Improving reporting in randomised trials: CONSORT statement and extensions

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CSM

"Whatever the outcome of a study, it is really hard for the average reader to interpret and verify the reliability of a poorly reported RCT. In turn, this problem could result in changes in clinical practice that are based on false evidence and that may harm patients."

[Zonta and De Martino. Standard requirements for randomized controlled trials in surgery. *Surgery* 2008]

What should be reported?

Methods

- **All key aspects of how the study was done**
  - "Describe statistical methods with enough detail to enable a knowledgeable reader with access to the original data to verify the reported results."

    [International Committee of Medical Journal Editors]
  - Similar principle should apply to many study aspects

Results

- **Main findings (corresponding to pre-specified plan)**

Reporting guidelines for RCTs: History of CONSORT

- **Few reporting guidelines before 1990s**
- **Two sets of recommendations published in 1994:**
  - SORT Group
  - Asilomar Group

- ***JAMA* editorial by Drummond Rennie**
  - Not room for 2 competing guidelines

- **CONSORT meeting Chicago, 1995**

  [CONsolidated Standards Of Reporting Trials]

- **CONSORT Statement published in *JAMA*, 1996**

The original CONSORT Statement

Special Communication

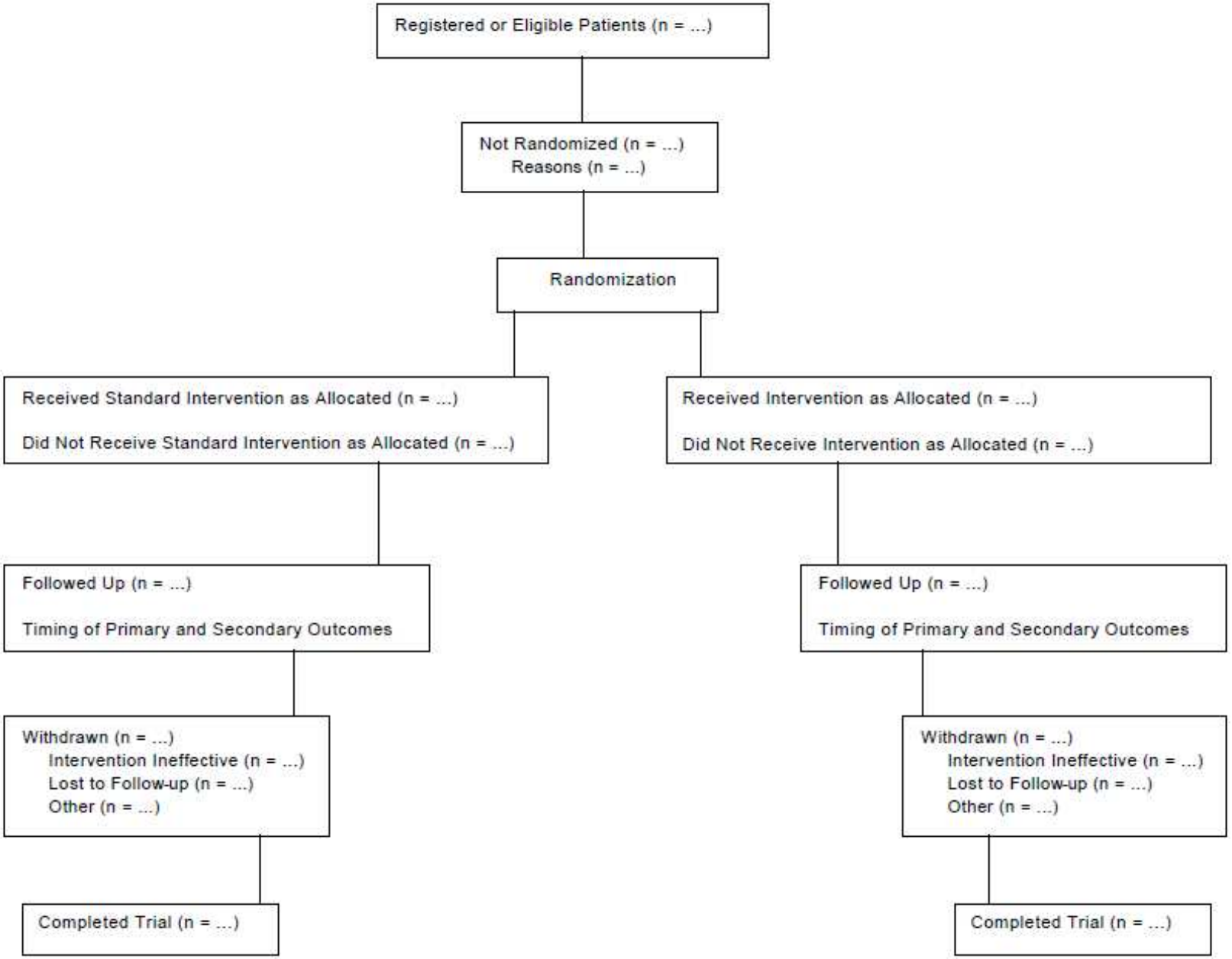
Improving the Quality of Reporting of Randomized Controlled Trials

The CONSORT Statement

Colin Begg, PhD; Mildred Cho, PhD; Susan Eastwood, ELS(D); Richard Horton, MB; David Moher, MSc; Ingram Olkin, PhD; Roy Pitkin, MD; Drummond Rennie, MD; Kenneth F. Schulz, PhD; David Simel, MD; Donna F. Stroup, PhD

[Begg *et al*, *JAMA* 1996]

Heading	Subheading	Descriptor	Was it Reported?
Title		Identify the study as a randomized trial.[7]	
Abstract		Use a structured format.[8,9]	
Introduction		State prospectively defined hypothesis, clinical objectives, and planned subgroup or covariate analyses[10]	
Methods	Protocol	Describe Planned study population, together with inclusion/exclusion criteria. Planned interventions and their timing. Primary and secondary outcome measure(s) and the minimum important difference(s), and indicate how the target sample size was projected.[2,11] Rationale and methods for statistical analyses, detailing main comparative analyses and whether they were completed on an intention-to-treat basis.[12,13] Prospectively defined stopping rules (if warranted)[14]	
	Assignment	Describe Unit of randomization (eg, individual, cluster, geographic).[15] Method used to generate the allocation schedule.[16] Method of allocation concealment and timing of assignment.[17] Method to separate the generator from the executor of assignment.[17,18]	
	Masking (Blinding)	Describe mechanism (eg, capsules, tablets); similarity of treatment characteristics (eg, appearance, taste); allocation schedule control (location of code during trial and when broken); and evidence for successful blinding among participants, person doing intervention, outcome assessors, and data analysts.[19,20]	
Results	Participant Flow and Follow-up	Provide a trial profile (Figure) summarizing participant flow, numbers and timing of randomization assignment, interventions, and measurements for each randomized group .[3,21]	
	Analysis	State estimated effect of intervention on primary and secondary outcome measures, including a point estimate and measure of precision (confidence interval).[22,23] State results in absolute numbers when feasible (eg, 10/20, not 50%). Present summer ,y data and appropriate descriptive and inferential statistics in sufficient detail to permit alternative analyses and replication .[24] Describe prognostic variables by treatment group and any attempt to adjust for them.[25] Describe protocol deviations from the study as planned, together with the reasons.	
Comment		State specific interpretation of study findings, including sources of bias and imprecision (internal validity) and discussion of external validity, including appropriate quantitative measures when possible. State general interpretation of the data in light of the totality of the available evidence.	


Registered or Eligible Patients (n = ...)
Not Randomized (n = ...)
Reasons (n = ...)
Randomization
Received Standard Intervention as Allocated (n = ...)
Did Not Receive Standard Intervention as Allocated (n = ...)
Received Intervention as Allocated (n = ...)
Did Not Receive Intervention as Allocated (n = ...)
Followed Up (n = ...)
Timing of Primary and Secondary Outcomes
Followed Up (n = ...)
Timing of Primary and Secondary Outcomes
Withdrawn (n = ...)
Intervention Ineffective (n = ...)
Lost to Follow-up (n = ...)
Other (n = ...)
Withdrawn (n = ...)
Intervention Ineffective (n = ...)
Lost to Follow-up (n = ...)
Other (n = ...)
Completed Trial (n = ...)
Completed Trial (n = ...)

CONSORT 2001

CONSORT statement

The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomised trials

*David Moher, Kenneth F Schulz, Douglas G Altman, for the CONSORT Group**

Lancet 2001; **357:** 1191–94

2001 Revision of CONSORT

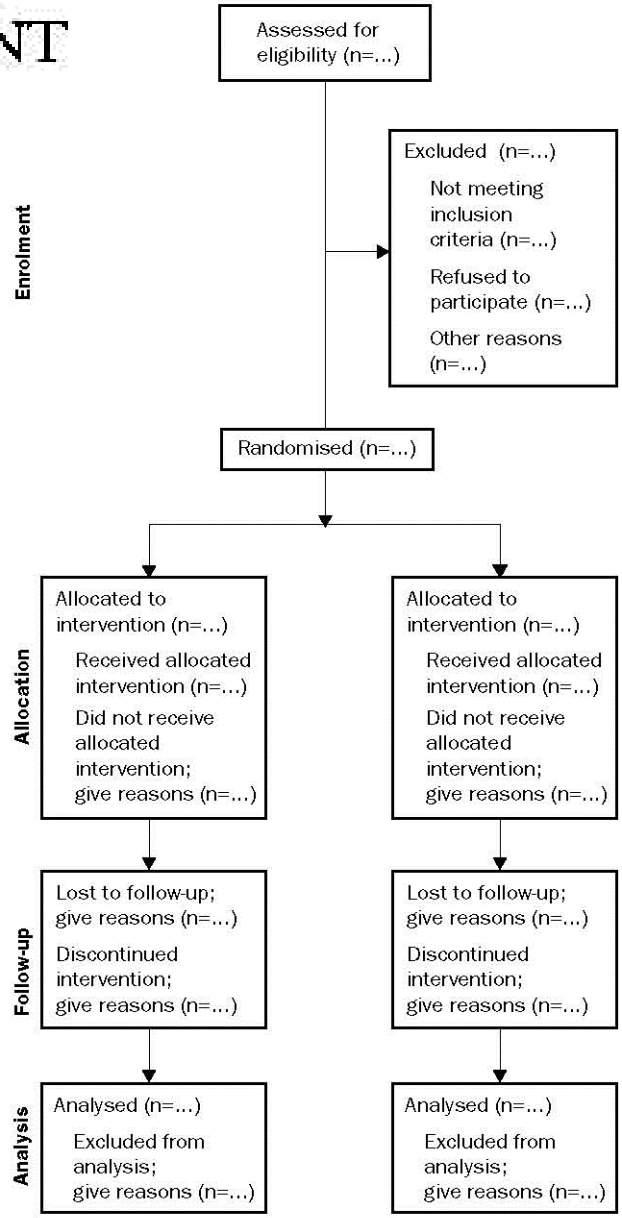
- **Major update published in 2001**
- **Checklist – major revision**
- **Also small changes to flow diagram**
- **Short paper ("The CONSORT Statement")**
  - published in 3 journals
- **Explanatory paper (E&E)**
  - Detailed explanations and examples

CONSORT STATEMENT

	Item number	Descriptor	Reported on page number
Title and abstract	1	How participants were allocated to interventions (eg, "random allocation", "randomised", or "randomly assigned").	
Introduction			
Background	2	Scientified background and explanation of rationale.	
Methods			
Participants	3	Eligibility criteria for participants and the settings and locations where the data were collected.	
Interventions	4	Precise details of the interventions intended for each group and how and when they were actually administered.	
Objectives	5	Specific objectives and hypotheses.	
Outcomes	6	Clearly defined primary and secondary outcome measures and, when applicable, any methods used to enhance the quality of measurements (eg, multiple observations, training of assessors, &c).	
Sample size	7	How sample size was determined and, when applicable, explanation of any interim analyses and stopping rules.	
Randomisation			
Sequence generation	8	Method used to generate the random allocation sequence, including details of any restriction (eg, blocking, stratification).	
Allocation concealment	9	Method used to implement the random allocation sequence (eg, numbered containers or central telephone), clarifying whether the sequence was concealed until interventions were assigned.	
Implementation	10	Who generated the allocation sequence, who enrolled participants, and who assigned participants to their groups.	
Blinding (masking)	11	Whether or not participants, those administering the interventions, and those assessing the outcomes were aware of group assignment. If not, how the success of masking was assessed.	
Statistical methods	12	Statistical methods used to compare groups for primary outcome(s); methods for additional analyses, such as subgroup analyses and adjusted analyses.	
Results			
Participant flow	13	Flow of participants through each stage (a diagram is strongly recommended). Specifically, for each group, report the numbers of participants randomly assigned, receiving intended treatment, completing the study protocol, and analysed for the primary outcome. Describe protocol deviations from study as planned, together with reasons.	
Recruitment	14	Dates defining the periods of recruitment and follow-up.	
Baseline data	15	Baseline demographic and clinical characteristics of each group.	
Numbers analysed	16	Number of participants (denominator) in each group included in each analysis and whether the analysis was by "intention to treat". State the results in absolute numbers when feasible (eg, 10/20, not 50%).	
Outcomes and estimation	17	For each primary and secondary outcome, a summary of results for each group, and the estimated effect size and its precision (eg, 95% CI).	
Ancillary analyses	18	Address multiplicity by reporting any other analyses performed, including subgroup analyses and adjusted analyses, indicating those prespecified and those exploratory.	
Adverse events	19	All important adverse events or side-effects in each intervention group.	
Discussion			
Interpretation	20	Interpretation of the results, taking into account study hypotheses, sources of potential bias or imprecision and the dangers associated with multiplicity of analyses and outcomes.	
Generalisability	21	Generalisability (external validity) of the trial findings.	
Overall evidence	22	General interpretation of the results in the context of current evidence.	

Checklist of items to include when reporting a randomised trial

CONSORT STATEMENT



Flow diagram of the progress through the phases of a randomised trial

Rationale for checklist items

- **Necessary to evaluate the study**
- **Evidence-based, whenever possible**
- **Minimum set of essential items**

The "explanation and elaboration" manuscript

- **To enhance the use and dissemination of CONSORT**
- **For each checklist item:**
  - examples of good reporting
  - detailed explanation
  - relevant empirical evidence

Ann Intern Med. 2001;134:663-694.

The Revised CONSORT Statement for Reporting Randomized Trials: Explanation and Elaboration

Douglas G. Altman, DSc; Kenneth F. Schulz, PhD; David Moher, MSc; Matthias Egger, MD; Frank Davidoff, MD; Diana Elbourne, PhD; Peter C. Gøtzsche, MD; and Thomas Lang, MA, for the CONSORT Group

Goals of CONSORT

Main objective

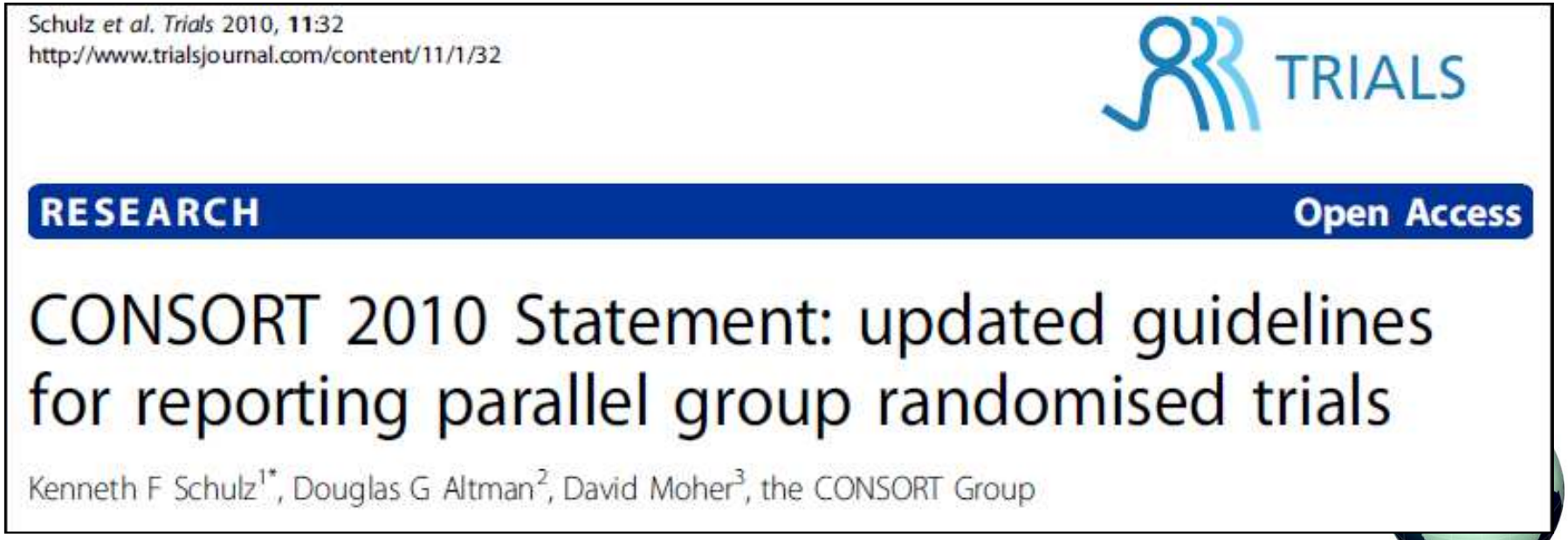
- **To facilitate critical appraisal and interpretation of RCTs by providing guidance to authors about how to improve the reporting of their trials**

Secondary objective

- **To encourage and provide incentives for researchers to conduct high-quality, unbiased randomized trials**

2010 Revision of CONSORT

- **Meeting in January 2007**
- **Revised checklist**
- **Short paper (published in 9 journals)**
- **Revised (and expanded) explanatory paper (E&E)**



Schulz *et al. Trials* 2010, **11**:32
http://www.trialsjournal.com/content/11/1/32

TRIALS

RESEARCH Open Access

CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials

Kenneth F Schulz[1*], Douglas G Altman[2], David Moher[3], the CONSORT Group

CONSORT checklist 2010 (25 items)

TITLE & ABSTRACT

INTRODUCTION

- Background
- Objectives

METHODS

- Trial design
- Participants
- Interventions
- Outcomes
- Sample size
- Randomization
  - Sequence generation
  - Allocation concealment
  - Implementation
- Blinding (Masking)
- Statistical methods

RESULTS

- Participant flow
- Recruitment
- Baseline data
- Numbers analyzed
- Outcomes and Estimation
- Ancillary analyses
- Harms

DISCUSSION

- Limitations
- Generalisability
- Interpretation

OTHER INFORMATION

- Registration
- Protocol
- Funding

Major changes in 2010

- **Added 3 new items**
  - Registration, Protocol, Funding
- **Added several sub-items,** e.g.
  - Any important changes to methods after trial commencement, with a discussion of reasons
  - Why the trial ended or was stopped
- **Made some items more specific**
  - e.g. allocation concealment mechanism, blinding
- **We simplified and clarified the wording throughout**

- All changes are documented in the paper

Box 2. Noteworthy Specific Changes in CONSORT 2010 Statement

- *Item 1b (title and abstract)*—We added a sub-item on providing a structured summary of trial design, methods, results, and conclusions and referenced the CONSORT for abstracts article [21].
- *Item 2b (introduction)*—We added a new sub-item (formerly item 5 in CONSORT 2001) on "Specific objectives or hypotheses".
- *Item 3a (trial design)*—We added a new item including this sub-item to clarify the basic trial design (such as parallel group, crossover, cluster) and the allocation ratio.
- *Item 3b (trial design)*—We added a new sub-item that addresses any important changes to methods after trial commencement, with a discussion of reasons.
- *Item 4 (participants)*—Formerly item 3 in CONSORT 2001.
- *Item 5 (interventions)*—Formerly item 4 in CONSORT 2001. We encouraged greater specificity by stating that descriptions of interventions should include "sufficient details to allow replication" [3].
- *Item 6 (outcomes)*—We added a sub-item on identifying any changes to the primary and secondary outcome (endpoint) measures after the trial started. This followed from empirical evidence that authors frequently provide analyses of outcomes in their published papers that were not the prespecified primary and secondary outcomes in their protocols, while ignoring their prespecified outcomes (that is, selective outcome reporting). [4,22] We eliminated text on any methods used to enhance the quality of measurements.
- *Item 9 (allocation concealment mechanism)*—We reworded this to include mechanism in both the report topic and the descriptor to reinforce that authors should report the actual steps taken to ensure allocation concealment rather than simply report imprecise, perhaps banal, assurances of concealment.
- *Item 11 (blinding)*—We added the specification of how blinding was done and, if relevant, a description of the similarity of interventions and procedures. We also eliminated text on "how the success of blinding (masking) was assessed" because of a lack of empirical evidence supporting the practice as well as theoretical concerns about the validity of any such assessment [23,24].
- *Item 12a (statistical methods)*—We added that statistical methods should also be provided for analysis of secondary outcomes.
- *Sub-item 14b (recruitment)*—Based on empirical research, we added a sub-item on "Why the trial ended or was stopped" [25].
- *Item 15 (baseline data)*—We specified "A table" to clarify that baseline and clinical characteristics of each group are most clearly expressed in a table.
- *Item 16 (numbers analysed)*—We replaced mention of "intention to treat" analysis, a widely misused term, by a more explicit request for information about retaining participants in their original assigned groups [26].
- *Sub-item 17b (outcomes and estimation)*—For appropriate clinical interpretability, prevailing experience suggested the addition of "For binary outcomes, presentation of both relative and absolute effect sizes is recommended" [27].
- *Item 19 (harms)*—We included a reference to the CONSORT paper on harms [28].
- *Item 20 (limitations)*—We changed the topic from "Interpretation" and supplanted the prior text with a sentence focusing on the reporting of sources of potential bias and imprecision.
- *Item 22 (interpretation)*—We changed the topic from "Overall evidence." Indeed, we understand that authors should be allowed leeway for interpretation under this nebulous heading. However, the CONSORT Group expressed concerns that conclusions in papers frequently misrepresented the actual analytical results and that harms were ignored or marginalised. Therefore, we changed the checklist item to include the concepts of results matching interpretations and of benefits being balanced with harms.
- *Item 23 (registration)*—We added a new item on trial registration. Empirical evidence supports the need for trial registration, and recent requirements by journal editors have fostered compliance [29].
- *Item 24 (protocol)*—We added a new item on availability of the trial protocol. Empirical evidence suggests that authors often ignore, in the conduct and reporting of their trial, what they stated in the protocol. [4,22] Hence, availability of the protocol can instigate adherence to the protocol before publication and facilitate assessment of adherence after publication.
- *Item 25 (funding)*—We added a new item on funding. Empirical evidence points toward funding source sometimes being associated with estimated treatment effects [30].

Evolution of the CONSORT Statement

Outcomes

- **CONSORT 1996**
  - "Primary and secondary outcome measure(s) …"
- **CONSORT 2001**
  - "Clearly defined primary and secondary outcome measures …"
- **CONSORT 2010**
  - "Completely defined prespecified primary and secondary outcome measures, including how and when they were assessed"

Evolution of the CONSORT Statement

Interventions

- **CONSORT 1996**
  - "Planned interventions and their timing"
- **CONSORT 2001**
  - "Precise details of the interventions intended for each group and how and when they were actually administered"
- **CONSORT 2010**
  - "The interventions for each group with sufficient details to allow replication, including how and when they were actually administered"

What do we need to know about treatment allocation?

- **Was the allocation sequence generated in an appropriately unpredictable way, e.g. by randomization ["Sequence generation"]**
  - How was the sequence determined?

- **Was the act of allocating a treatment to a patient done without any knowledge of what treatment they will get? ["Allocation concealment"]**
  - What was the mechanism of allocation?

Description of randomization in RCTs

So important that CONSORT checklist has 3-4 items:

Item 8a. Method used to generate the random allocation sequence

Item 8b. Type of randomisation; details of any restriction (such as blocking and block size)

Item 9. Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned

Item 10. Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions

Good (clear) reporting

Sequence generation:

- "Independent pharmacists dispensed either active or placebo inhalers according to a computer generated randomization list." [Bolliger et al, *BMJ* 2000]
- ... The randomization code was developed using a computer random number generator to select random permuted blocks. The block lengths were 4, 8, and 10 varied randomly ..." [Coutinho et al, *Obstet Gynecol* 2008]

Clear reporting but poor methodology

"Randomization was alternated every 10 patients, such that the first 10 patients were assigned to early atropine and the next 10 to the regular protocol, etc. To avoid possible bias, the last 10 were also assigned to early atropine."

[Lessick et al, *Eur J Echocardiography* 2000;1:257-62]

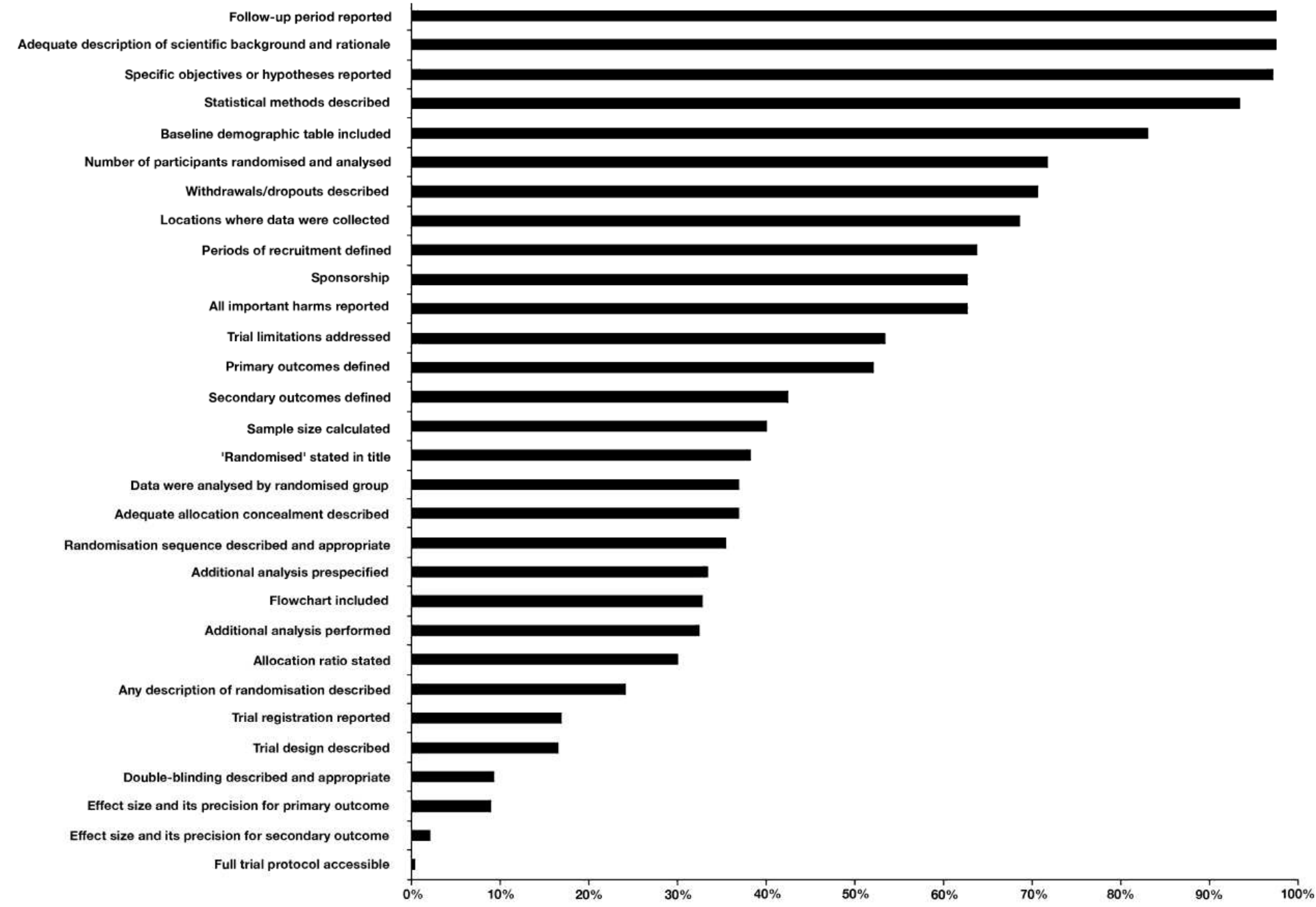


Figure 1 Compliance to the 30 items of the CONSORT statement (n = 290 trials).

Liu et al., *Transplant Int* 2013

Extensions to CONSORT

- **Abstracts**
- **Harms**
- **Patient reported outcomes**
- **Specific trial designs**
  - cluster randomised trials
  - non-inferiority and equivalence trials
  - …

Implementations of CONSORT

- **Herbal medicines**
- **Non-pharmacological treatments**
- **Pragmatic trials**
- **Acupuncture (STRICTA)**

Annals of Internal Medicine | ACADEMIA AND CLINIC

Reporting Randomized, Controlled Trials of Herbal Interventions: An Elaborated CONSORT Statement

Joel J. Gagnier, ND, MSc; Heather Boon, PhD; Paula Rochon, MD, MPH; David Moher, PhD; Joanne Barnes, PhD, MRPharmS FLS; and Claire Bombardier, MD, for the CONSORT Group*

Herbal medicinal products are widely used, vary greatly in content and quality, and are actively tested in randomized, controlled trials (RCTs). The authors' objective was to develop recommendations for reporting RCTs of herbal medicine interventions, based on the need to elaborate on the 22-item CONSORT (Consolidated Standards of Reporting Trials) checklist. Telephone calls were made and a consensus meeting was held with 16 participants in Toronto, Canada, to develop these recommendations. The group agreed on context-specific elaborations of 9 CONSORT checklist items for RCTs of herbal medicines. Item 4, concerning the herbal medicine intervention, required the most extensive elaboration. These recommendations have been developed to improve the reporting of RCTs using herbal medicine interventions.

Ann Intern Med. 2006;144:364-367. www.annals.org

For author affiliations, see end of text.

*The members of the CONSORT Group are listed on the following Web site: www.consort-statement.org/profiles/partners.html.

ORIGINAL ARTICLE

Zoonoses Public Health. **57** (2010) 95–104

The REFLECT Statement: Methods and Processes of Creating Reporting Guidelines for Randomized Controlled Trials for Livestock and Food Safety by Modifying the CONSORT Statement†

A. M. O'Connor, J. M. Sargeant, I. A. Gardner, J. S. Dickson, M. E. Torrence and Consensus Meeting Participants*: C. E. Dewey, I. R. Dohoo, R. B. Evans, J. T. Gray, M. Greiner, G. Keefe, S. L. Lefebvre, P. S. Morley, A. Ramirez, W. Sischo, D. R. Smith, K. Snedeker, J. Sofos, M. P. Ward and R. Wills

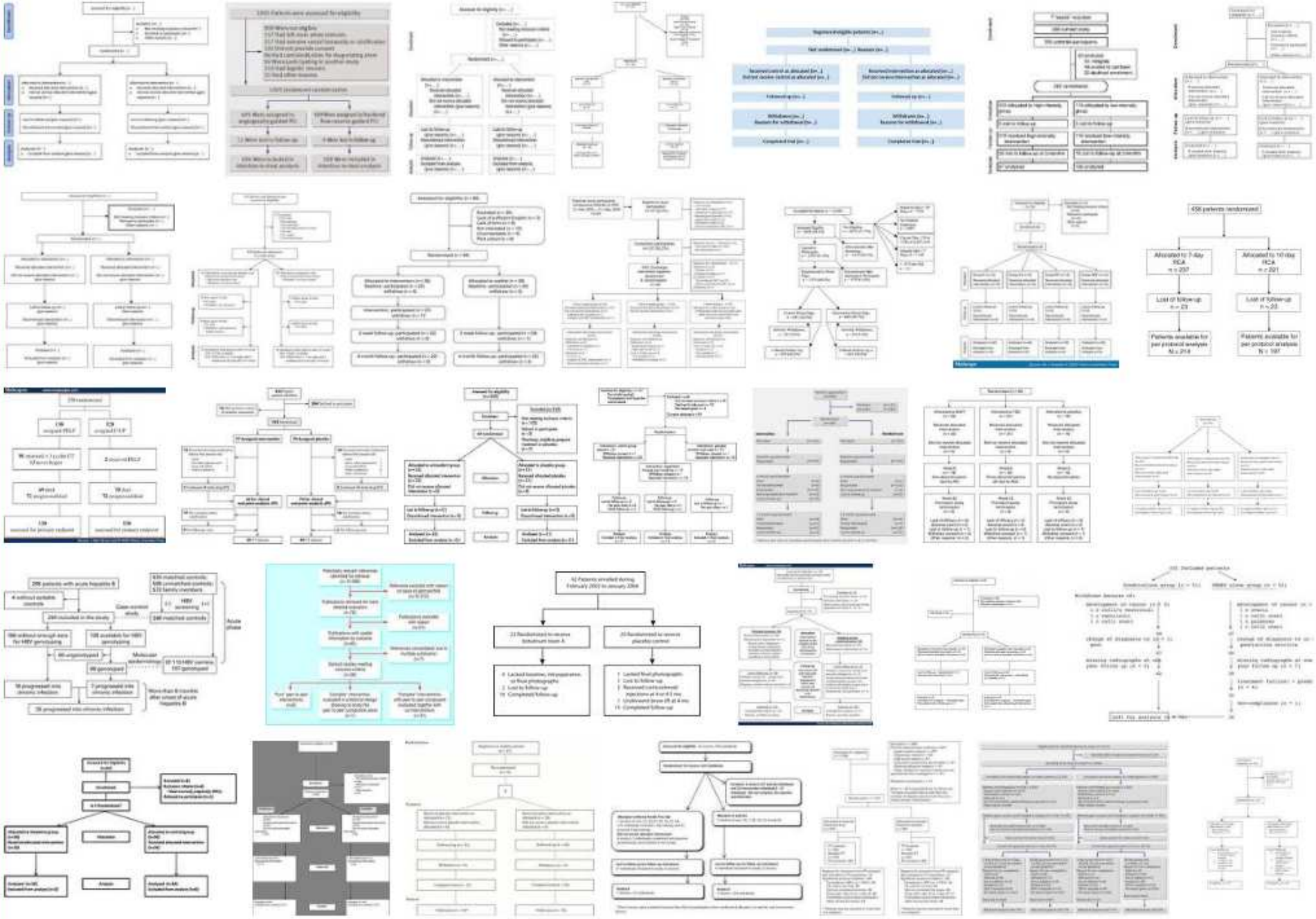
equator network

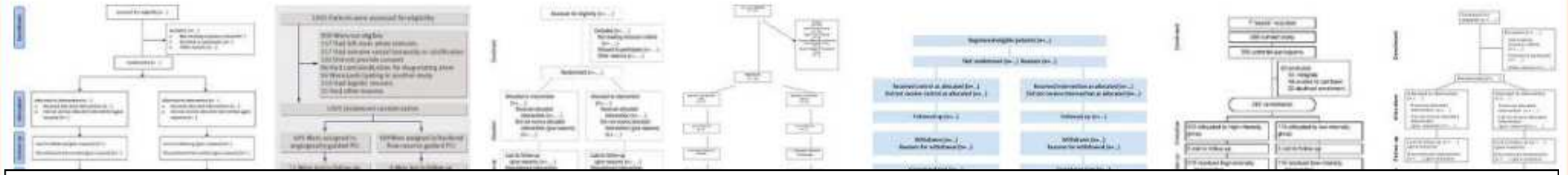
www.consort-statement.org

Impact of CONSORT

- **CONSORT has wide support from journals**
  - >600 journals
  - Editorial groups:
    - Council of Science Editors
    - World Association of Medical Editors
    - International Committee of Medical Journal Editors
  - Peer review granting agencies
    - Canadian Institutes of Health Research

- **Reporting guidelines have had limited impact**
  - Passive dissemination through publication only
  - Compliance not required by journals
  - Potential impact of CONSORT not being realised





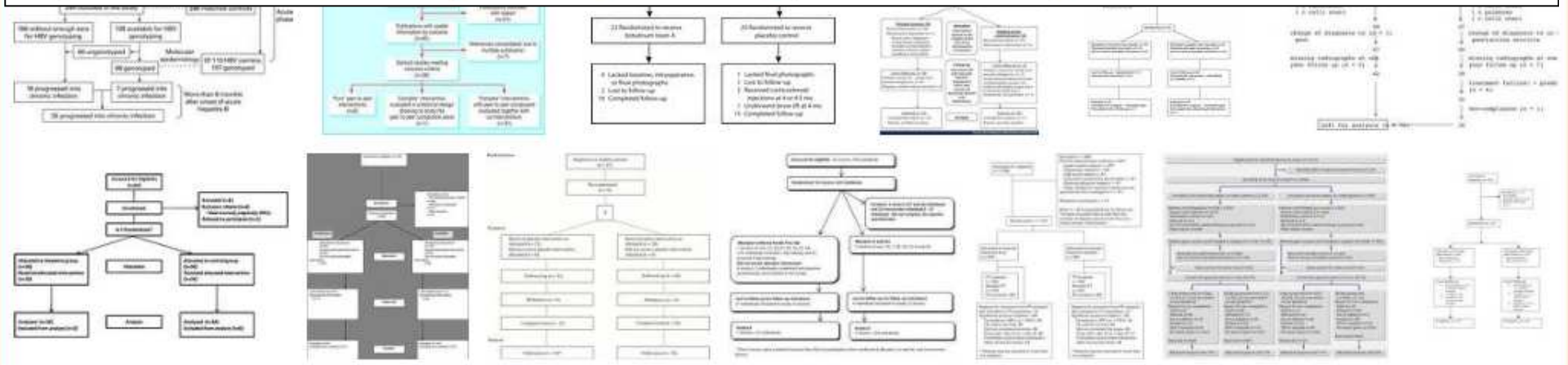
Hopewell *et al. Trials* 2011, **12**:253
http://www.trialsjournal.com/content/12/1/253

TRIALS

RESEARCH **Open Access**

Reporting of participant flow diagrams in published reports of randomized trials

Sally Hopewell*, Allison Hirst, Gary S Collins, Sue Mallett, Ly-Mee Yu and Douglas G Altman



Turner *et al. Systematic Reviews* 2012, **1**:60
http://www.systematicreviewsjournal.com/content/1/1/60

SYSTEMATIC REVIEWS

RESEARCH Open Access

Does use of the CONSORT Statement impact the completeness of reporting of randomised controlled trials published in medical journals? A Cochrane review[a]

Lucy Turner[1], Larissa Shamseer[1], Douglas G Altman[2], Kenneth F Schulz[3] and David Moher[1,4*]

"The results of this review suggest that journal endorsement of CONSORT may benefit the completeness of reporting of RCTs they publish ... However, ... completeness of reporting of trials remains suboptimal.
Journals are not sending a clear message about endorsement to authors submitting manuscripts for publication."

Conclusions

- Findings of all randomised trials should be published
- Trial reports should be complete and transparent
- Many trials reports omit crucial information, weakening their clinical value
- Peer reviewers and editors are failing to ensure that reports of trials are usable by readers
- Adherence to the CONSORT checklist and flow diagram would maximise the value of trial reports
- Journals should institute systems to ensure compliance with CONSORT
- **Good reporting is not an optional extra: it is an essential component of doing good research**

Nutrition trials

- **To what extent could the CONSORT statement help to improve reporting of randomised trials in human nutrition that underpin health claims?**

- **As for other areas, adherence to CONSORT would greatly enhance the value of publications reporting RCTs**
  - Recommendations
  - Requirements

- **The challenge is achieving adherence**

www.consort-statement.org

www.equator-network.org