Q3), Min-Max	3.4 (2.0-5.5), 0.05-55.9
IF ≥ 10	2,314 (11)
IF 5 – 10	3,134 (15)
IF < 5	12,496 (60)
No IF, n (%)	2,976 (14)
10 highest represented journals, n (%)	2,386 (11)
<i>New England Journal of Medicine</i>	384 (2)
<i>The Lancet</i>	367 (2)
<i>American Journal of Obstetrics and Gynecology</i>	257 (1)
<i>Obstetrics and Gynaecology</i>	225 (1)
<i>The BMJ (British Medical Journal)</i>	224 (1)
<i>BJOG: An International Journal of Obstetrics and Gynaecology</i>	219 (1)
<i>Pediatrics</i>	207 (1)
<i>Journal of the American Medical Association</i>	194 (1)
<i>Journal of Pediatrics</i>	158 (1)
<i>Journal of Clinical Oncology</i>	151 (1)

IF, impact factor

* A journal can have several categories according to the Journal Citation Reports

Risk of bias in trial articles (N=20,920)

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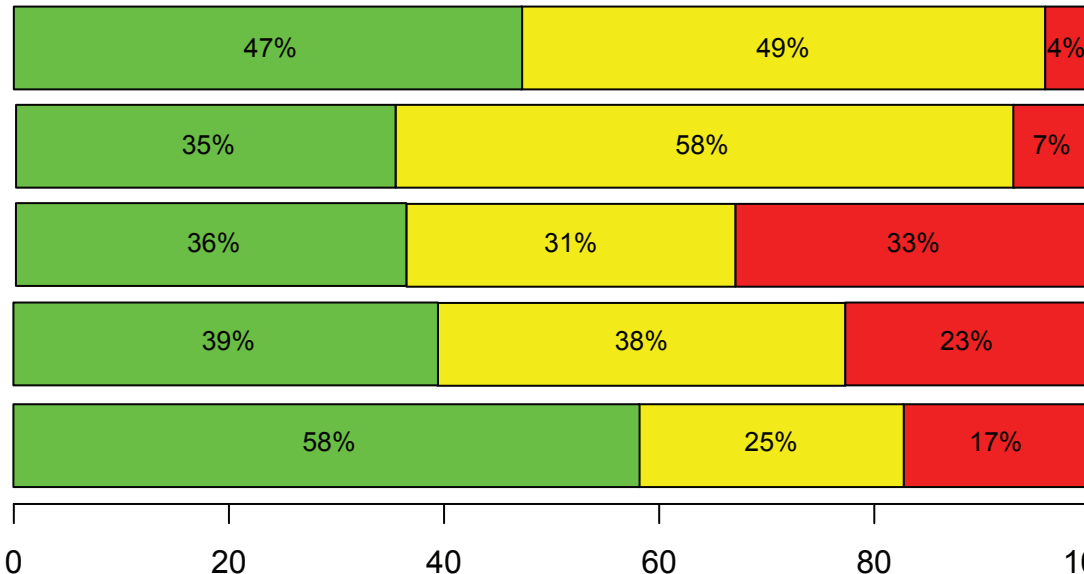
Sequence generation

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Blinding of participant and personnel

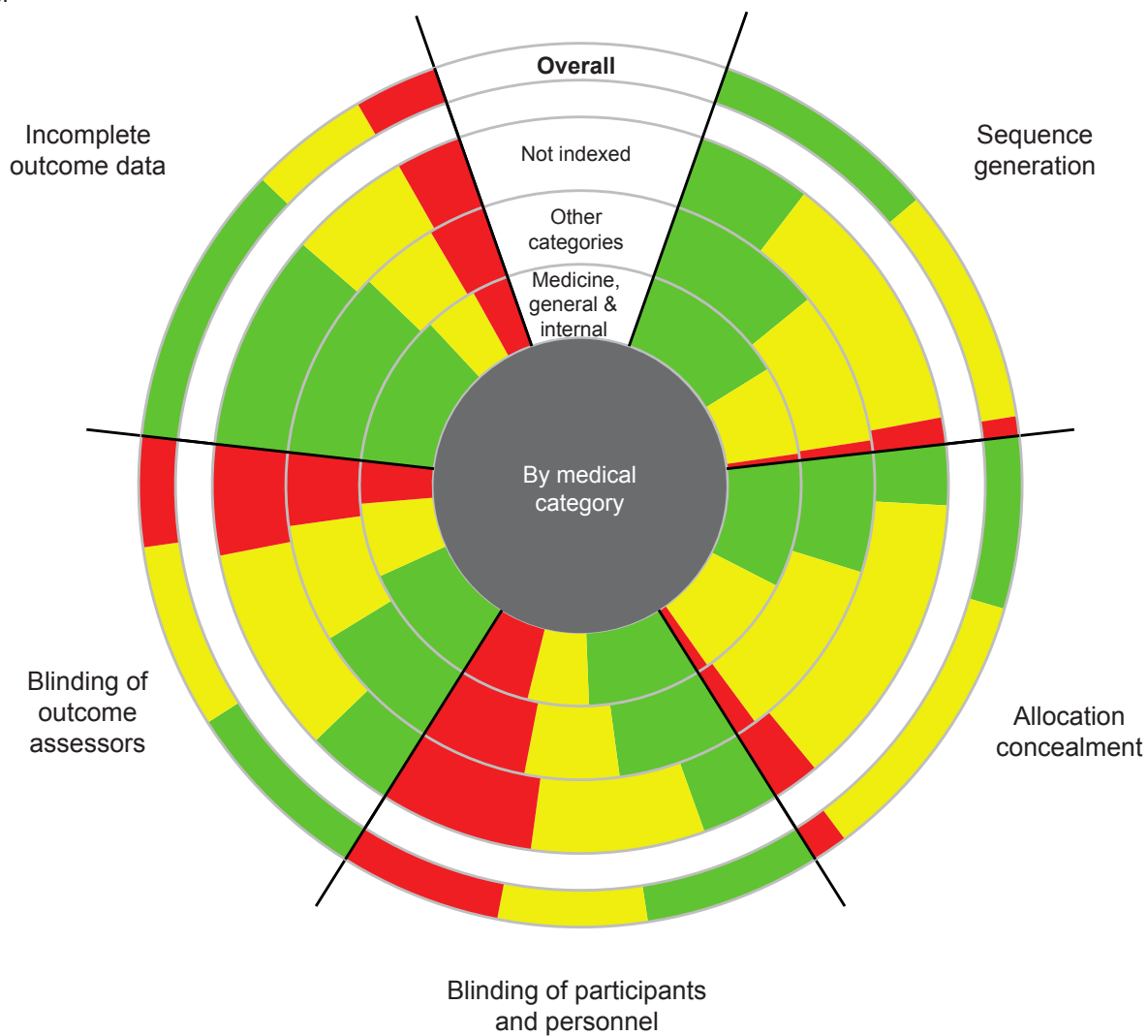
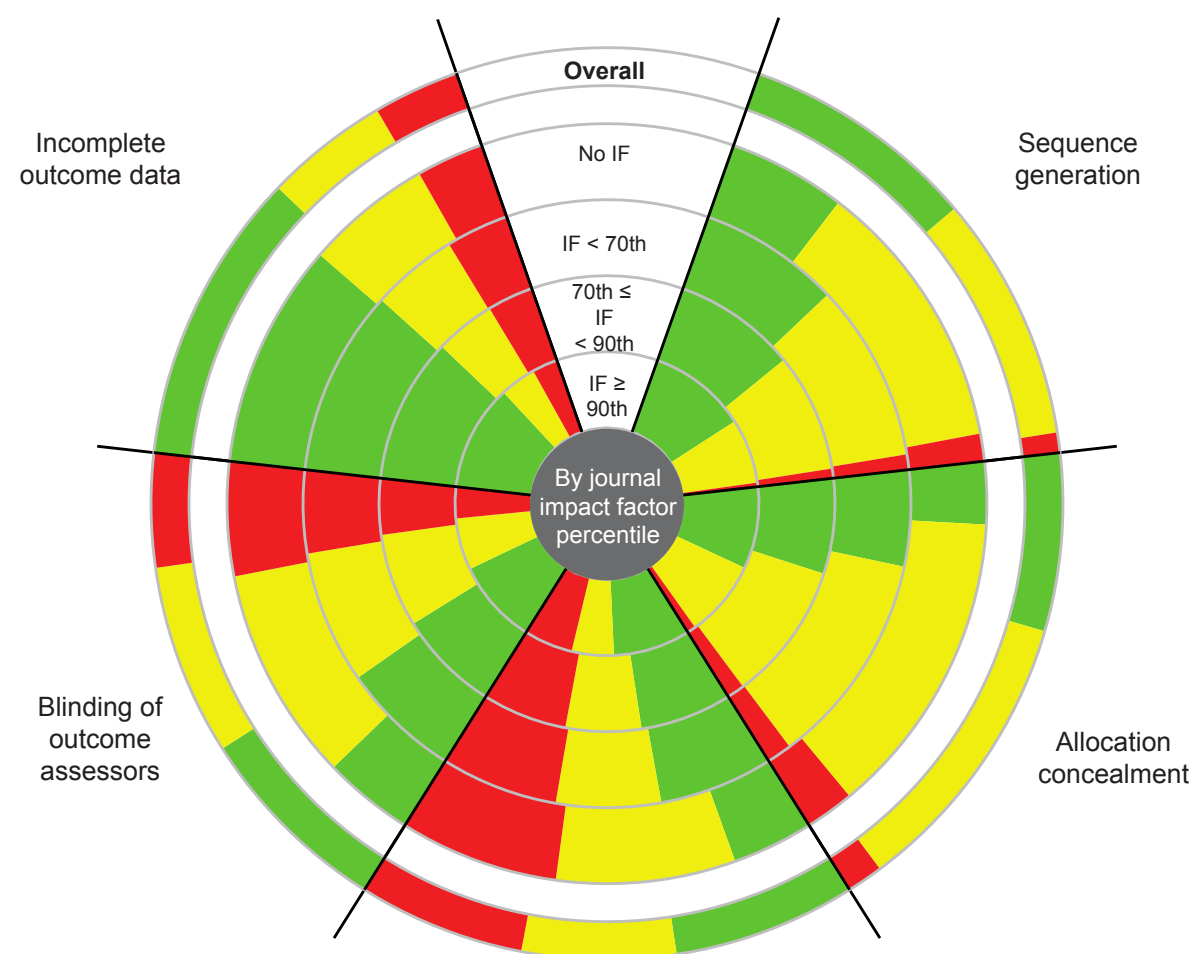
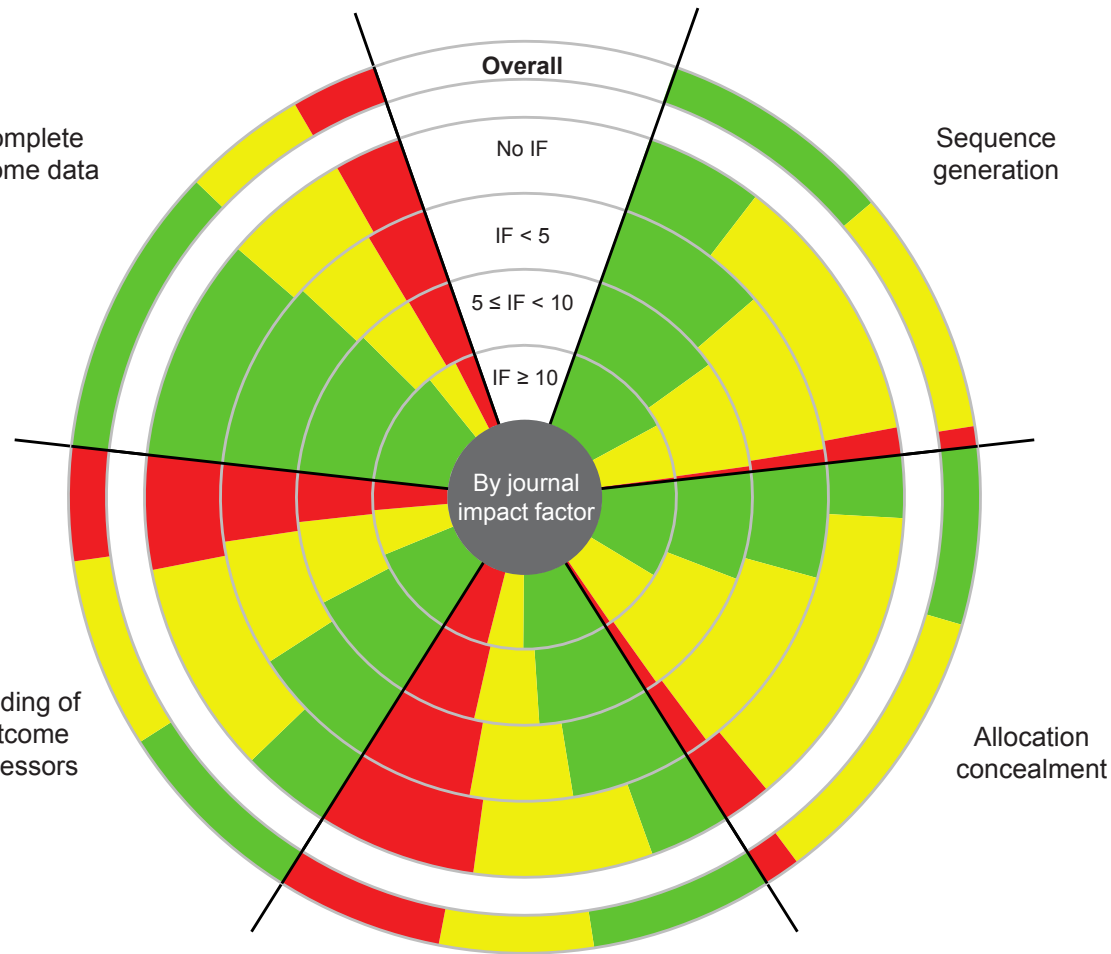
Blinding of outcome assessors

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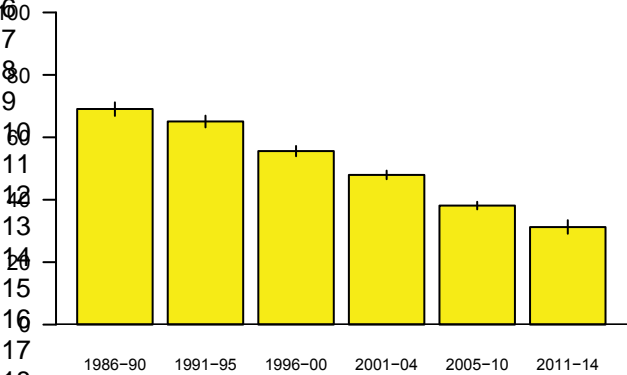
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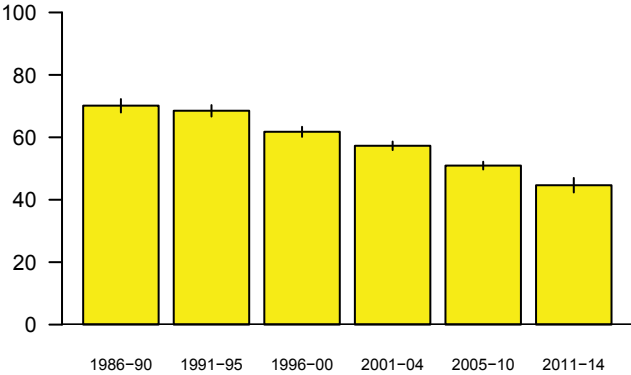
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Evolution of poor reporting over time

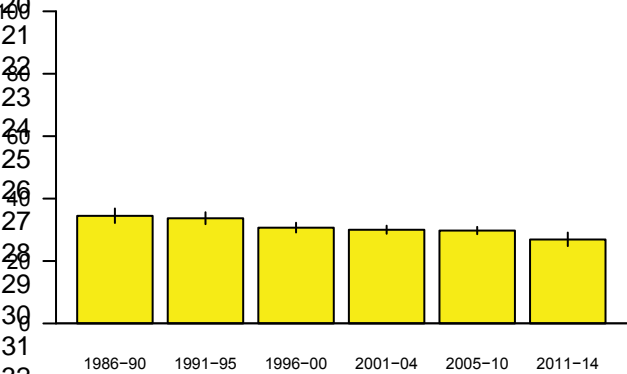
Sequence generation (n = 20,920)



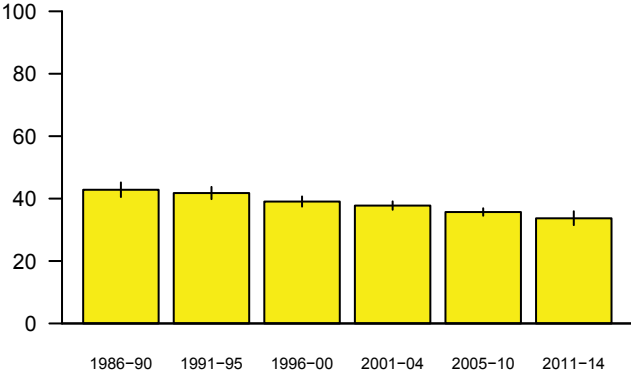
Allocation concealment (n = 20,920)



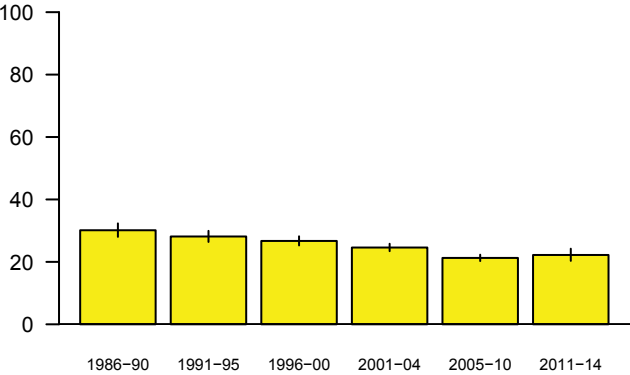
Blinding of participants and personnel (n = 19,794)



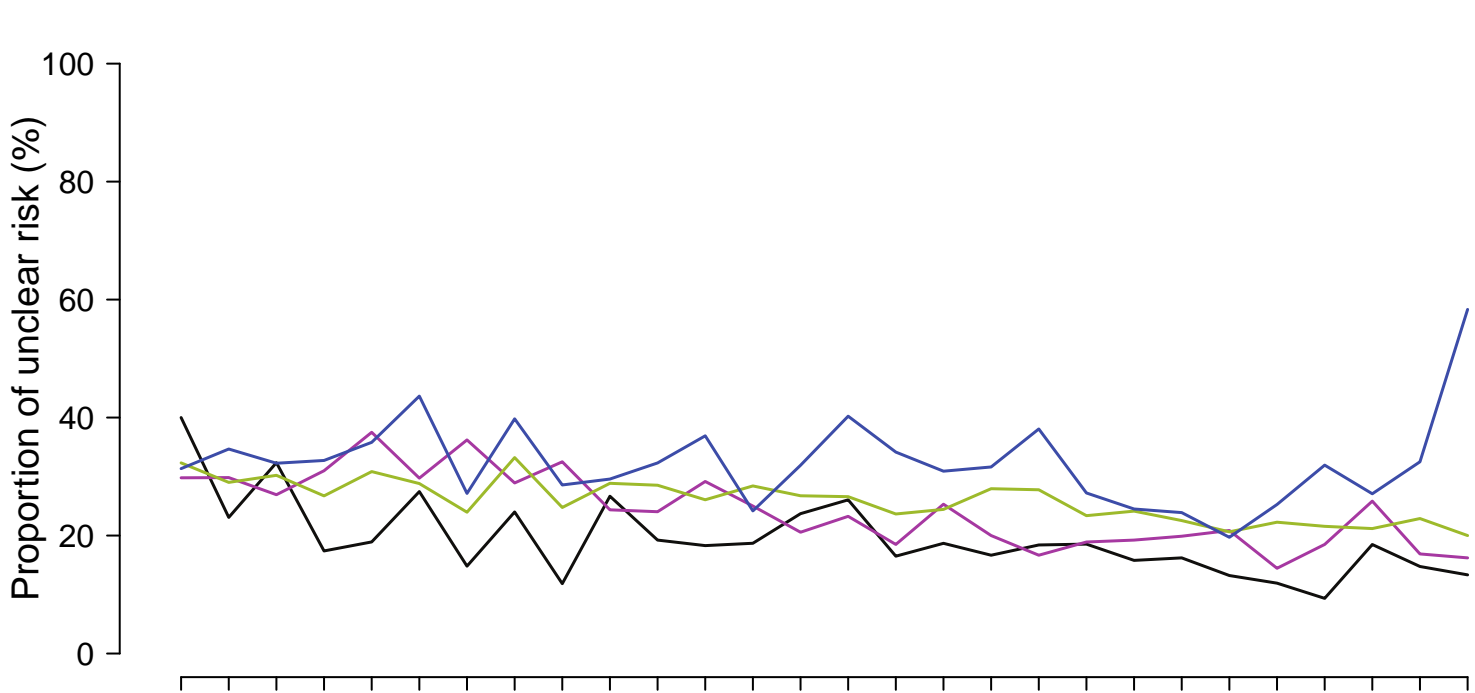
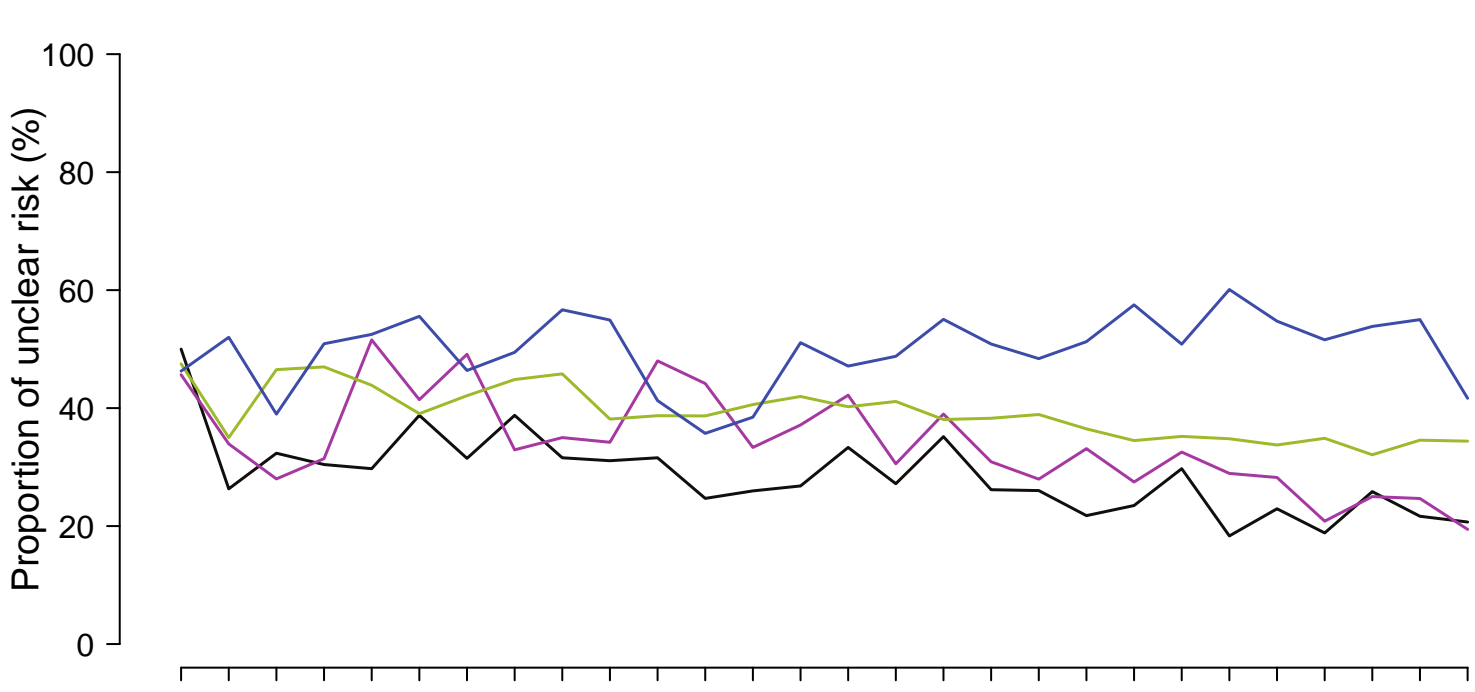
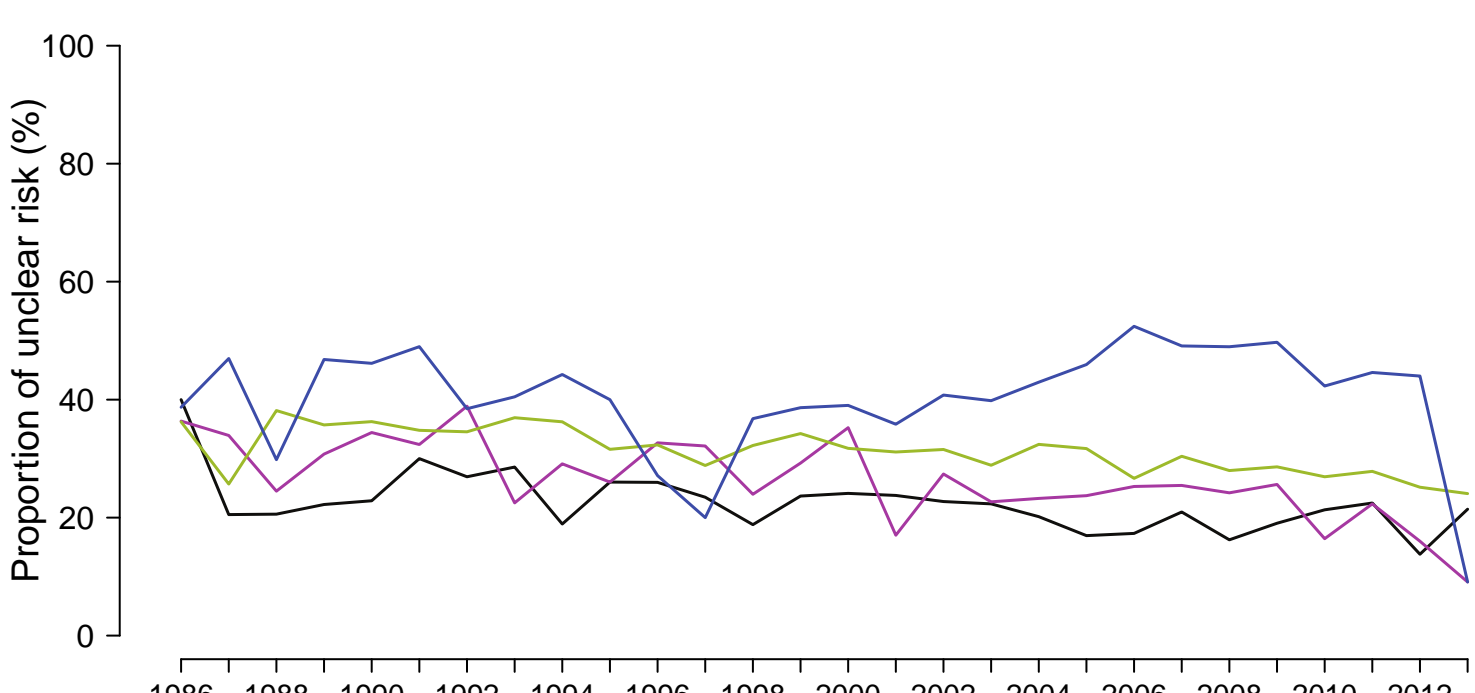
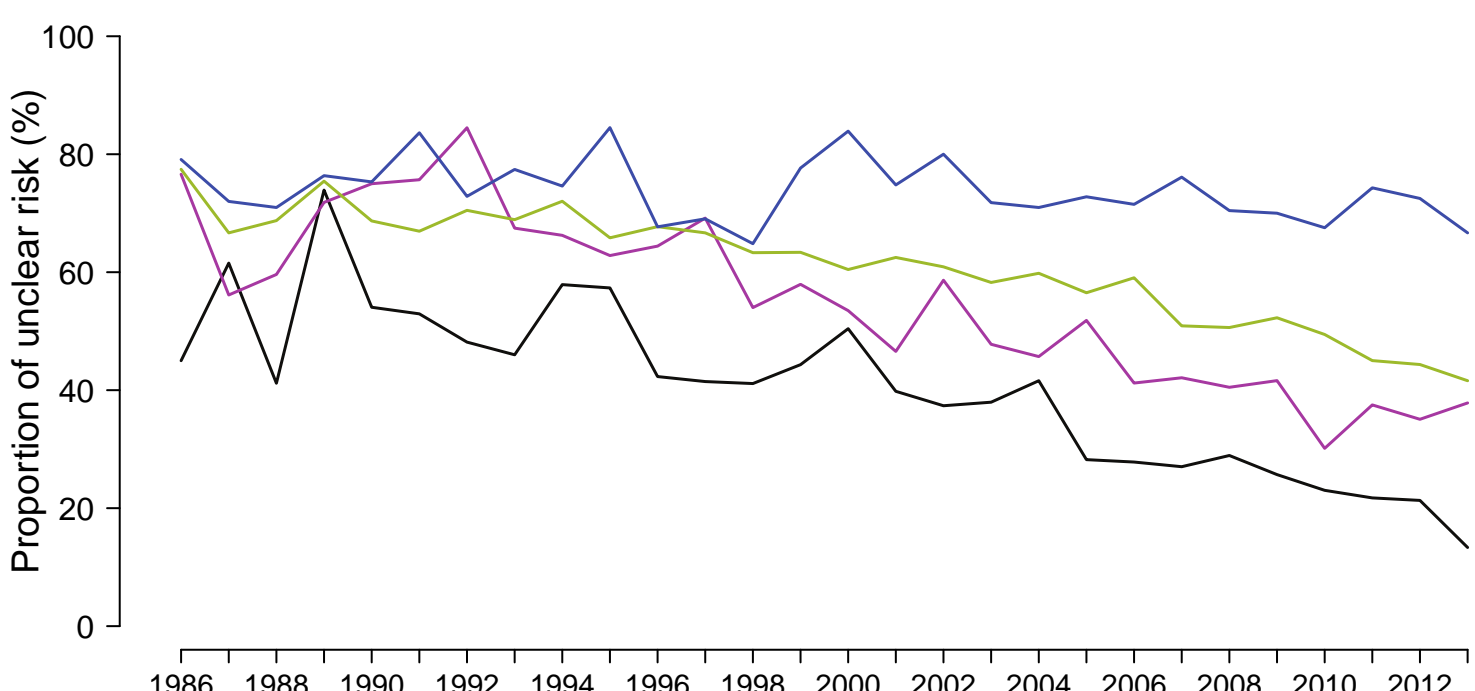
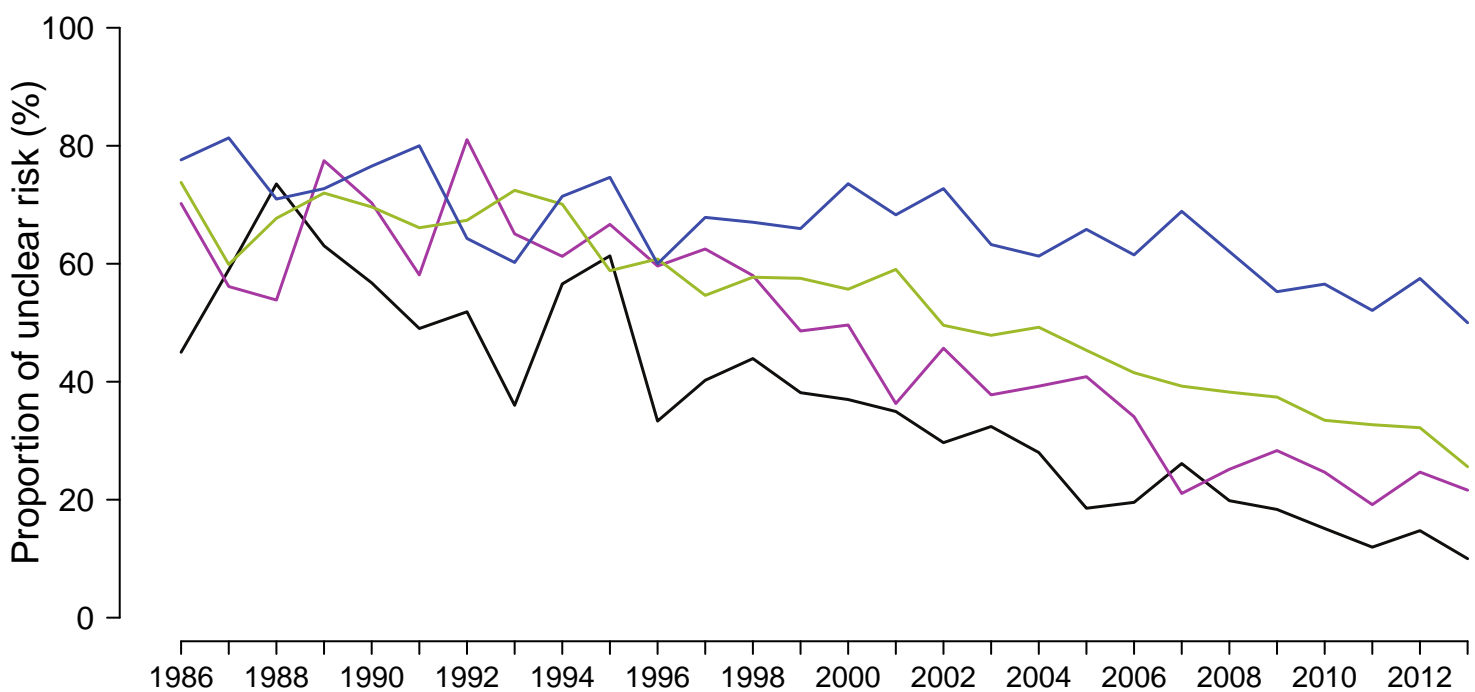
Blinding of outcome assessors (n = 20,712)



Incomplete outcome data (n = 20,920)



Evolution of poor reporting over time according to journal impact factor



— IF ≥ 10
— 5 ≤ IF < 10
— IF < 5
— No IF

Sequence generation

Allocation concealment

Blinding of participants and personnel

Blinding of outcome assessors

Incomplete outcome data

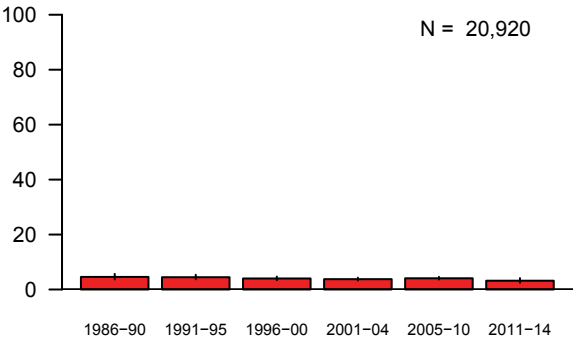
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Evolution of inadequate methods over time

Sequence generation

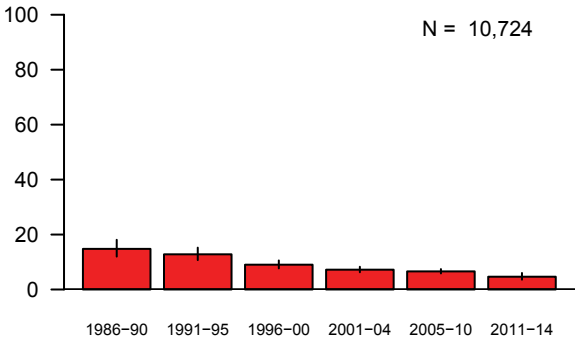
A. All trials

N = 20,920



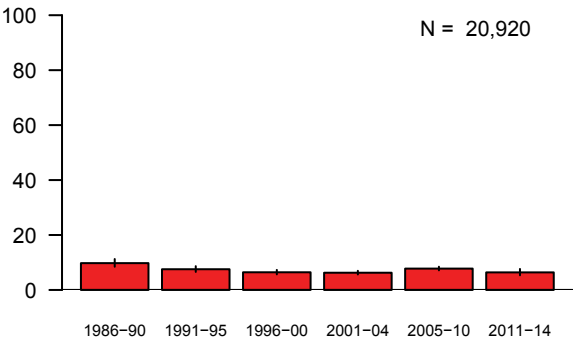
B. Trials not at unclear risk of bias

N = 10,724

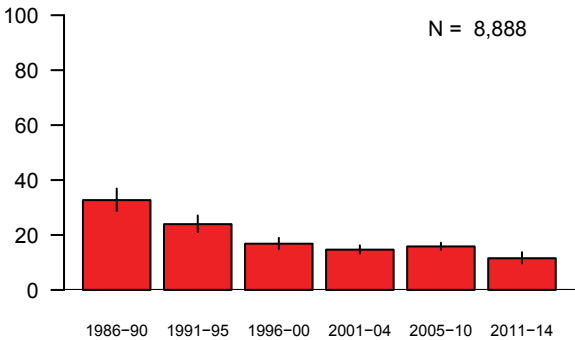


Allocation concealment

N = 20,920

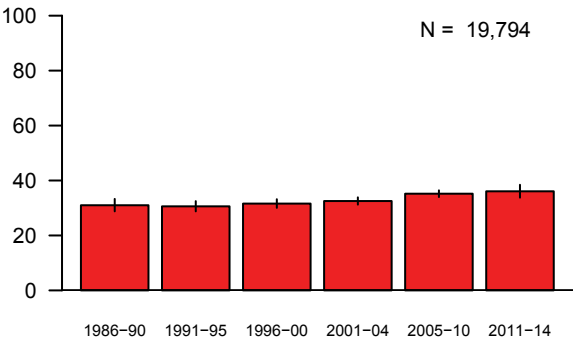


N = 8,888

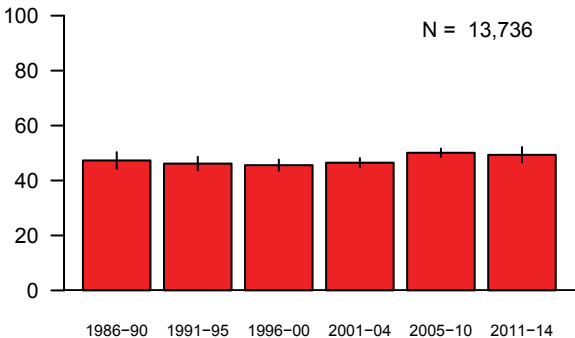


Blinding of participants and personnel

N = 19,794

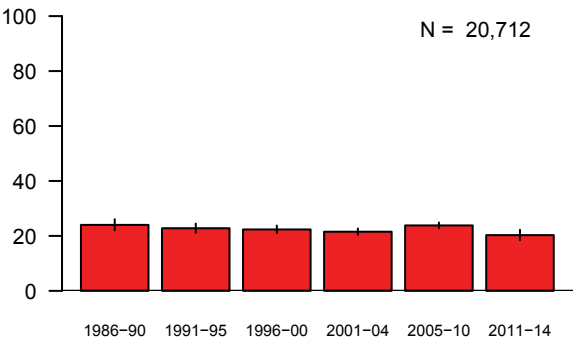


N = 13,736

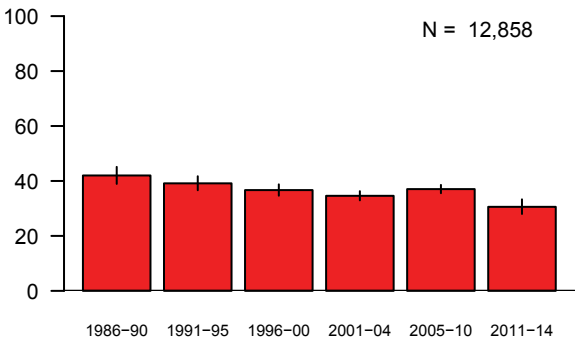


Blinding of outcome assessors

N = 20,712

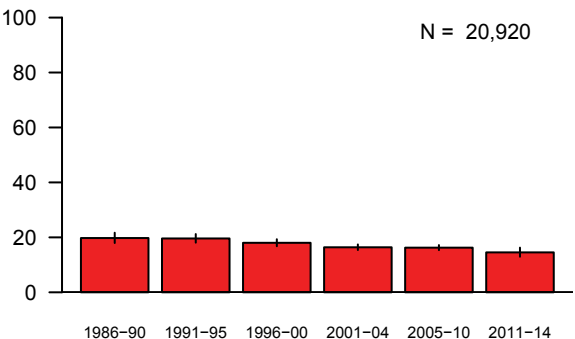


N = 12,858

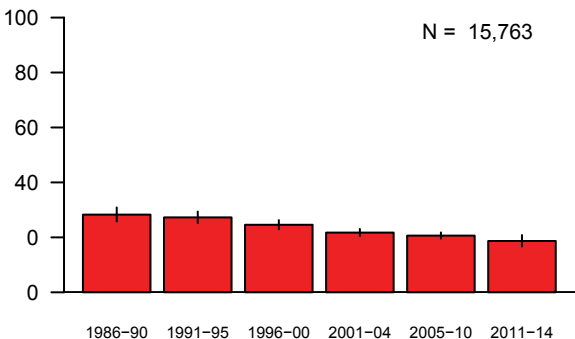


Incomplete outcome data

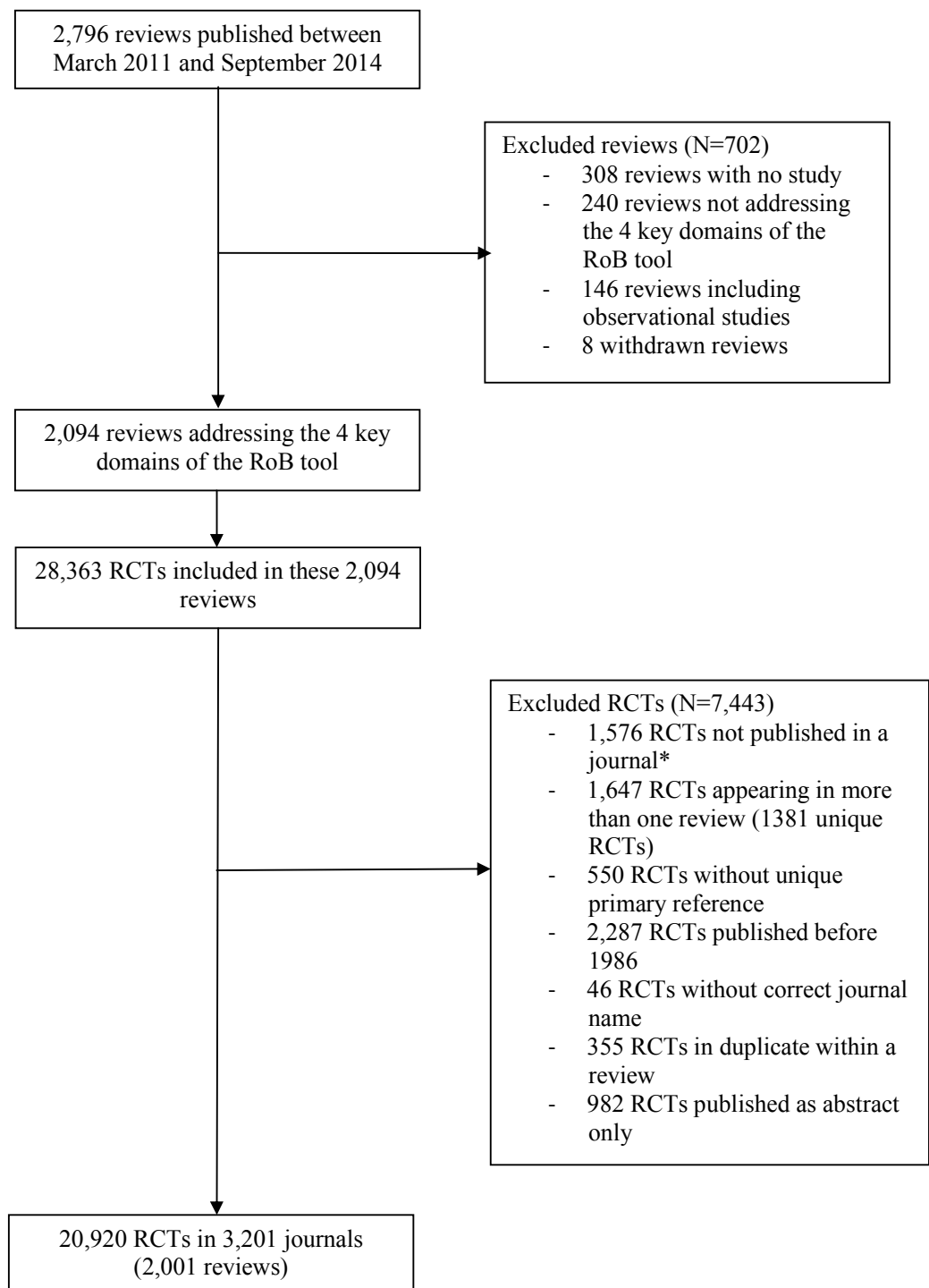
N = 20,920



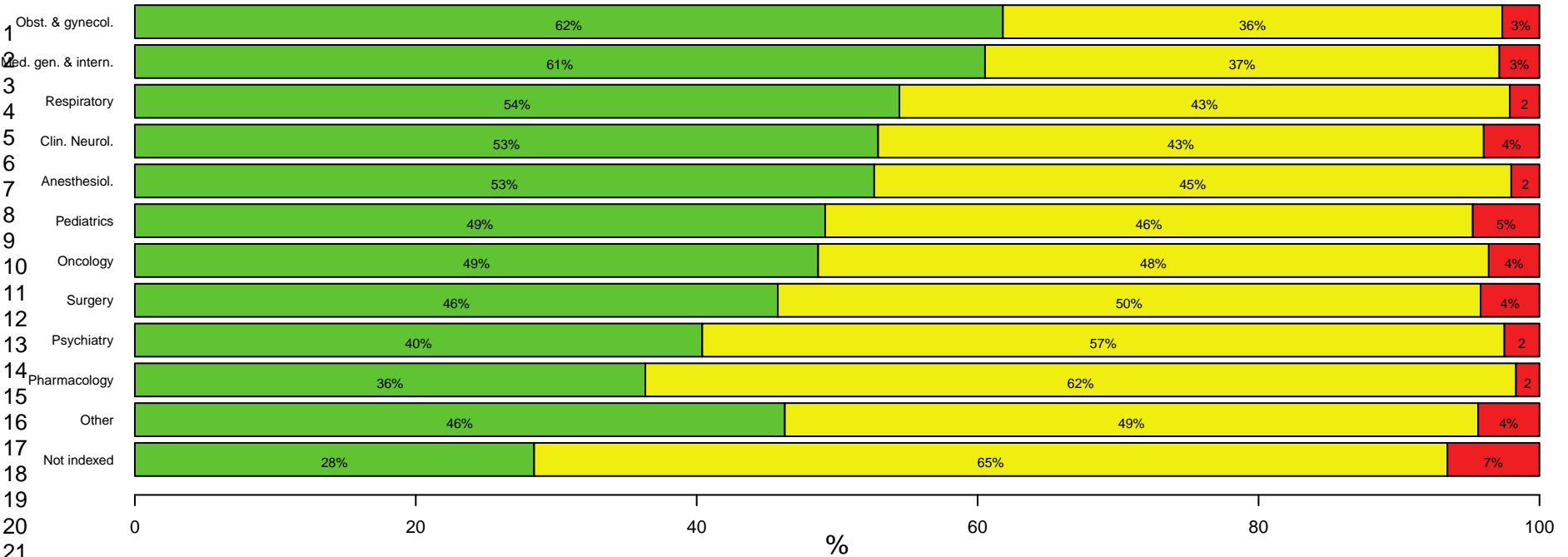
N = 15,763



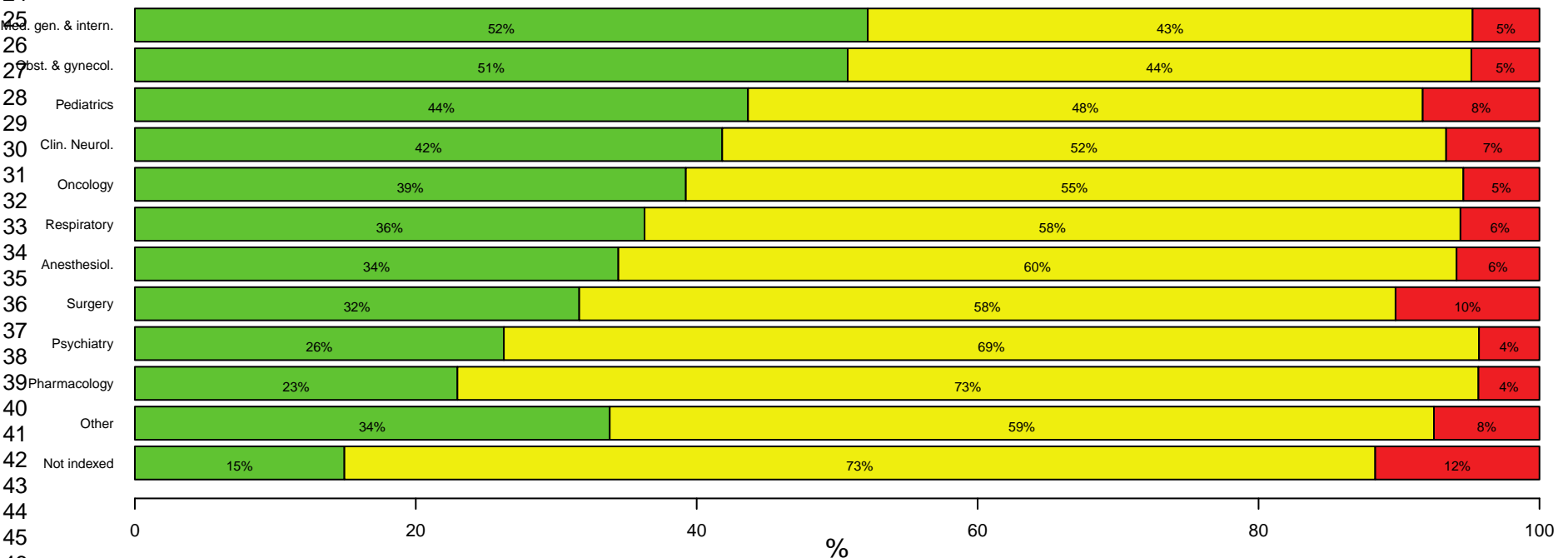
eAppendix 1: Flow chart of the selection process



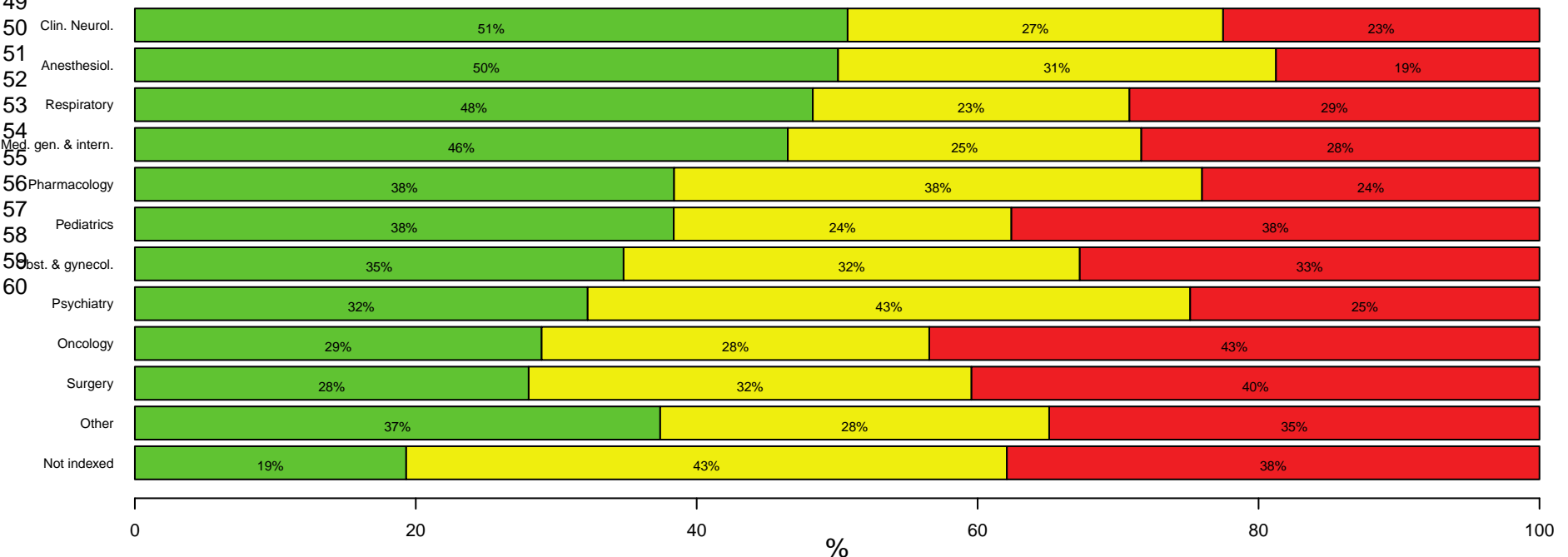
Sequence generation



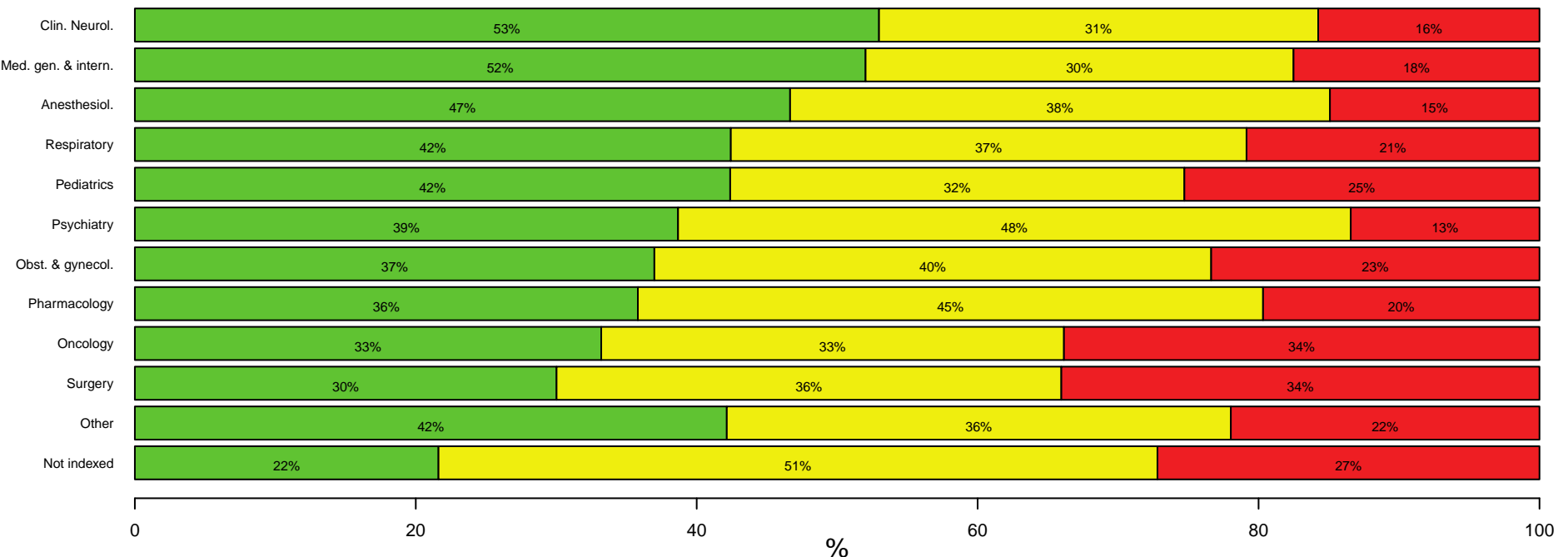
Allocation concealment



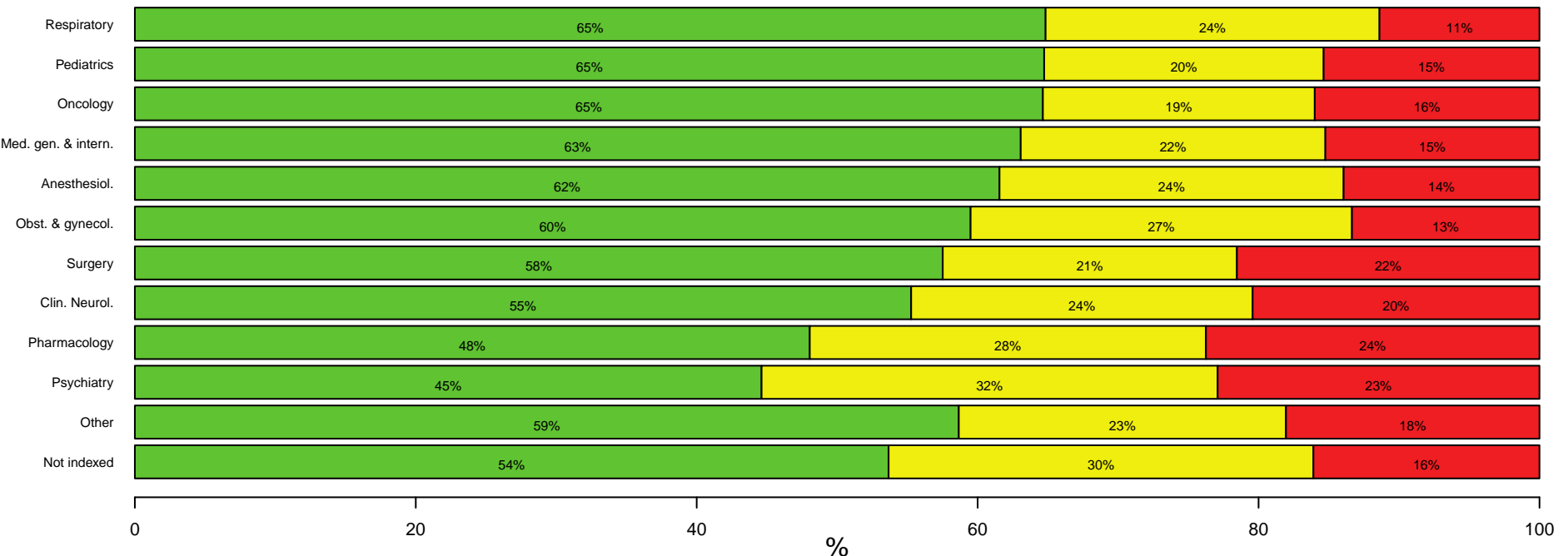
Blinding of participants and personnel



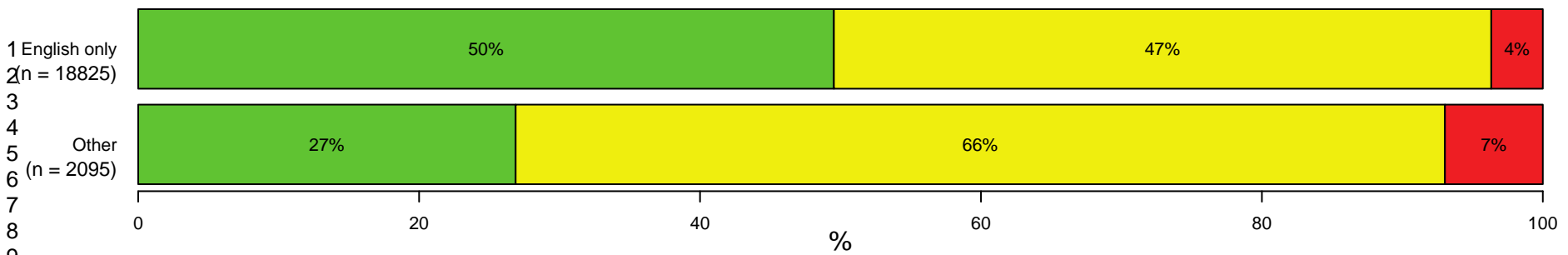
Blinding of outcome assessors



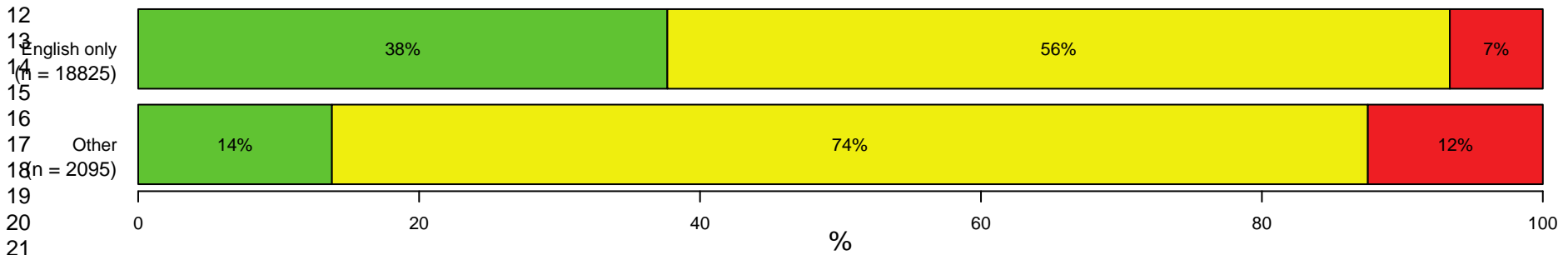
Incomplete outcome data



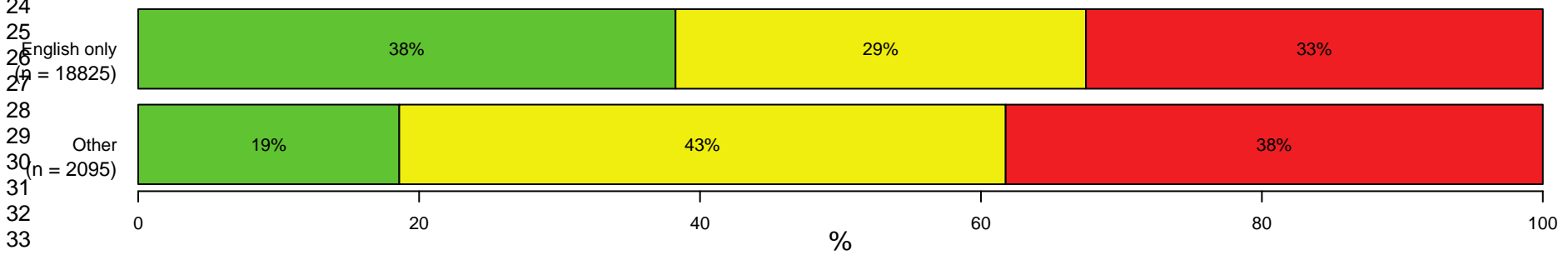
Sequence generation



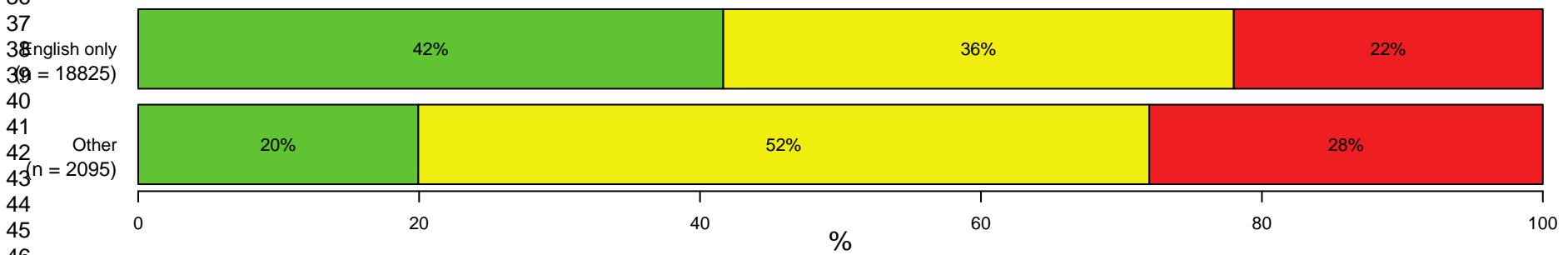
Allocation concealment



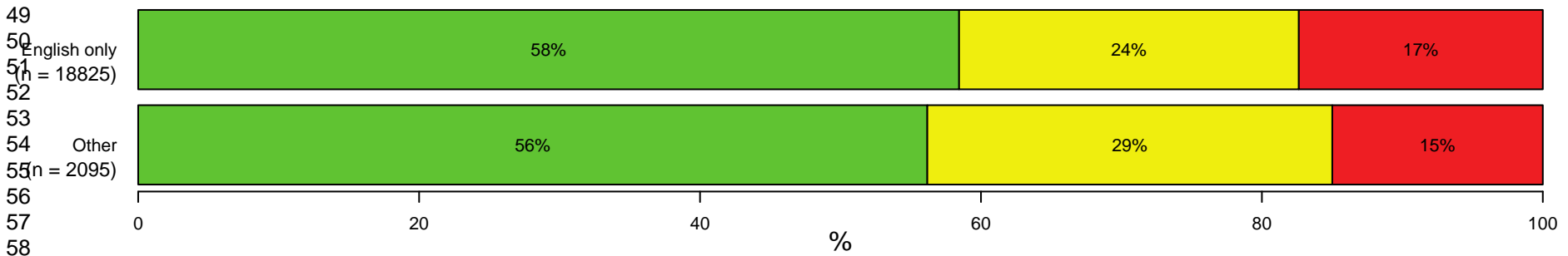
Blinding of participants and personnel



Blinding of outcome assessors

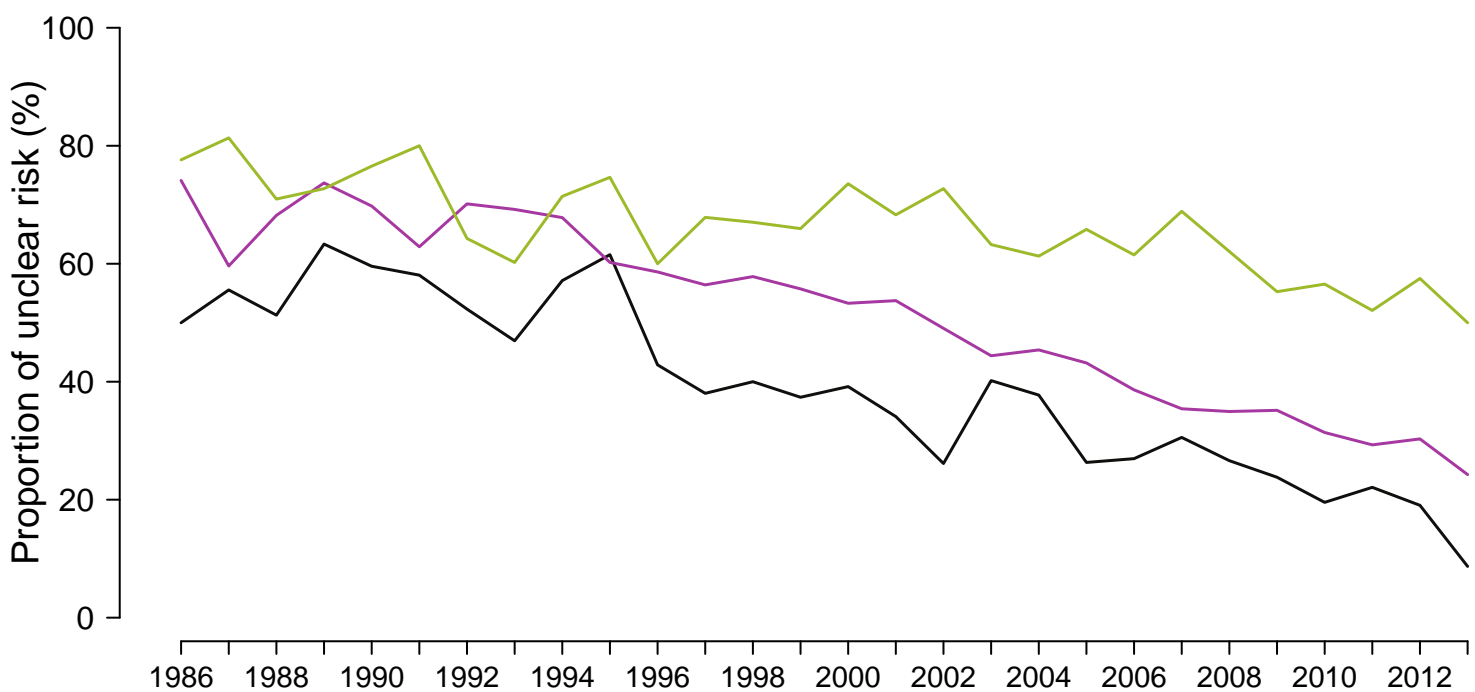


Incomplete outcome data

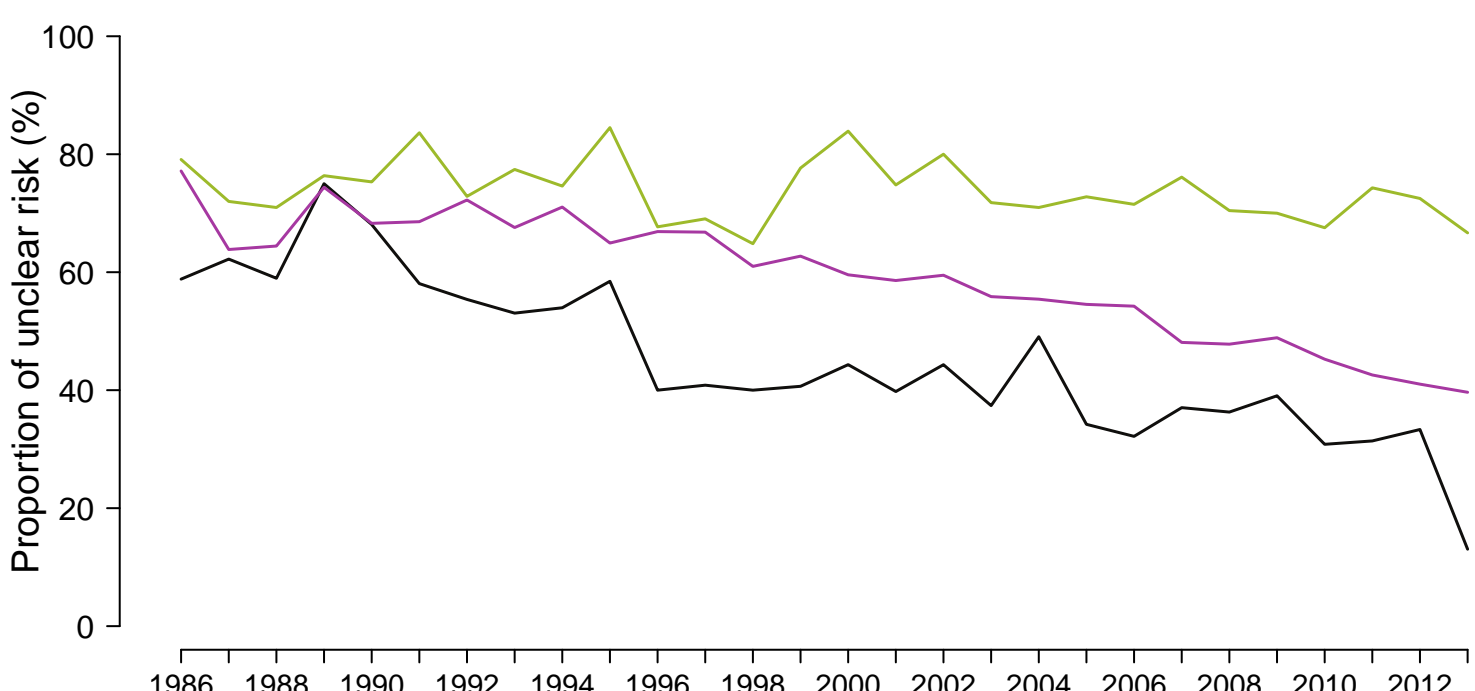


Evolution of poor reporting over time according to journal category

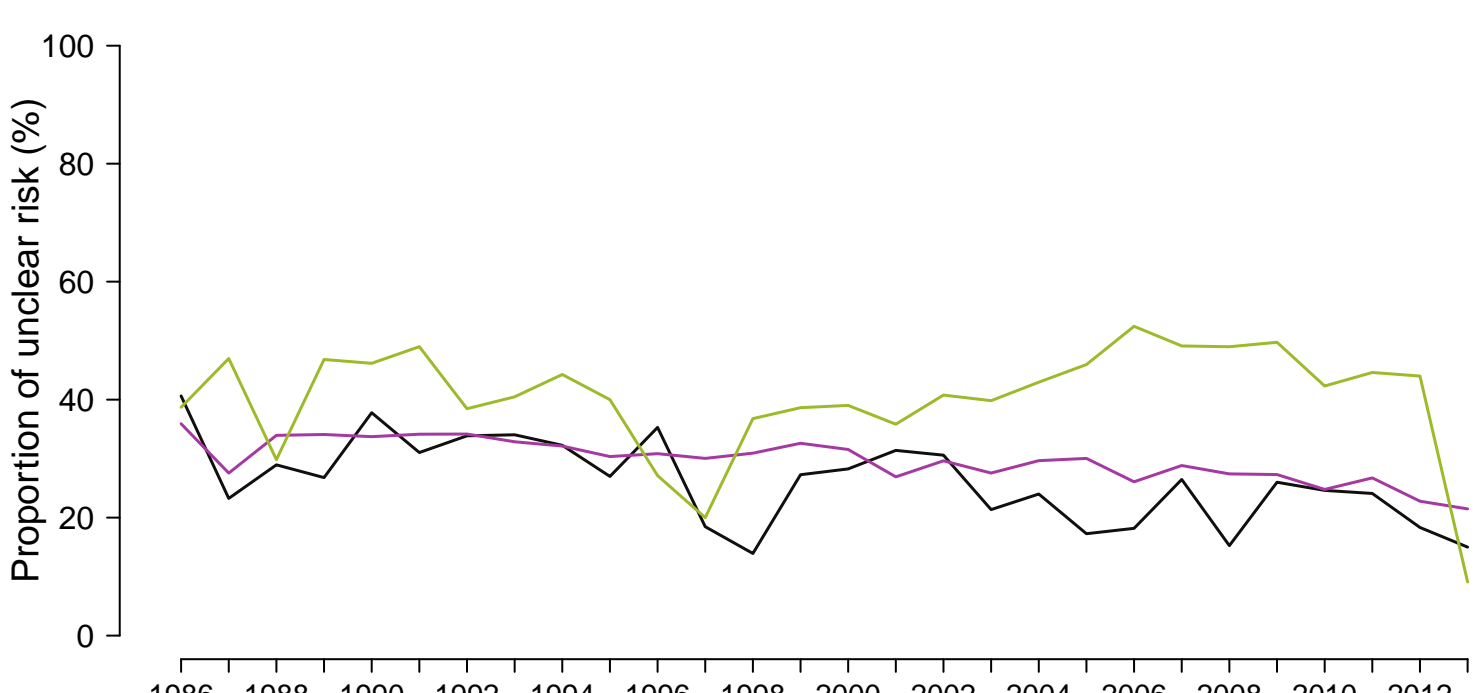
Sequence generation



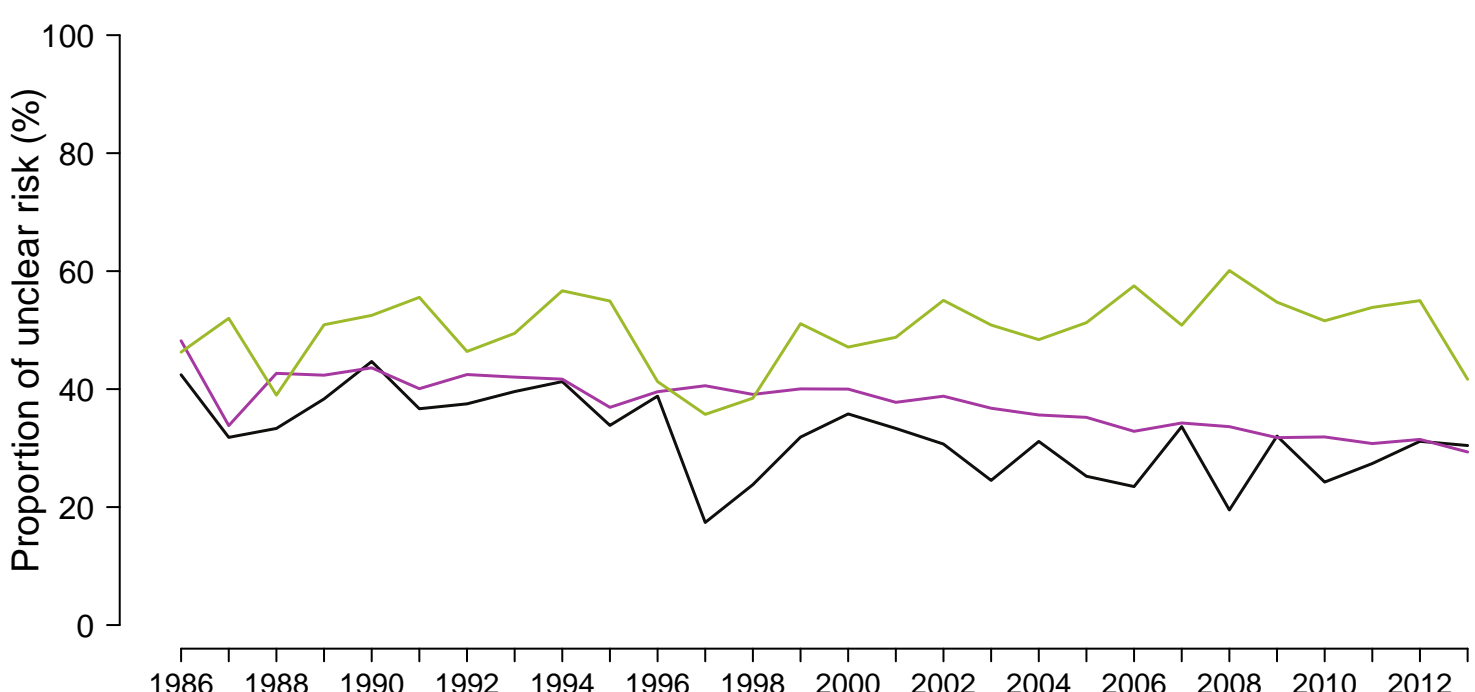
Allocation concealment



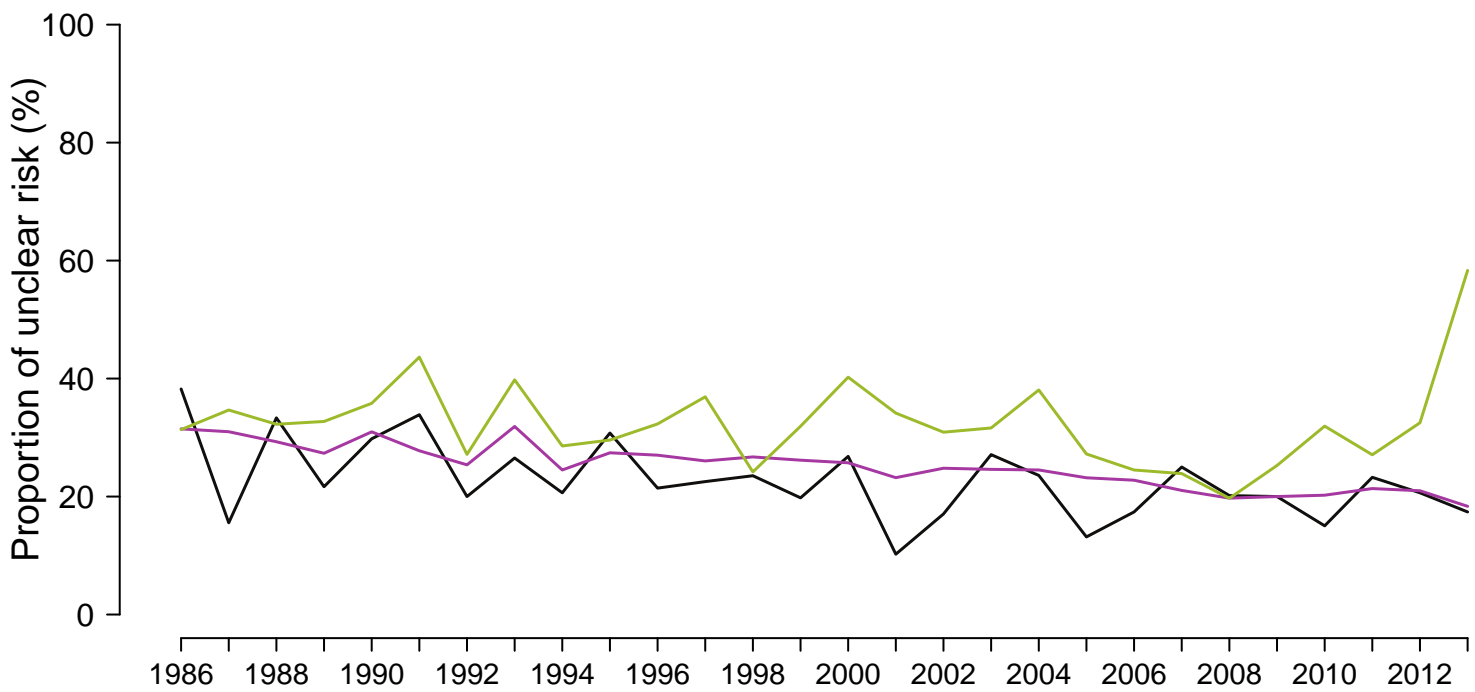
Blinding of participants and personnel



Blinding of outcome assessors



Incomplete outcome data

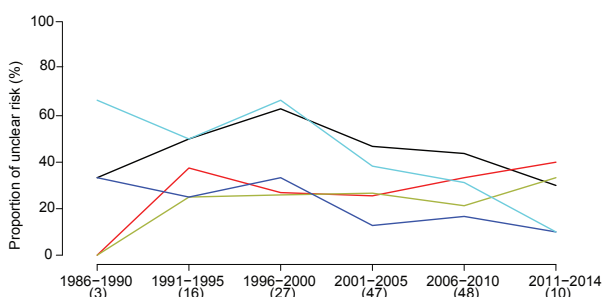
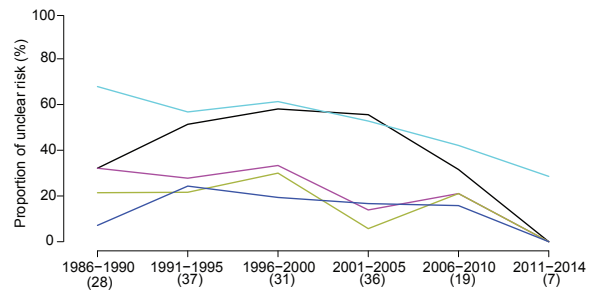
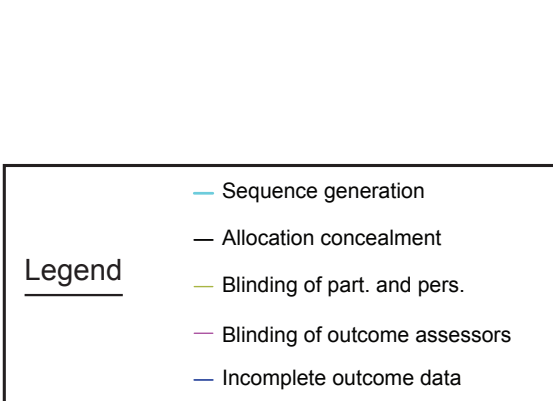
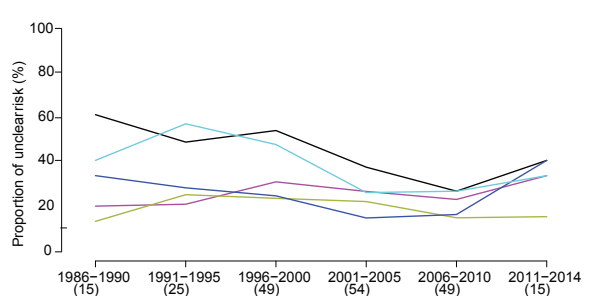
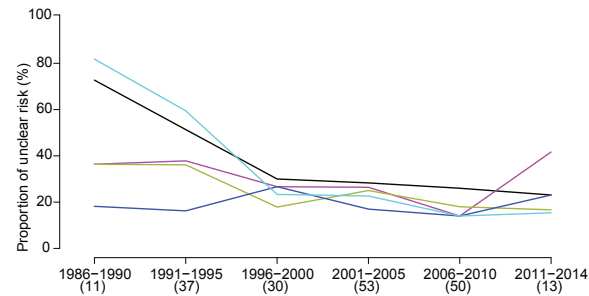
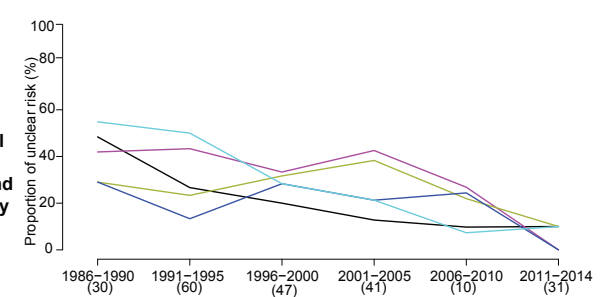
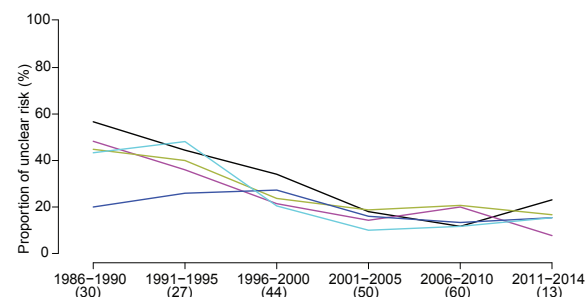
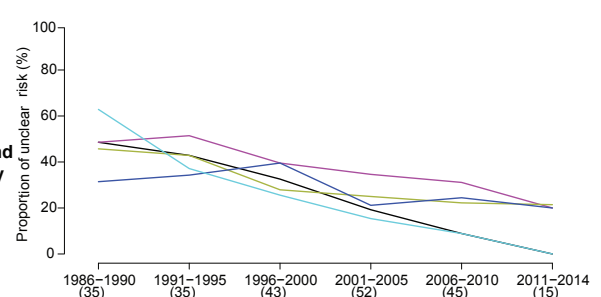
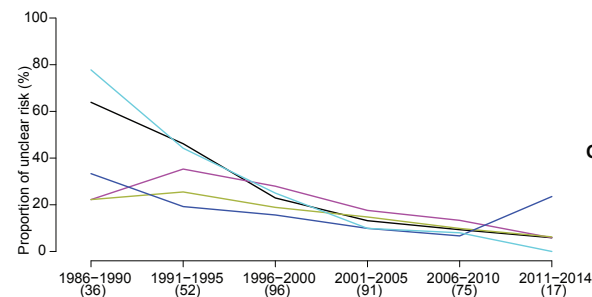
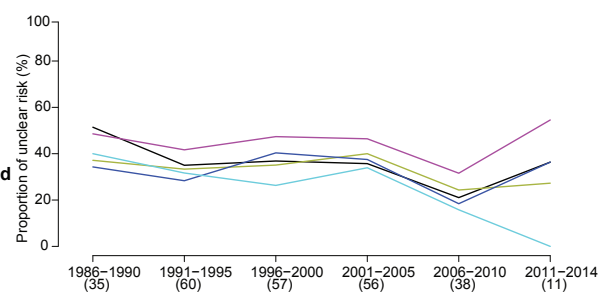
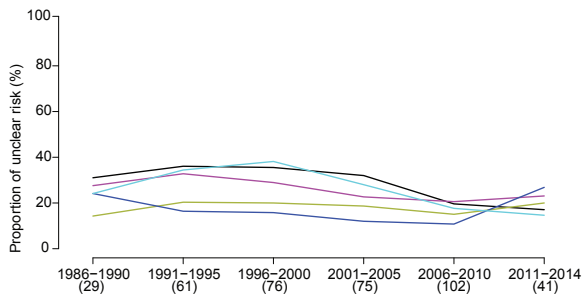


- Medicine, general & internal
- Other categories
- Not indexed

Evolution of poor reporting over time for

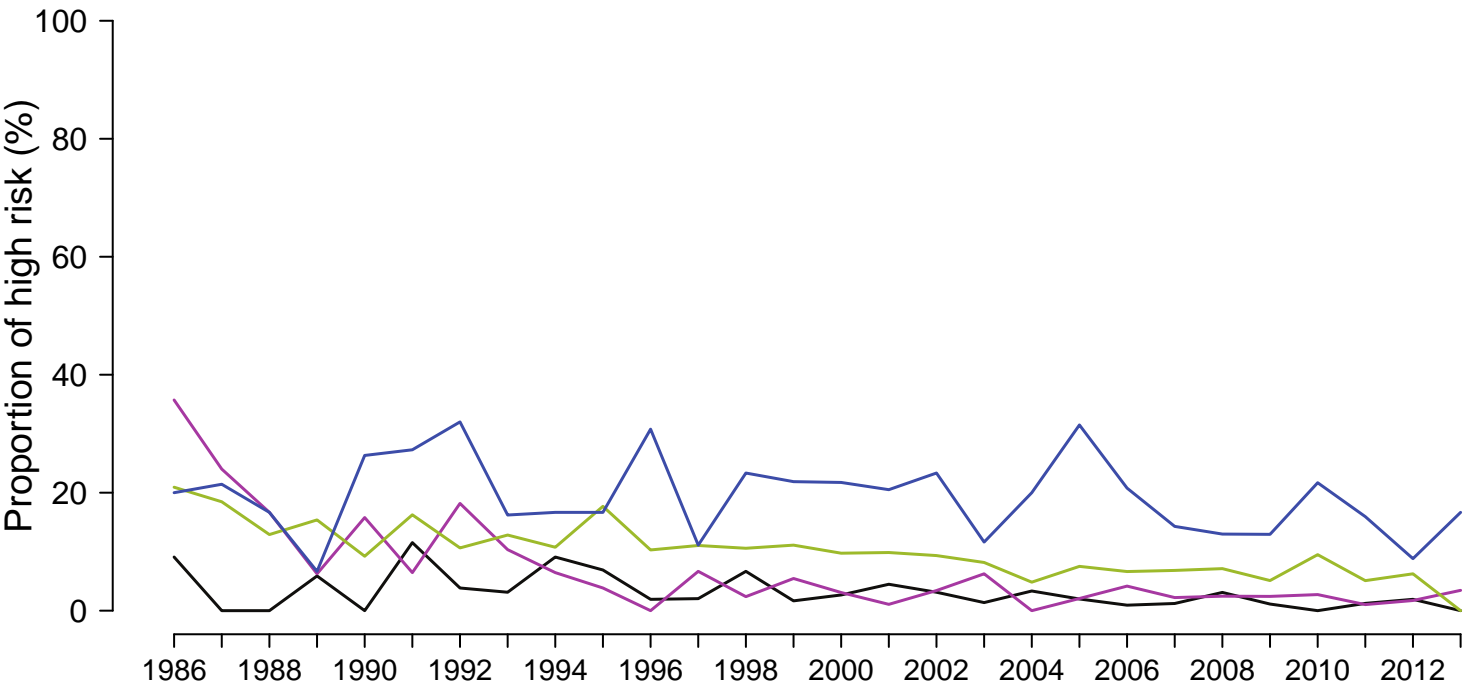
the 4 most represented general journals

the 6 most represented specialist journals

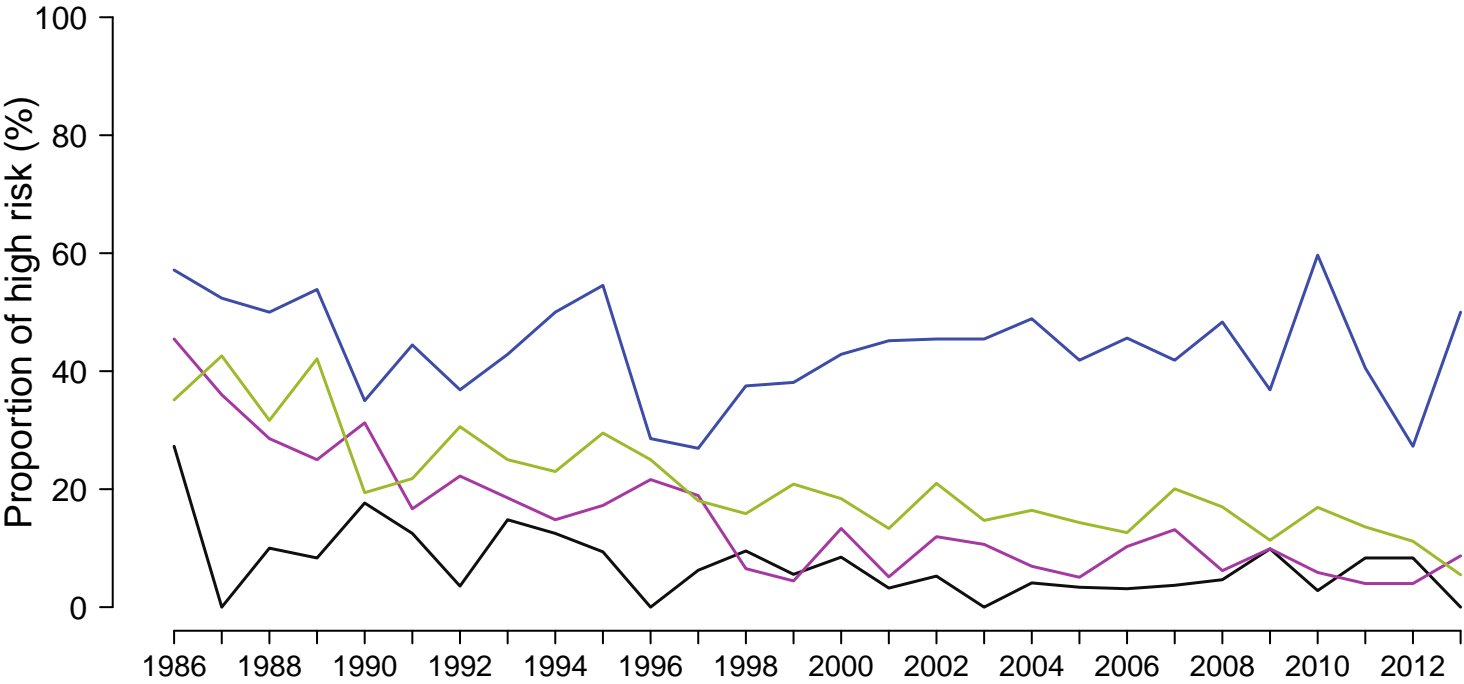


Evolution of inadequate methods by journal impact factor for trials not at unclear risk of bias

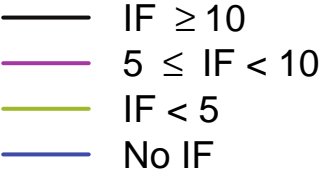
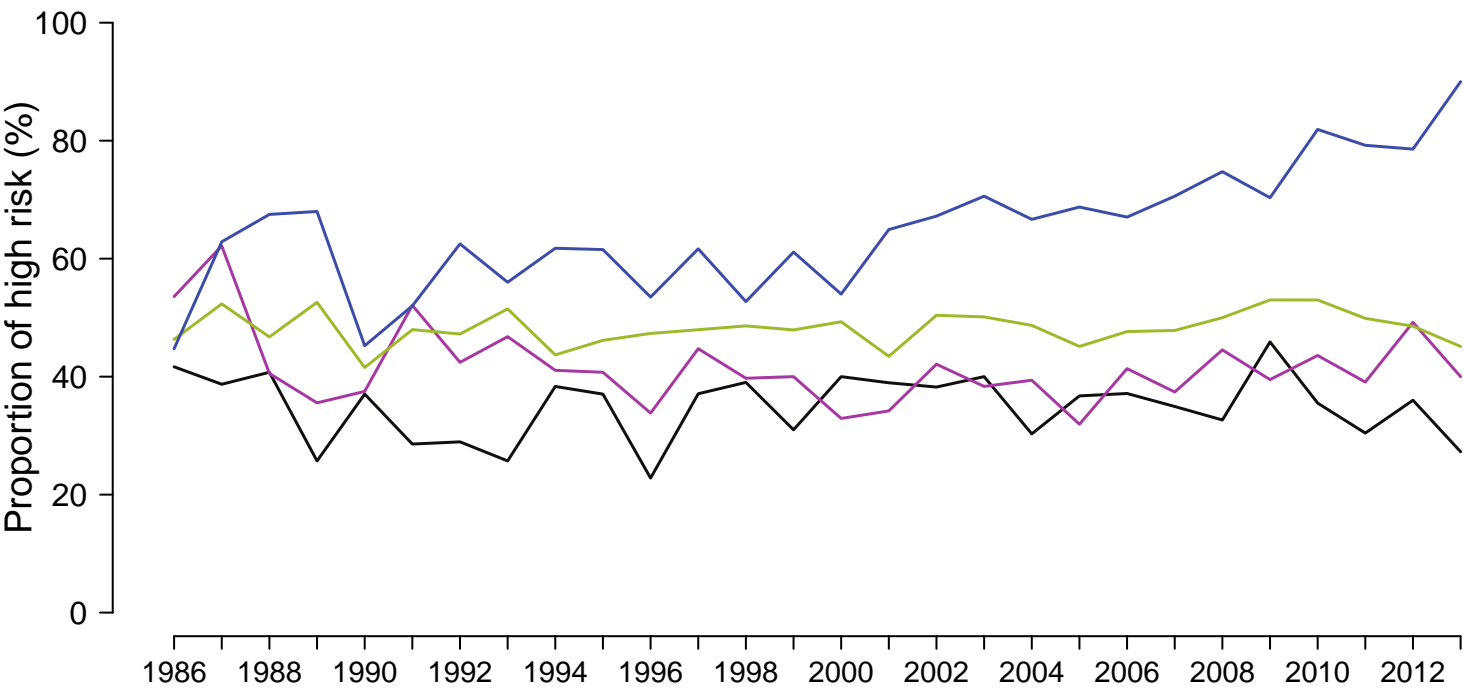
Sequence generation



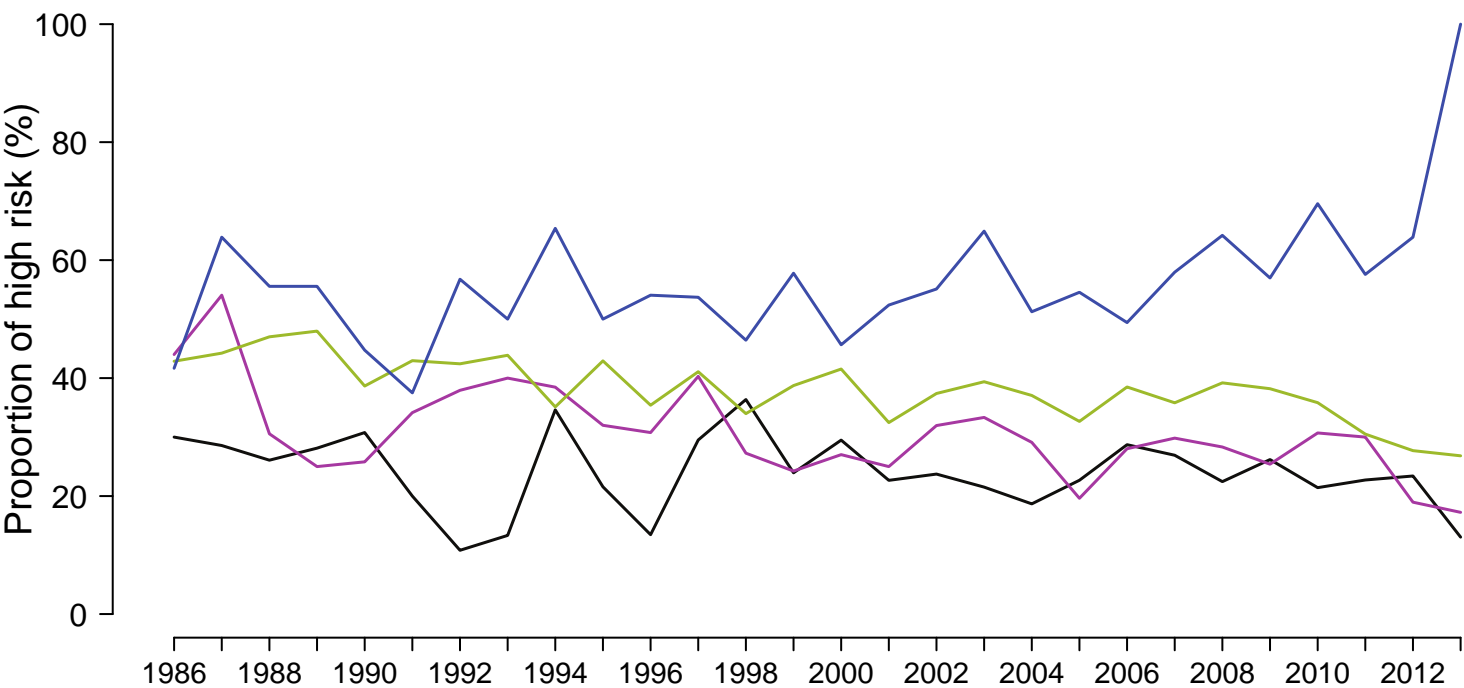
Allocation concealment



Blinding of participants and personnel



Blinding of outcome assessors



Incomplete outcome data

