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# The IMRaD format

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# Why IMRaD

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*“The man of science appears to be the only person who has something to say just now, and the only man who does not know how to say it.”*

– Sir James Barrie

# WWWHWAW

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*“I keep six honest serving-men  
(They taught me all I knew)  
Their names are **What** and **Why** and **When**  
And **How** and **Where** and **Who**”*

-- Rudyard Kipling (1865-1936). “The Elephant’s Child”

# What is IMRAD?

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**I** Introduction

**M** Methods

**R** Results

**a** and

**D** Discussion

# History

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1665	Origin of scientific papers
1600s and 1700s	Letters and experimental (descriptive) formats coexisted
1800s (second half)	Increasing Methods description (“theory – experiment – discussion”)
1900s (early)	Organized as in book chapters (heading according to subject)
1900s (second half)	Adoption of IMRaD format



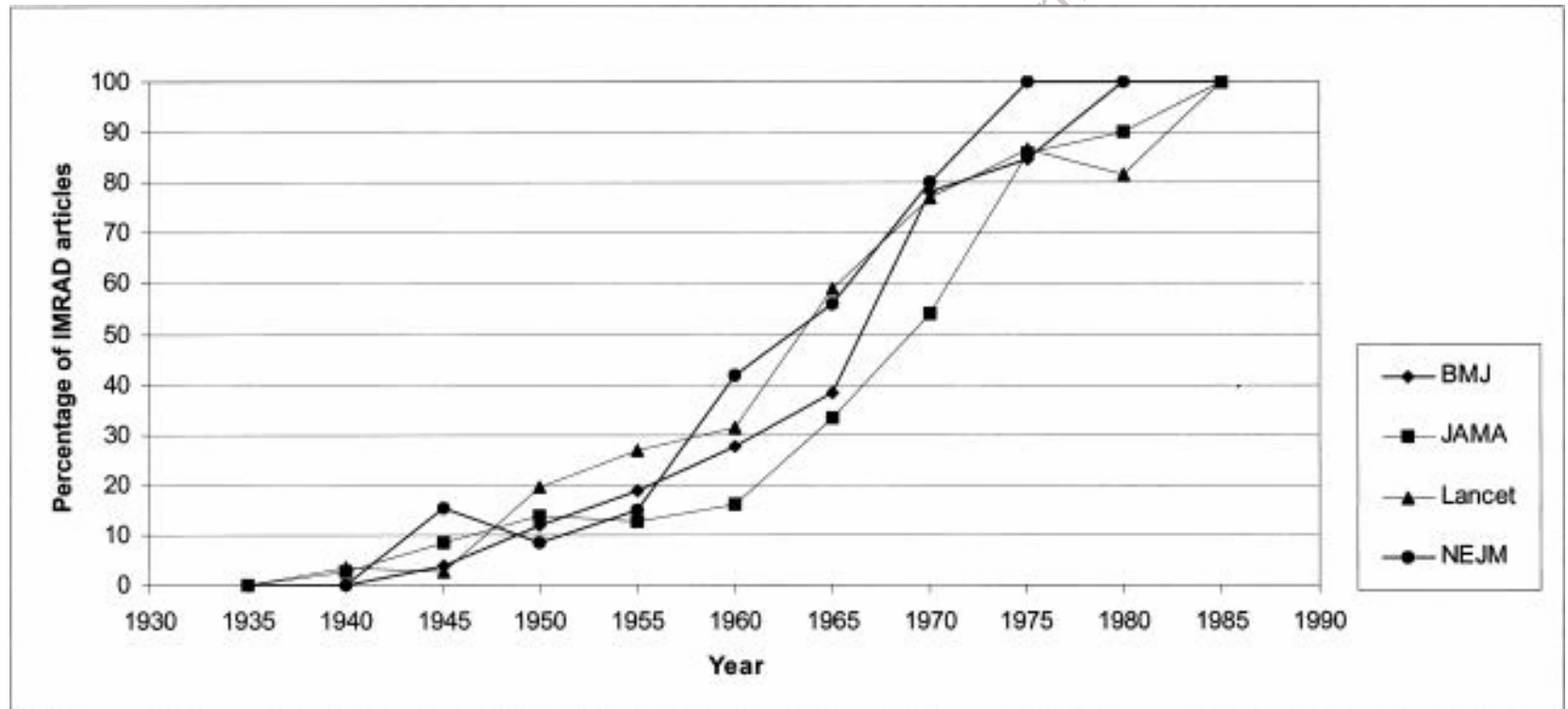
# Background

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- Considered ideal outline in early 1900s
- Physics adopted IMRaD in 1950s
- After World War II, international conferences on scientific publishing recommended IMRaD
- Late 1970s, International Committee of Medical Journal Editors (“Vancouver Group”) first published guidelines
- Wide use of IMRaD may be credited to editors, to benefit readers and facilitate peer review

# IMRaD adoption by major journals

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# Bradford Hill's questions

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**Introduction**

Why did you start?

**Methods**

What did you do?

**Results**

What did you find?

**and**

**Discussion**

What does it all mean?

# Starting a conversation

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**A:** What's news, babe?

**B:** You know that guy Rakesh ... done a lot of work on hepatitis E ... I think he's asked good questions ... but, you know what ... you and I can find holes in his arguments and come up with a shocker ...

**A:** Wow! ... tell me more ... keep singin', babe

# Introduction

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- Brief and arresting
- Define nature and scope of problem, but
- Do not hide inconvenient facts

# Introduction

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- Adequate information to allow reader to understand and evaluate present study without referring to previous publications
- Define lacunae and shortcomings in current state of knowledge
- Key references to support background information provided
- Refer to your previous preliminary work and closely related papers appearing elsewhere

# Introduction: “funneling” down

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- Provide rationale for current study
  - What gap in knowledge did you try to fill?
  - What controversy did you try to resolve?
- State aim of study
- May briefly state study group, design and methods used, especially why these are better than in previous studies
- May state principal result/conclusion  
(but this may take away “surprise” element ...  
oh, well, it’s already out in the Abstract)

# Methods

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## The three questions

- What has been done?
- What did you look for?
- How was it done?

*Should be reproducible by another group*

# Methods: details

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- **Study design** (drug trial / intervention; prospective / retrospective; randomized, blinded; sensitivity of method; questionnaire; case report; guidelines; meta-analysis)
- **Setting**
- **Who is the study about?**
  - Participants and control subjects (in animal studies, specify genus, species)
- **What did you do?**
  - Intervention
  - Follow up
- **What did you look for?**
  - Outcome measure

# Methods: details

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- Inclusion criteria
- Exclusion criteria
- Sample size calculation
- Circumstances under which intervention done
  - Lab settings
  - In-patient or real life
- Consent
- Ethics clearance

(Sections and subsections help)



# Methods: interventions and tests

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- If standard, give reference
- If new or modified, provide details (sufficient for reproduction by other workers)
- Timing and duration of intervention
- Equipment / kits / manufacturer

# Methods: outcome measurement

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- Define outcome
- Parameters to assess outcome
- Endpoint, cut-off values
- Adverse events, if any

# Follow up

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- Frequency, method, duration (including minimum acceptable duration)
- Criteria for termination or drop-out
  - Per-protocol vs. intention-to-treat

# Statistical analysis

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- Methods used for different parameters
- Software

# Methods: general

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- Sub-headings should be consistent with those of Results
- Try to avoid more than 3 levels of heading

# Results: general

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- What did you find?
- Should answer all points raised in Methods
- No new parameters
- No mismatch in numbers between text and tables / figures

# Results: participants

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- How many screened?
- How many eligible?
- How many recruited / excluded?
- How many completed study?
- Reasons for lack of completeness
- Compliance with therapy / protocol

All subjects should be accounted for

# Results: data presentation

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- Cause of incomplete data, if any (sample lost, incomplete study)
- No repetition between text and tables
- No interpretation
- No adjectives (most, some, often..)
- Use % only if  $n > 100$
- Restrict decimal points to 1 or 2
- Provide value of p (“highly significant”, “very highly significant”  
meaningless)



# Discussion: outline

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- Recapitulation of major findings
- Discussion of major findings in light of available data
- Discussion of important minor findings
- Alternative explanations
- Strengths and limitations of study
- Implications of findings
- Unanswered questions and future research
- Summary / conclusion

# Common mistakes: Introduction

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- History starting from Adam
- Details of previous studies
- Aggrandizement
- Abbreviations without full form
- Details of Results and Conclusions
- Intermix with Discussion

# Good Introduction

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*“We wish to suggest a structure for the salt of deoxyribose nucleic acid (D.N.A.). This structure has novel features which are of considerable biological importance.”*

-- Watson JD, Crick FHC. A structure for deoxyribose nucleic acid. *Nature* 1953;171:737-8

# Common mistakes: Methods and Results

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- Mixed up
- Errors in data (e.g., mean age 25, range 17-22)
- Mismatch of data in Methods / Results / Tables / Figures
- Misinterpretation of data

# Common mistakes: Discussion

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- First study in the world / India / Maharashtra...(megalomania)
- Repeating results
- Emphasizing strengths of study over its weaknesses
- Inflating importance of findings
- Going beyond evidence and drawing unjustified conclusions

# Benefits of IMRaD

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- Development and changes in internal organization of scientific article is answer to constant growth of information
- IMRaD structure facilitates modular reading
- Readers usually do not read in linear way but browse in each section of article, looking for specific information, which is normally found in pre-established areas of the paper

-- Meadows. *J Inf Sci* 1985;11:27-30

# You thought IMRaD was gospel?

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- *Nature Medicine* prints Methods last and in smaller type
- *Science* buries explanatory footnotes within reference list
- *Lancet* editor referred to “...shaky pillars of IMRaD”
- IMRaD suggests perfectly planned and beautifully executed projects free from accidents and human error
- IMRaD does not tell writer how much to put in or leave out or what level of reader to aim at

# Sections not covered by IMRaD

(but covered by Kipling)

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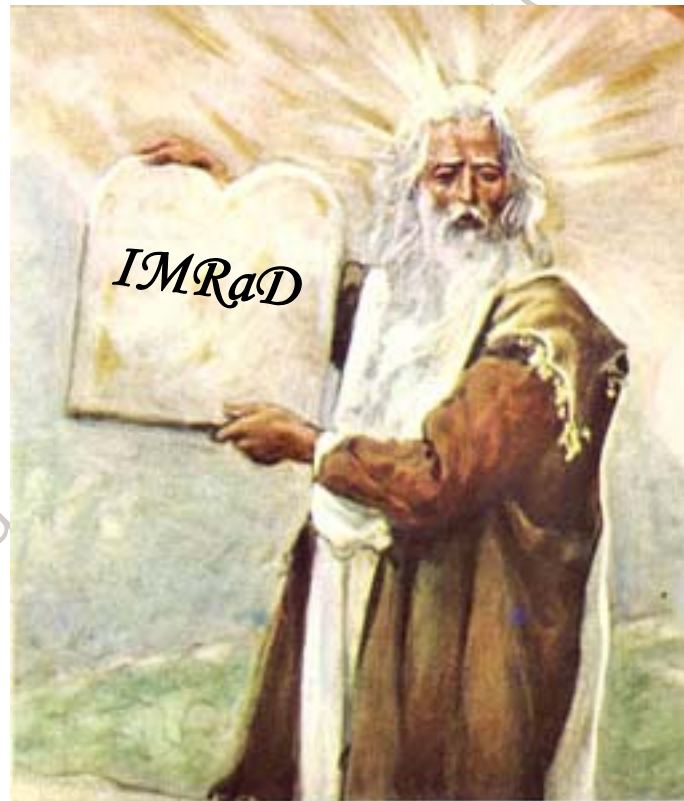
Title	How long; how many parts; declamatory (or not)?
Authorship	Who is best defined in advance; what does "authorship" mean; how many?
Summary	What structure; where to place it; how long?
Conclusion	Who needs one?
Acknowledgments	Who should be thanked; who paid; who has conflicts?
References	How many; what are they for; how to set them out?



International **C**ommittee of **M**edical **J**ournal **E**ditors,

**not**

Immaculately **C**onceived **M**oses, **J**esus, **E**t al



# An alternative to IMRaD

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- Brief description of context
- Outline of problem
- Key measures for improvement
- Process of gathering information
- Analysis and interpretation
- Strategy for change
- Effects of change
- Next steps

-- *Br Med J* 2000;321:1428  
(recommended for Quality Improvement Reports)

*Abide by Instructions, but*



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*Abide by Instructions, but a little liberty is sometimes in order*



Scientific communication need not be oh so boring!