# Guidelines for Annotating Errors in Patient Summaries

We will present you with a pair of a brief hospital course (BHC) and a patient after visit summary (AVS). The AVS is also referred to as discharge summary. The BHC contains a detailed summary of the hospital stay written by medical service. It usually contains medical jargon, and it can follow different structures based on the hospital course and responsible medical specialty. The AVS summarizes the hospital stay for the patient in plain language. In practice, the BHC is not the only source of information to write the AVS. However, in our setting we treat the BHC as the only context for the summary.

For this labeling task, we are interested in errors in the AVS that are either unsupported by the BHC, contradict content in the BHC, or are wrong medical facts. We allow statements that contain general medical knowledge or advice that are often used in patient summaries. Most errors are due to unsupported facts, so we further distinguish those based on their specific content. This leads to the following error types or labels:

1. Unsupported condition
2. Unsupported procedure
3. Unsupported medication
4. Unsupported time
5. Unsupported location
6. Unsupported number
7. Unsupported name
8. Unsupported word
9. Unsupported other
10. Contradicted fact
11. Incorrect fact

## Allowed General Medical Knowledge and Medical Advice

We allow general medical knowledge and advice that is often part of the AVS. Usually, these are information that are not specific for the hospital course given in the BHC. For example

* “Please take your medications as prescribed” contains no error even though the BHC does not contain this instruction because this is general medical advice.
* “If the symptoms get worse, please contact your doctor” contains no error even when the BHC does not contain this fact, since it is general medical knowledge that a doctor should be seen for worsening symptoms.

## Determining Span of Errors

We label the smallest possible consecutive span that specifies the error given the BHC as a context. Removing further parts from the span would remove important information. A useful heuristic is to identify the minimal span that must be replaced to obtain a correct statement that is grammatically correct. For example

* “We performed an esophageal-gastro-duodenoscopy (EGD).” when no such procedure is reported in the BHC. The article “an” is not labeled as an error. When no procedure at all was performed “performed an esophageal-gastro-duodenoscopy (EGD)” should be labeled as error because there is no suitable substitute for “esophageal-gastro-duodenoscopy (EGD)”.
* “After the surgery, we transitioned you to oral oxycodone.” when the BHC contains no information for such a transition. If another medication transition is mentioned in the BHC and makes sense in this sentence only “oral oxycodone” should be labeled. If another oral medication transition is mentioned in the BHC only “oxycodone” should be labeled.
* “Your symptoms responded well.” when no part of the sentence makes sense in the given context of the AVS.

Also, to get reliable error counts a span should only contain a single error.

* “You received Tylenol and Ciprofloxacin” when there is no evidence in the BHC that the two medications were administered to the patient.
* “You have a follow-up appointment with your PCP and your cardiologist” when no such follow up is mentioned in the BHC. Both errors are labeled separately.

## Dealing with Deidentified Information

The data contains deidentified information shown with “\_\_\_” in the text. We always treat this as non-existent information. So, the annotators should not infer what the deidentified information could be. In general, deidentified fields in the AVS should not be labeled as errors. However, sometimes they belong to a wrong statement or clearly contain unsupported information (e.g., a doctor’s name or phone numbers) that are not given in the BHC. In these cases, deidentified fields should be included in the error span. For example

* “Take \_\_\_ 200mg daily and try to rest” when no such dosage information is provided in the BHC, but the statement to rest. The deidentified medication name is excluded from the error span.
* “Please avoid going up more than \_\_\_ stairs at a time” when restrictions for the number of stairs taken at a time are note mentioned in the BHC.
* “Dr. \_\_\_ will follow up with you” when no follow-up is mentioned in the BHC.
* “Please stop taking Aspirin on \_\_\_” when no stopping date is given in the BHC.
* “Your RBC peaked at \_\_\_ million” if there is no hint of a specific red blood cell count given in the BHC.

## Error Types

We distinguish different error types. In general, we ask for the most specific error that is applicable. If there is uncertainty which type applies, prefer the one mentioned first in the enumeration of all error types shown earlier.

For instance, if the error contains an unsupported medication name, the *Unsupported medication* type should be used instead of the *Unsupported name* type.

### Unsupported Condition

Unsupported conditions include unsupported symptoms, diseases, or findings of the patient. For example

* “You were found to have a left clavicle fracture” when no information was given for this condition in the BHC.
* “The ultrasound showed no blood clots in your leg” when the ultrasound showed a deep vein thrombosis in the right leg.

### Unsupported Procedure

Unsupported procedures include any unsupported medical procedures. For example

* “You had a filter placed in your vein” when no intervention with a filter was mentioned.
* “You underwent a left clavicle repair” when the humerus was repaired.

### Unsupported Medication

This type contains all errors related to unsupported medications. This includes medication classes, substances, routes, frequencies, and dosages. For example

* “You were placed on antibiotics” when only blood thinners were prescribed.
* “We gave you blood thinners by mouth” when blood thinners were administered by IV.
* “You received IV antibiotics” when no route was specified in the BHC.
* “Please take amitriptyline daily” when no interval for amitriptyline is given.
* “We started you on Coumadin 5 mg” when no dosage for the Coumadin is provided.

### Unsupported Time

Unsupported time includes all errors for unsupported time or interval statements. For example

* “Keep your arm in a sling for the next 6 weeks” when no specific duration is given.
* “Your family arranges home care while you are getting discharged” when the family was instructed to establish home care before the patient gets discharged.

### Unsupported Location

Locations include both unsupported physical places as well as regions of the patient. For example

* “The patient was admitted to the Acute Surgery Service” when no admission location was provided in the BHC.
* “There was concern for a thrombus in the right leg” when no side of the thrombus was specified.

### Unsupported Number

Unsupported numbers are any number either as digits or written that are unsupported. This also includes words such as “a” and “an”. For example

* “Your pacemaker rate was increased to 50” when the rate of 50 is not given in the BHC.
* “You had a fracture of your second metacarpal” when no information about which metacarpal bone was fractured is given in the context.
* “If you have another episode” when the context asks for at least two more episodes.
* “You can take one more of this pill” if two additional pills are allowed according to the BHC.

### Unsupported Name

Named entities that are not supported by the BHC. For example

* “You were seen by the interventional pulmonary service” when no consult with this service was mentioned in the BHC.
* “We discharged you the Gold Housing assisted living” when the name of the assisted living facility is not provided in the context.

### Unsupported Word

Word mistakes are incorrect or inappropriate words or phrases which do not fit in any of the above types. For example

* “We will send you home with a drain in place” when drain not mentioned in the BHC.
* “Limit your use of stairs” when movement is encouraged.

### Unsupported Other

If there is a mistake which clearly does not belong to any of the above categories, you may use this category as a last resort. We cannot give precise instructions because the “other” category is very broad.

### Contradicted Fact

This error type is independent of the content and contains all facts that clearly contradict information provided in the BHC. For example

* “Your pacemaker rate was increased to 50” when the context state a pacemaker rate of 40.
* “We started you on ASS 81 mg” when the BHC contains a dosage of 300 mg for ASS.

### Incorrect Fact

This error type is independent of the content and contains all facts that clearly contradict general medical knowledge or advice. For example

* “We diagnosed a seizure, and you can continue driving your car” when no reason for allowing driving after a seizure is provided this contradict common medical knowledge.

## Special Situations

### Grammatical Errors

We try to ignore grammatical errors in the BHC and AVS. If the original meaning can still be inferred (e.g. “medictaions” instead of “medications), the most likely corrected form can be used. If the meaning cannot be inferred, they can be ignored in the BHC or labeled as *Unsupported Other* in the AVS.

### Repeated Content

If a sentence or phrase is repeated, then please treat it as you would any other sentence and highlight all errors (even if you did so in a previous sentence). For example

* “Please take Tylenol. Please take Tylenol” when Tylenol was prescribed in the BHC.
* “Limit your use of stairs. Please limit use of stairs” when movement was encouraged.

### Complex Mistakes

If there are multiple ways in which you can annotate a sentence, follow the following rules:

1. Choose the alternative with fewest total mistakes.
2. Choose the alternative with the smallest error spans.
3. If both annotations would lead to the same number of mistakes with the same span sizes, prefer the error mentioned first in the enumeration of all error types above.

## Additional Clarifications

### Clarifications from first batch of 5 test examples

* If a condition is a consequence of another condition, it is not labeled as an error even if it is not directly mentioned.
  + For example, “You had pain during your admission” if a severe trauma is mentioned in the BHC.
* If another doctor takes over the treatment, it can be assumed that they re-evaluate the patient and can decide the following treatment.
  + For example, “Please continue your medications until your PCP appointment” if no stopping time for the medications was mentioned in the BHC.
* Facts classified as general medical knowledge are considered from a doctor’s perspective. The doctors write the AVS; hence, this general knowledge needs no support in the BHC but can be assumed to be known by any doctor.
  + For example, “After we placed a drug-eluting stent you will receive two blood thinning medications” if the BHC mentions the placement if a drug-eluting stent, the antiplatelet therapy can be assumed as general knowledge.
* If a medical specialty commonly treats a condition or performs a procedure, this is considered general knowledge and not considered as an unsupported fact.
  + For example, “Neurology evaluated your EEG” if the EEG evaluation was mentioned in the BHC but though no specialty was given.

### Clarifications from second batch of 5 test examples

* Specific names of departments are not treated as general knowledge even though it is likely that they treat a condition or perform a procedure. We require those to be explicitly named in the BHC.
  + For example, “Neuro Epilepsy Service evaluated your EEG” if the EEG evaluation was mentioned in the BHC but no responsible department was given.
* The main condition for admission named in the summary (“You were admitted for …”) cannot only be derived from the main condition named in the BHC. Sometimes another major reason relevant to the patient is mentioned later in the BHC, so it is also acceptable to use this.
  + For example, “You were admitted for abdominal pain.” If the BHC states an ileus as the main reason but also mentions the abdominal pain.

### Clarifications from agreement procedures of 100 examples

* A reference to additional material or information that are not part of the AVS (e.g., medication plan or phone number) are considered as unsupported facts.
  + For example, “Your medication plan is attached.” If no medication plan is mentioned in the BHC.
* Generalizations and simplifications of medical conditions or procedures that are still close to the information in the BHC and aid patient understanding are not considered as unsupported facts.
  + For example, “You WBC was low” when the BHC mentions a neutropenia.
* If a span contains different error types, it is labeled as “unsupported word”.
  + For example, “The lab test showed an increased risk of bleeding.” when no lab test or increased risk of bleeding is mentioned in BHC. The error is labeled with one span since logically they belong together.
* If a common daily dosage of a medication is given, we treat instructions for daily intake in the AVS as general knowledge.
  + For example, “You therapy was changed to Plavix 75 mg daily.” If the BHC only contains the therapy change to Plavix 75 mg.
* If unsupported entities are clearly referred to in the next sentence, they are again labeled as an error.
  + For example, “Vascular Surgery was consulted. They recommended no surgery.” if the vascular surgery team is not mentioned in the BHC.