Introduction sections: where are we going and why should I care?

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Abstract: This chapter aims to provide an instructional review about how to write effective introduction sections for original medical research articles. First, the basic function and aims of the introduction section are discussed. The introduction has the most important social role in the text as it should act as a bridge for the reader to the more technical parts of the document. It should thus be written with the reader kept carefully in mind, and should be able to interest them and convince them of the study's significance. Next, the major functions of a successful introduction are reviewed including the general background and motivation, the academic background and literature gap, the research problem statement, the methodology and the social impact. Using examples, these functions are analyzed according to the common English language features associated with them such as verb tense, noun types, common words and phrases etc. Some recurring errors made by non-native English writers relating to these language features are also identified. After this, ways to ensure that the separate introduction functions are crafted into a unified section are outlined. A general structure beginning from the broadest statement and narrowing to the most specific is suggested. Placing content-similar functions together, and binding them with cohesive techniques provides further connectedness within and between paragraphs and increases the readability of the text. Finally, a sample introduction and related exercises are given, so the reader can apply the concepts covered in this chapter.

Keywords: Introductions; original research articles; introduction functions; cohesion

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The introduction

Although the introduction, ranging from 250 to 600 words in length, is one of the first parts of the article your reader will see, it is usually the last part to be completed in the writing process. This is because you should already have a clear idea of your methodology, results, and implications of these results (discussion), before you begin to write your introduction. In short, you need to be clear about what you are introducing before you introduce it.

This is due to the main purpose of the introduction: while other sections mainly correspond to the steps of the medical research process as a record or description, the introduction does not. Instead, its role is social and interpersonal, and has the task of welcoming, engaging, convincing, and providing clarity to the reader.

Consequently, as medical writers, we need to give particular attention in our introduction to how our writing is being perceived by the person who will be reading it. Indeed, the introduction sections can be the most conversational part of the article, as compared to the more technical or logical parts found in other sections. This does not mean that the tone of the introduction is informal or non-academic, but rather that the writing style can, and probably should, be more expressive and inviting.

We can think of our introduction as the moment when our passenger (the reader) first gets into our car. They will want to know where they are going (the general idea of our research), they will want to know why they are going there (the value of our research), they will want to know how we will get there (the main structure of our article), and very importantly, they will want to know we are a safe and skillful driver (the quality of our writing).

Apart from the abstract, which is fairly impersonal, the

introduction is going to be the first thing the reader sees, and therefore it will give them the first impression of you as a writer and researcher. This will usually be the point where the reader decides if they will continue reading, and will be a good opportunity for you to help them understand the rest of the article. If the introduction is written poorly, if it is confusing, and if it does not tell a story, the reader will not recognize or value our groundbreaking results, or innovative methodology found later in the paper, because they will have stopped stop reading.

At the end of our introduction then, we want our reader to feel both interested about where we are going in our paper, clear about how we will get there, and confident about our ability to take them there as a writer. Given the choice between two drivers, we, on the one hand, do not want a driver who appears out of control, reckless, and not sure about where they are going. Rather, we want one who seems competent, confident, and welcoming.

Introduction functions

In order to make sure that our introduction successfully acts as a bridge to the rest of our paper, we can think of the introduction as a series of functions that accomplish different roles. Fulfilling the criteria of most, or all, of the important functions, will guarantee that the reader has the necessary information, and hopefully the motivation, to propel them through the rest of our article.

A short description of each of the introduction functions follows. Please note that this is only one way to think about the introduction, and that in many cases, these functions are not separated in the writing, but are often integrated or overlapped.

(I) **Outline the topic background and/or discuss the motivation for the research.** This is the minimum information needed to help the reader get familiar with what we will be talking about, and also, why we, as authors and researchers chose to explore our topic. The background frames the most general boundary of the article, and should be accessible to even the most uninformed reader. It is helpful then if the information used here is either interesting, or has clear importance to most people.

(II) **Outline the academic background and identify the gap in literature.** This is usually the longest part of the introduction, and might take the most time to compose. We need to relate to the reader what the most relevant and up-to-date research has to say about our topic, and also identify what is missing from this body of research. We can think of this as the academic justification or purpose behind our research, to convince our reader that our findings are novel. Science writers often make the mistake of going into too much detail about specific studies, or simply listing sentences about others' research. The goal rather is to use the sources to tell the reader the academic story so far concerning our research area, and show them that the story is incomplete.

(III) **State the research problem, question, hypothesis or objective of the research.** This is the core of our introduction—what we are actually doing or did for our research—and might be the shortest but most important part of the writing. It needs to be clear, detailed, and concise. It is likely going to be the most information-dense part of the introduction (1–2 sentences long), and should answer the what, why, when, how, who, and where questions of our study. Extremely precise and unambiguous language is required here as the research problem statement has a direct relationship to the methodology, results and discussion sections. For the reader to continue on understanding our paper, they need to be properly informed of the technical parameters of our research.

(IV) **Explain the social impact.** This should identify how your research might be important outside of filling a gap in academic knowledge. That is, how might the new knowledge gained by your research specifically help patients or the medical community or society in general. Too often this function is overlooked by writers who take for granted that the reader can understand how your findings might be applied in the "real world". Explaining this clearly for your reader can immediately make your research more interesting, relevant, accessible and significant.

(V) **Describe how you plan to answer the research question.** This is essentially describing what the basic methodology is. This does not need to be very detailed, and can be generally reduced to a mention of the methodology type (meta-analysis, systematic review, prospective study, retrospective study etc.). Often, this can be addressed within the research problem statement itself.

(VI) **Significant results.** More often than not, the results do not appear in the introduction, and

perhaps should not, depending on whom you ask, or perhaps the publisher whom you are submitting to. If the results are presented in the introduction, they should only include the findings most relevant to answering the research question, and should be clearly, and succinctly stated.

Introduction functions and related language features

Given the nature of the functions described above, we can expect to find common language features of grammar, vocabulary and structure resulting from the communicative role these parts are performing. What follows is a description, with examples, of some of these functions and their related language features, along with some common errors that non-native English writers make. It is important to note that these are not strict rules about how to write these introduction functions, but rather general guidelines to follow in order to increase the likelihood that the writing is grammatically correct, lexically accurate, and communicatively effective.

Background and motivation

Given that the background part is supposed to provide the reader with the basic, necessary information needed to begin to understand the topic, it will usually include sentences detailing facts, truths or common knowledge. Because of this, most sentences of the background function have the same verb tense and noun type which need to be used in a specific way.

The following is an example of a sentence in the background section:

Example 1

Coronary artery bypass grafting (CABG) remains an effective option for revascularization for those with extensive coronary artery disease. (1)

Verb tense

If we look at the green part in this example, we can see the use of the simple present tense.

The **simple present tense** does not only mean the "*present*" but can also be used in a "*timeless*" sense. Something was true in the past, is true in the present, and will be true in the future. It is a truth. This tense is then used to discuss things such as facts, common knowledge, recurring events, habits etc. which will be predominant in the background part of the introduction.

Also notice the use of "*s*" here at the end of "*remains*". The verb needs to agree with the subject verb, "*Coronary artery bypass grafting*", which is a 3rd person singular subject. This "*s*" is often overlooked, but is very noticeable to a native English reader. Make a habit of checking whether the subject noun is singular or plural when using simple present tense verbs.

Defining abbreviations

In yellow, the abbreviation, "*(CABG)*", shortened for "*coronary artery bypass grafting*", can be seen. It is defined on first mention in the article. Usually, the words of the defined term do not need to be capitalized, unless they are names. Be certain to define any abbreviations that will be used the first time they appear in the text.

Example 2

In the following example, we can again see the simple present tense of the verb in green, and the definition of terms and their abbreviations in yellow:

Percutaneous coronary intervention with stents and minimally invasive direct coronary artery bypass (MIDCAB) grafting are well-established strategies for patients with isolated proximal stenosis of left anterior descending (LAD) artery (1). (2)

Generic nouns

Nouns used in these types of background sentences and in this context are usually generic: they are not referring to a specific thing in the world, but rather all the cases of that noun, "in general".

In the example above, if we look at the nouns in red, "*stents*", "*strategies*", and "*patients*", we notice that they are all pluralized. This is because it is both a generic sentence, and the nouns are **count nouns**. That is, we can count their amount. We usually pluralize count nouns in generic sentences.

In contrast, the words in purple can both be considered count or **non-count nouns**. In this case, they are both processes or procedures, and the author has decided to consider them as non-count nouns. We cannot pluralize non-count nouns, so they are not pluralized here.

It is important to determine whether the nouns we are using are non-count, or count nouns, and follow these rules accordingly to avoid fairly common, but glaring errors.

Academic background

As stated previously, the academic background's purpose

is to discuss previous research as it relates to discussion of the present topic, both in the sense of a general trend, or academic consensus in the field, or as specific results or studies in that field. In both cases, it is important that the author take control of the sources they are citing and use them to craft the academic story they are trying to tell. Good research writers use sources, bad ones let the sources use them.

Example 3

Here is an example section of the academic background:

> While studies have shown that RPF improves sternal stability and healing and reduces sternal complication rates compared with WC, adoption of RPF by cardiac surgeons has been limited by the perception that outcomes with WC are adequate and their initial cost is low compared to RPF (9-14). (3)

Verb tense

A look at the verbs in green, "*has shown*" and "*has been limited*", reveals they are written in the **present perfect tense**. Sentences discussing the general state, or shift in research will usually use this tense. As nearly any study referred to in this section will have occurred in the past, it needs to be connected to current relevance by using the present perfect tense. This tense is used to connect actions in the past to the present in some way, and is invaluable to show how past events affect or can continue in the present.

Subject nouns

The noun in yellow, "*studies*", belongs specifically to the vocabulary area of academic study. Most subject nouns in the academic background will relate in some way with academic research. This signals to the reader that the topic is the research itself, and not simply the background information of the topic. This shift is important because we are trying to ultimately show how our research is *academically justifiable*.

Example 4

Here is another excerpt demonstrating the use of both the present perfect tense and academic subject nouns:

> Meta-analyses have investigated the impact on graft patency of aspirin use compared to placebo (7), as well as dual antiplatelet use compared to aspirin alone (1,8,9) in patients following CABG. (4)

Verb tense

In this next example the verb in green, "*have investigated*", can indicate two things: (i) the meta-analyses have an effect on the present discussion, and (ii) it is possible that more meta-analyses are happening now, or will happen in the future.

Again, as a very versatile tense, the present perfect can bring "dead things" in the past back to life, and back to present importance. In most cases, if what you are talking about what occurred in the past, you can use the present perfect tense without error. It can give your writing more life and relevance.

Subject nouns

As before, the subject noun in yellow, "*meta-analyses*" shows that we are talking about the academic background, not the general topic background. Note that the plural use of the noun indicates a general trend or pattern of the academic research. The reader has the sense that this has been a common occurrence.

Example 5

Here is an example of the academic background referring to a specific study:

> In the Radial Artery Patency Study (RAPS), a longitudinal angiographic trial, in addition to the LITA to the LAD, patients were randomized to receive both a SVG and RA to either the left or right coronary arteries using a within patient randomization design whereby patients served as their own control (9,10). (1)

Verb tense

In the example above, the verb in green, "*were randomized*", is in the **simple past tense** and not the present perfect. This is because the author is identifying a specific, or single study, and discussing the specific results which occurred at a specific time in the past. This gives the sense that the action is complete, and therefore the simple past is more appropriate here. Also, as it is a specific study, there is little chance that it can continue into the present.

Subject nouns

Notice that the subject noun in yellow, "*Radial Artery Patency Study*", refers to a single, specific study, not a general body of research as was the case with Example 4 and "*meta-analyses*". Commonly, if a specific study is identified, use the simple past to discuss its results. Conversely, when using the simple past, be sure to identify a specific study as the subject, otherwise, you may confuse your reader.

Example 6

Here is another example of using the simple past tense in the academic background:

> In 2006, we developed a hybrid procedure called the "Lupiae technique", which is an aortic (ascending and arc) replacement using a specifically designed Dacron multi-branched graft that reroutes the origin of the neck vessels close to the sino-tubular junction, creating a Dacron proximal landing zone at the level of the distal ascending aorta (5). (5)

Verb tense and time phrases

In this example, the text in yellow, "*In 2006*", indicates that the time of the action occurred in the past (time phrases like "*last week*", "*a year ago*", "*in the 1990's*", "*yesterday*" etc. would have the same effect). What is important here is that the time is in the past and the time is finished. In this case, we *must* use the simple past to reflect that the action is over. Using the present perfect tense here would be an error because the action cannot proceed to the present.

Literature gap

The "gap" is what is not conclusively agreed upon or known in the research in your topic, and should provide the academic justification or motivation for examining your specific research question. Clearly, there is no worth in doing research about a topic that is already well-known. The literature gap directly relates to the academic background because detailing what has already been researched clarifies what is specifically missing in the research.

This being the case, comments about the literature gap usually talk about what is not here or has not been done, and the vocabulary used to talk about the gap is usually limited to several common words or phrases.

Examples 7–9

These are three examples of literature gap statements:

However, to date, the relationship between inflammation and/or stress and outcome does not appear to have been investigated. (6)

However, the Id-1 proteins alterations related to clinical outcomes have not been adequately studied in patients with ESCC. (7)

Evidence regarding critical resection depth in laser surgery of the lung is scarce, reliable data and surgical guidelines have as yet not been presented. (8)

Verb tense

In all the examples above, the text in yellow highlights the verb in the present perfect tense. Literature gaps using the present perfect tense generally talk about an action that has not happened yet: it has not happened in the past, and it is not happening in the present.

In the last example the author also uses the simple present tense, "*Evidence is scarce*", in combination with the present perfect construction, "*has not yet been presented*". There is no problem with using both tenses.

Negative adverbs

All these examples use the negative adverb "*not*", to show there has been a lack or missing. Also, in the second example above the adverb "*adequately*" more precisely modifies the noun. In this case, there might be some studies on the subject, but overall the knowledge they provide is unsatisfactory.

Examples 10–13

These are four examples of literature gap statements using a different tense:

however, with no direct evidence of the endothelial differentiation in bone marrow-derived stem/progenitor cells induced by Shh. (9)

However, even in the light of recent progress, …there is still a lack of data on how these new approaches have been translated into daily clinical practice and whether or not they have improved the prognosis for patients in advanced stages of NSCLC. (10)

However, the mechanism and characteristics of cough after pulmonary resection remain controversial. (11)

However, the pathogenesis of AE is poorly understood and no standard treatment is yet available. (12)

Verb tense

We can use the simple present tense to talk about the literature gap in the sense of something missing or unclear in the present.

Transition words

Notice also here that all of our literature gap examples are preceded by the word "*however*". This acts as a bridge between the known academic background, and the unknown gap: we know x *but* we do not know y. It signals to the reader that there is a shift in function and meaning occurring, and helps to draw attention to the gap as major part of establishing the value of the research problem.

Common phrases discussing the literature gap

There are some common or formulaic ways to state the literature gap.

The following are some present perfect phrases:

(i) *x has not yet been studied/investigated/researched;*

(ii) *x has not been properly/adequately studied/investigated/researched.*

In these two examples, the first might be used if there is no research in this particular area, whereas the second, by using the adverbs "*properly*" or "*adequately*", might be used if there is some, but not enough, research in this particular area.

The following are some present perfect phrases:

(i) *There is little/no evidence/literature/research for x;*

(ii) *There are few/no studies/articles about x;*

(iii) *There is no agreement/consensus about x;*
(iv) *x is still poorly/not well understood;*
(v) *x is still controversial/ much debated;*
(vi) *Evidence/research for x is still scarce/lacking/conflicting;*
(vii) *Studies/articles about x are still scarce/lacking/conflicting.*

Count *vs.* non-count nouns

Notice that for #1 in the examples above, the singular verb "*is*" is used, whereas in #2 the plural verb "*are*" is used. There is a reason for this difference. Again, the distinction is that the nouns in #1 are generally non-count nouns and are usually not in plural form or used with plural verbs.

Common academic-related non-count nouns include words like "*evidence*", "*literature*", "*research*", "*information*", and "*knowledge*". These words are generally not considered countable, and should not be pluralized. For example the word "*literatures*" would be an error and very noticeable to a native English reader.

If we want to use academic **count nouns** that are countable or can be pluralized, we can use words like "*studies*", "*articles*", "*reports*" and "*results*".

Research problem/question statement (with methods)

The research problem should be stated with as much detail as possible. Optimally, the statement should be discrete. This means that it should be so well specified that once the reader knows the results, they should be able to answer or resolve the research question on their own, because it has been discretely stated. Without this level of specification, the reader will not be adequately informed as they read on in your paper, and will not be as interested or invested in reading about your findings. In addition to this, your research problem statement should be concise, meaning it should be short, but effective, and written in about 1 or 2 sentences.

The three sentences below are research problem statements showing different levels of specification:

Statement 1

The goal of the present study was to clarify the role of decorin in AE of idiopathic interstitial pneumonia (IIP).

Vague (12)

In the first example, the statement can be considered vague. We have the verb "*clarify*" here which is adequate to state as a goal of research, but it does not help define what is being done in terms of a scientific study. We do not know how this clarification will occur, what we will be measuring to find this clarification, or who (what types of patients), this will occur in.

Statement 2

The aim of this systematic review was to evaluate long-term outcomes of patients who underwent CABG with open as compared to endoscopic SVG harvest techniques.

Specified (13)

The second example provides a little more detail. The main verb used is "*evaluate*" which means that something will be judged as true or false, or its quality will be decided upon. We also know that this will be accomplished by "*systematic review*", along with what measure will determine this evaluation: "*long-term outcomes*". Finally, the patient population is more specified: "*patients who underwent CABG with open …SVG harvest techniques*".

Statement 3

The aim of this study was to evaluate changes in clinical presentation, diagnosis, and therapeutic schemes among two single-center cohorts with NSCLC patients, and whether these changes have led to an improvement in short-term survival rates over the last 5 years among patients with advanced stages (IIIB and IV) of NSCLC.

Discrete (10)

The final example here is long, but clear. Again, not only is the verb "*evaluate*" used, but it is specified what exact areas will be evaluated: "*presentation*", "*diagnosis*" and, "*therapeutic schemes*".

We also know the context of this study, "*two single-center cohorts*", and the nature of the patients, "*NSCLC patient…with advanced stages*". Most importantly, we have a specific measure to determine the conditions of our evaluation: "*short-term survival rates over the last 5 years*". Given the detail of this information, the reader will be more able to read the results and understand their meaning given the discrete nature of this research problem statement.

Examples 14,15

The goal of the present study was to clarify the role of decorin in AE of idiopathic interstitial pneumonia (IIP). (12)

To clarify the prognostic and clinical impact of PNI in lung cancer, we conducted a meta-analysis of the current published studies on PNI and survival of lung cancer. (14)

Verb tense

Tense in research problem statements is usually simple past tense. This gives a sense of the authors intention before they began the research, or the actions they completed as part of their methodology.

In the first example, the word "*goal*" indicates the researchers intent before their research started.

In the second example, the verb "*conducted*" refers to completion of the methodology, which is itself indicated by the word "*meta-analysis*".

Examples 16,17

This report elaborates the contribution of VADs as a bridge to heart transplantation in infants and children (≤18 years old) with end-stage heart failure. (13)

This network meta-analysis aims to summarize the relative efficacies for maintaining graft patency when using none, one or two antiplatelet agents following CABG. (15)

Verb tense

Research problem statements using the simple present tense are less common but still acceptable. Simple present tense is usually used to talk about the paper itself or the present moment of reading.

In the first example, the verb "*elaborates*" (meaning to discuss in detail) is in the simple present tense, and has the "*s*" conjugation for the singular 3rd person subject, "*this report*". Notice that "*this report*" refers to the paper itself, and takes the simple present tense.

In the second example, the subject "*this network-meta-analysis*" again refers to the text itself, and so the verb "*aims*" uses the simple present tense to indicate the current time of reading.

Example 18

We hypothesized that NLR would be higher in WF patients than in WS patients. (6)

Hypothesis statements

The research problem can be framed using a hypothesis statement. Usually, we hypothesize about a truth, fact, or outcome and so we need to introduce another clause using the word "that". A clause is a construction with a subject and a verb.

(I) We hypothesized that X clause (subject + verb)

In the example above, the verb "*hypothesize*" is used with "*that*" to introduce the clause consisting of "*NLR*" and its verb "*would be*".

The noun form "*hypothesis*" can also be used in this kind of statement. In this case we have to say "our hypothesis was that…." with a clause following after.

(II) Our hypothesis was that X clause (subject + verb)

Summary of introduction function and language features

Table 1 summarizes some of the language features discussed in this section. Again, it is important to remember that these are not hard rules, but rather the most common structures found in these introduction function types.

The background and motivation talk about general facts or truths. According to this, we usually see simple present tense and generic nouns used.

In the academic background, when discussing multiple studies, or discussing the general state of research, the present perfect is normally used, along with generic nouns. When referring to a specific or single study, the simple past tense is normally used, with definite articles.

For discussing the literature gap, we can use the present perfect to talk about something missing in the past and still missing in the present, or we can use the simple present to indicate something is currently not existent or inadequate. In both cases, generic nouns are used.

In the research problem statement, the simple past can be used to talk about the author's past intent, or to talk about what methodology was completed. The simple present is usually used when referring to the paper itself and the time of reading. In both cases, definite nouns are generally used.

The social impact section is similar in language features to the general background. We can use the simple present to discuss a current possibility (e.g., "*If we develop this treatment*, *many patients can be saved*"), or discuss a potential future (e.g., "*If we develop this treatment*, *many patients will be saved*").

Finally, methods are almost always in the simple past tense because they outline a past action, and use definite nouns to describe your specific methodology.

Making your introduction flow

Given the social and interpersonal role of the introduction, we must take particular care to make sure our writing is unified, connected, and easy to follow. While it is important to provide well-written content for the functions described in the previous section, simply having the complete parts of the introduction is not sufficient; we need to have a way to put these parts together. The meaning of any piece of writing arises both from the content of each sentence or paragraph, and how the sentences or paragraphs relate to one another. For example, unless we connect our research problem statement to our literature gap, by stating that our research can obtain an important missing piece of knowledge, a reader will not know or fully understand why our research is significant. As writers, we cannot expect the reader to make these connections by themselves, and

Table 1 Introduction functions and related verb tense and noun types

Function	Verb tense(s)	Nouns
Background and motivation	Simple present (general truths or facts)	Generic (plural count-nouns)
Academic background	Present perfect (multiple studies/ background research)	Generic
	Simple past (single, specific study)	Definite
Literature gap	Present perfect (something that has not been done yet)	Generic
	Simple present (something currently inadequate)	Generic
Research problem	Simple past (previous intention, methods completed)	Definite
	Simple present (reference to current article or present time of reading)	Definite
Social impact	Simple present (current possibility)	Generic
	Simple future (future reality)	Generic
Methods	Simple past	Definite

must help them by using proper structure and technique to clarify the connections within our writing. If we do not take care to provide these links, the reader will become confused, annoyed, and be more inclined to stop reading.

Structure and order

Assuming we have written out our introduction functions, or at least have a clear idea about what they are, we also need to consider in what order and in what organization to put these parts in. Which should come first? Which should come last? Which should go in the middle?

In terms of ordering, there are no strict rules, but there are two main principles that can be followed to organize the introduction structure in a way which is easier for the reader to follow:

Go from general information to specific information

Essentially, begin with the broadest statement you can make, and end with the most detailed statement. In between the beginning and the end, the writing should gradually become more and more specific. This kind of writing can be visualized (*Figure 1*) as an upside down triangle or funnel. Writing this way will allow the reader to more comfortably narrow their attention to the details and purpose of our research. If we immediately begin with the specifics of the research problem, there is no context and the reader is lost.

Put functions that logically relate together next to each other

As you think and write about the individual functions of your introduction, you will begin to see how they might be connected or relate to each other in some way. Which functions connect to each other might depend on the specific content of your research, but there are some functions which naturally go together. For example, we might have a literature gap part focused around the questionable or inadequate methodologies of previous studies, and then we might have a methods part detailing our improved and more valid methodology. Placing these parts next to each other makes sense because the reader can immediately see how your methodology can help fix the gaps in previous research.

Figure 1 illustrates the "funnel" structure of most successful introductions, which move gradually from most general to most specific. In terms of ordering introduction functions, the background, being the most general, almost always goes first, and the research problem statement, being the most specific, almost always goes last. Between these two parts, the other functions can be placed in any way they logically fit together depending on their specific content. *Figure 1* is only an example of a possible structure and indeed the writer is encouraged to organize their writing in a way that makes sense to the content of their research. As long as the writing is logical and can be followed by the reader, any structure is theoretically possible.

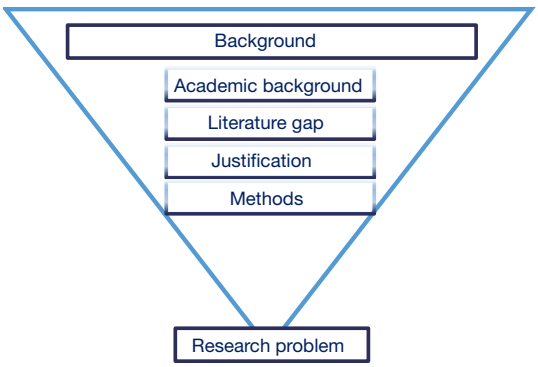

Figure 1 Example of an introduction "funnel" structure and possible order of functions.

Cohesion

After intelligently and logically ordering our introduction functions, it is still necessary to clarify precisely what the relationship is between then, more explicitly state how they are connected, and bind the writing to itself so it is one *cohesive* whole.

Cohesion is how well the basic structural elements of our writing (words, sentences and paragraphs) are connected. If we are talking about a car, it is the nuts and bolts, if we are talking about a dress, it is the stitches and seams, and, if we are talking about writing, it is our words and grammar. Cohesion can be improved using the following techniques:

(I) **High similarity of content between sentences (same words or synonyms).** This means repeating words in sentences you want to connect, or using synonyms—different words that mean the same thing—to create unity in theme and subject across sentences.

(II) **Transition words (to show the logical connection between sentences).** These are words or phrases that explain the relationship between sentences, for example "additionally", "however", "therefore" etc. These words not only show that two or more sentences are related but indicate to the reader *how* they are related.

(III) **Pronouns (that point to previous sentences).** These are nouns that stand in or take the place of other nouns that occur in other sentences. These pronouns include words like "*it*", "*them*", "*she*", "*these*", "*those*" etc. These enable the writer to point to topics in other sentences and provide continuity in topic between sentences, without sounding repetitive.

The following section will show examples of two functions which are commonly connected, and instances of cohesive techniques providing unity between the sentences of these sections.

Example 19 Connecting the background and social impact

The universally practiced heart preservation technique using cold ischemic storage is largely dependent on time; cold ischemic duration of longer than 4 hours has been shown to aggravate ischemia-reperfusion (IR) injury and adversely affect survival (1).Therefore, developing a preservation method that offers a longer tolerable ischemic time may not only improve outcome but facilitate distant procurement and ultimately increase the overall donor pool. (16)

In the example above, the background in yellow, is being connected with the social impact in green. This is a common connection. Cohesion here is made by repeating words such as "*preservation technique*", "*cold ischemic storage*", "*time*". The transition word "*therefore*", clarifies that the second sentence is a logical consequence of the first. That is, the background discusses how time is critical to keeping hearts viable in storage, and the social impact section reasons that extending this time would lead to better patient outcomes and enlarge the organ donor pool.

Example 20 Connecting the background and academic background

Id-1 belongs to a protein family which contains a helix-loop-helix (HLH) motif through that it inhibits the basic HLH transcription factors from DNA binding, therefore regulating gene transcription (5). It has been implicated in different steps in carcinogenesis such as tumorigenesis, differentiation and metastasis (6,7). In ESCC vitro experiments, ectopic Id-1 expression... (7)

In this example, the general background in yellow is connected with the academic background in green. The subject of the background, "*Id-1*", continues in the academic background with a pronoun referent, "*It*". We have the same topic in the second sentence but are looking at it now through a different perspective: an academic one. This shift in perspective is indicated by the use of an academic subject noun, "experiments". Also, the background has the simple present tense, "*belongs*" but changes to the present perfect tense, "*it has been implicated*", when the academic background is discussed.

Example 21 Connecting academic background and research problem statement

Furthermore, decorin can inhibit connective tissue growth factor (CTGF)-induced collagen production in fibroblasts (16). Taken together, these reports strongly suggest that decorin is involved in the pathogenesis of pulmonary fibrosis. The goal of the present study was to clarify the role of decorin in AE of idiopathic interstitial pneumonia (IIP). (12)

In this example, the academic background in yellow is being connected to the research problem in green. There are three sentences here, and cohesion between them is created by repeated use of the noun "*decorin*". We also have a transition phrase combined with a pronoun phrase "*Taken together*, *these reports…*". This phrase refers to the body of text preceding this example which discusses different studies, and now refers to them to bring up the relevance and viability of the author's research approach. It is an excellent way to summarize the content of one function (the academic background) and indicate its importance and connection to another (the research problem statement).

Fixing disconnected sentences

As can be seen in the examples above, using cohesive techniques can provide our writing with readability by making the relationship between sentences clear. The more we use these cohesive techniques, the more readable our text will be. Conversely, the less we use these techniques the more our writing will be disconnected and *incoherent*.

To show how confusing a piece of writing without using these techniques can be, and how these techniques can improve disconnected writing, the example below is provided:

Example 22 Lack of cohesion

Prospective randomized investigations concerning omission or delay of established components of sepsis treatment are rare for obvious ethical reasons. Analyses of Kumar et al. (6) and other investigators (7,8) showed that a delay in appropriate antibiotic treatment may result in increased mortality and this knowledge is accepted as "state of the art". It also appears self-evident, that a delay or even omission of fluid resuscitation would be equally harmful. A retrospective study of Seymour et al. analyzed the median time of initiation of broad-spectrum types and completion of intravenous fluid bolus regarding mortality (9).

Here we have a passage of writing that lacks cohesion. The first sentence describes a lack of studies ("*are rare*"), yet the second sentence begins by detailing a specific set of studies by Kumar *et al.*, while the 3rd sentence discusses another specific study by Seymour *et al.* with no direct connection between the 2nd or 3rd sentence. In order to understand the connection between these sentences, and to therefore understand the real meaning of the text, requires the reader to do their own reasoning and make a lot of guesses about the relationship between these sentences. As writers, we do not want the reader to do too much work to understand our writing.

In order to make the writing clearer here requires the use of cohesive techniques. The following example is the same text improved by these techniques:

Example 23 Improved cohesion

(4,5). **Prospective** randomized **studies** ~~**investigations**~~ concerning omission or delay of established components of sepsis **treatment** are rare for obvious ethical reasons. **Despite this**, **retrospective studies** ~~**analyses**~~ of Kumar et al. (6) and other investigators (7,8) showed that a delay in appropriate antibiotic **treatment** types may result in increased mortality and this knowledge is accepted as "state of the art". **Additionally**, It also appears self-evident, that a delay or even omission of fluid resuscitation would be equally harmful. **another retrospective study** of Seymour et al. analyzed the median time of initiation of broad-spectrum **treatment** types and completion of intravenous fluid bolus regarding mortality (9).

This example shows how the use of some cohesive techniques improves the readability of a passage.

The first change to note is that the academic nouns "*investigations*" and "*analyses*" have been changed to the word "*studies*". In this way, we have the same noun repeated throughout each sentence. Now, we have a basis to compare the first and the second sentence according to the *type of* study: the first sentence discusses prospective studies, while the second and third sentences discuss retrospective studies. The topic word "*treatment*" is repeated to emphasize that all these studies are investigating the same topic, but the ones in the first sentence are doing it in a different way.

The first and second sentences are further connected by the transition phrase and pronoun "*despite this*". This makes it clearer that while there are few prospective studies on this topic, there are in fact abundant retrospective studies. It provides a contrast.

The third sentence is then connected to the second with the use of the transition phrase "*additionally*", which indicates that Seymour *et al.*'s study is of the same type as Kumar *et al.*'s study. This is solidified by the pronoun "*another*".

From using all these techniques, we have a clearer picture of the author's expression and intended meaning: there are not many prospective studies about sepsis treatment; however, there are a great deal of retrospective studies, like Kumar and Seymour's, which do provide ample useful information on the topic.

Notice that even with flawless grammar and precise vocabulary use, if we do not take care to guide our reader through binding and connecting our sentences, our writing fails, because our reader becomes lost.

Introduction exercises

To see how a complete introduction comes together, and to apply the knowledge discussed in the section, a complete introduction with exercises to complete is provided below. All the questions refer to the introduction sample (Sample 1).

Question 1 Introduction functions

Briefly look at Sample 1. In which paragraph will you find the following introduction functions? Find the function and write the number of the paragraph where you found it. Some functions can be found in multiple paragraphs.

(I) Background ____
(II) Academic background ____
(III) Justification/Social impact ____
(IV) Literature gap ____
(V) Methods ____
(VI) Research problem ____

Question 2 Nouns

Look at the *nouns* on lines 1, 3, 7, 11 from Sample 1. Find and correct any errors.

Question 3 Verbs

Look at the *verbs* in brackets like "*(to remain)*" _____. Write what you think the best form of the verb is in the blank. Consider aspects such as tense, voice and number.

Question 4 Transition words

moreover, hence, therefore, however, in addition

Look at the letters in brackets, (l) to (v), and choose the best *transition phrase* from the box to fill the blank _____. More than one word might be acceptable for each blank.

Sample 1 Introduction sample [adapted from (6)]

Neutrophil/lymphocyte ratio is helpful for predicting weaning failure: a prospective, observational cohort study

Introduction

Weaning from invasive mechanical ventilation (IMV) **(to remain)** _____ a huge challenge to critical care physician (1,2). The weaning process can account for 40–50% of the total duration of IMV, which can delay extubation and lead to complications and/or death (2-4). Although spontaneous breathing trial (SBTs) **(to be)**_____reliable tests for judging weaning outcomes, 13% of patients with successful SBT results still require reintubation (2,5). **(A)**_____, roughly 30% of IMV patients experience difficult or prolonged weaning, which can lead to morbidities or even death (2). **(B)**_____, it is of critical importance to enhance the accuracy of methods predicting weaning outcome.

Researches **(to indicate)**_____that the ratio of neutrophils to lymphocytes (NLR) in peripheral blood samples may correlate closely with systematic inflammation and/or stress and may have promising predictive ability under several clinical circumstances as a simple, inexpensive, and clinically accessible marker (6-21). In critically ill patients, NLR **(to prove)** _____to have a robust association with the severity of disease and mortality (7,9). In an emergency care setting, NLR was found to be more accurate for predicting bacteremia and the severity of disease than other markers (10,11). In another studies among sepsis patients, the ratio **(to correlate)** _____ with extremely poor clinical prognoses (12) and among patients with chronic obstructive pulmonary disease in a 2016 study (COPD), it **(to associate)** _____ with predicting the severity of disease and the potential for exacerbations (14). **(C)**_____, NLR has been shown to be a valuable prognostic marker for various chronic conditions ranging from oncological to cardiovascular diseases (6,15-21).

Patients would show an inflammatory response when suffering from systematic or local infections and when undergoing endotracheal intubation and subsequent IMV (7,22-24). Moreover, such a response would become more severe in the presence of IMV-related complications such as ventilator-induced lung injury (25). In addition, previous studies (26-28) have shown that patients who fail weaning (WF) experience higher pulmonary and cardiovascular stress than those who are successfully weaned (WS). **(D)**_____, patients with signs of such responses might be prime candidates for WF. **(E)**_____, to date, the relationship between inflammation and/or stress and weaning outcome does not appear **(to investigate)**_____.

In a prospective cohort study, we hypothesized that NLR would be higher in WF patients than in WS patients. Accordingly, **we (to evaluate)** _____the utility of NLR for predicting WF in patients receiving IMV, compared to traditional inflammatory markers such as leukocyte counts and levels of C-reactive protein (CRP).

Answer key

Question 1 Introduction functions

(I)	Background	1
(II)	Academic background	2, 3
(III)	Justification/social impact	1
(IV)	Literature gap	3
(V)	Methods	4
(VI)	Research problem	4

Question 2 Nouns

Line 1- physicians
Line 3- trials
Line 7- research__
Line 11- study__

Question 3 Verbs

(I) (to remain) remains
(II) (to be) are
(III) (to indicate) has indicated
(IV) (to prove) has been proven
(V) (to correlate) was correlated
(VI) (to associate) was associated
(VII) (to investigate) to have been investigated
(VIII) (to evaluate) evaluated

Question 4 Transition words

(I) in addition, moreover
(II) hence, therefore
(III) in addition, moreover
(IV) hence, therefore
(V) however

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