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Temporal Structure of Clinical Narratives in Portuguese

Ana Luísa Cardoso da Silva Vieira Fernandes

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Ana Luísa Cardoso da Silva Vieira Fernandes

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To my parents

For what is time? Who can easily and briefly explain it? Who can even comprehend it in thought or put the answer into words? Yet is it not true that in conversation we refer to nothing more familiarly or knowingly than time? And surely we understand it when we speak of it; we understand it also when we hear another speak of it.

What, then, is time?

— Saint Augustine, *Confessions*, Book XI, Chapter XIV

Summary

Declaration of Honour	7
Acknowledgments	8
Resumo	10
Abstract	12
List of Figures.....	14
List of Tables	15
List of Charts	16
List of Abbreviations and Acronyms	17
Introduction.....	18
1.The Narrative: Linguistic, Computational, and Medical Perspectives	23
1.1. The Concept of Narrative: from Antiquity to Linguistics.....	23
1.2. Types of Narratives in the Context of Computational Linguistics	30
1.3. Medical Reports as Clinical Narratives.....	32
2.Temporal and Aspectual Features.....	36
2.1. The Concept of Time, Tense, and Aspect.....	36
2.2. Theoretical Approaches to Tense	40
2.2.1. Jepserson (1924).....	40
2.2.2. Reichenbach (1947).....	42
2.2.3. Comrie (1985).....	45
2.2.4. Declerck (1991)	47
2.2.5. Kamp and Reyle (1993)	51
2.3. Tense and Mood in the Portuguese Verbal System	55
2.3.1. The Indicativo Mood: Presente, Pretérito Perfeito, and Pretérito Imperfeito	57
Presente do Indicativo (Present of the Indicative).....	57
Pretérito Perfeito do Indicativo (Simple Past of the Indicative).....	61
Pretérito Imperfeito do Indicativo (Simple Past Imperfectum of the Indicative)	63
2.4. Theoretical Approaches to Aspect	65
2.4.1. Vendler (1967).....	65
2.4.2. Dowty (1979).....	69
2.4.3. Mourelatos (1981).....	75
2.4.4. Moens (1987)	81
2.4.5. Cunha (1998, 2004)	86

3.Annotation of Clinical Narratives.....	94
3.1. Annotation Schemes: Foundations, Development and Applications.....	94
3.2. Linguistic Studies on Clinical Narratives.....	96
3.3. Annotation of Clinical Narratives: Main Proposals	97
3.4. Annotation of Clinical Narratives: Temporal Annotation.....	99
3.5. Annotation of Clinical Narratives in Portuguese.....	104
4.The Study.....	106
4.1. Description and Characterisation of the Data Corpus	107
4.2. Development and Application of the Annotation Scheme	110
4.2.1. Design and Validation Process of the Annotation Scheme	110
Phase 1 – Literature review and selection of annotation schemes	111
Phase 2 – Expansion of the scheme with domain-specific categories	112
Phase 3 – Empirical validation	114
Phase 4 – Consolidation and refinement	119
4.2.2. Architecture and Technical Specifications of the Annotation Scheme	119
4.2.3. Manual Annotation Protocols and Procedures	128
4.3. Analysis and Interpretation of Results	135
4.3.1. Event and Temporal Expressions Attributes in the Annotated Corpus	135
General Event.....	136
Specialized Event.....	142
Temporal Expression.....	145
TLINKs.....	146
4.3.2. Inter-documents Temporal Analysis of Clinical Reports	149
4.3.3. Temporal Characterisation by Report Type	161
4.3.4. Identification of Linguistic Factors in Temporal Relation Inference.....	169
5.Final Considerations and Perspectives	173
References	177

Declaration of Honour

I hereby declare that this dissertation is of my authorship and has not been used previously in another course, degree, curricular unit or subject, at this or any other institution. References to other authors (statements, ideas, thoughts) scrupulously respect the rules of attribution and are duly indicated in the text and bibliographical references, in accordance with the rules of referencing. I am aware that the practice of plagiarism and self-plagiarism is an academic offence.

I further declare that I have not used generative artificial intelligence tools (chatbots based on large language models) to carry out part of this dissertation.

Porto, 15th September 2025

Ana Luísa Cardoso da Silva Vieira Fernandes

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Resumo

Os relatórios médicos contêm grandes volumes de texto não estruturado, o que limita a sua utilização na prática clínica e na investigação. Dado que 70–80% dos dados clínicos se encontram em formato textual, o Processamento de Linguagem Natural (PLN) é essencial para a extração automática de informação. Contudo, a criação de corpora de elevada qualidade permanece desafiante em línguas menos estudadas, como o português. Esta lacuna é particularmente evidente em doenças de prognóstico reservado, como a Leucemia Mieloide Aguda (LMA), em que a compreensão da trajetória do doente depende da reconstrução da cronologia dos acontecimentos registados em múltiplos relatórios. Neste contexto, a análise temporal interdocumentos, capaz de construir linhas de tempo ordenadas, pode contribuir com resultados relevantes no âmbito da semântica temporal e, simultaneamente, representa um avanço significativo para o PLN clínico.

De uma perspetiva linguística, os relatórios médicos podem ser entendidos como narrativas clínicas, dado que, apesar da sua natureza técnico-científica, apresentam sequências de eventualidades (sintomas, exames, diagnósticos, tratamentos, evoluções) que se desenrolam ao longo do tempo e constroem uma linha temporal coerente. Estas narrativas distribuem-se por diferentes tipos de relatórios (consultas de grupo, notas de alta e relatórios gerais) que oferecem perspetivas complementares e interligadas.

O objetivo deste estudo é analisar a organização temporal interdocumentos de narrativas clínicas em português, contribuindo para o estudo de questões semânticas de tempo e para a caracterização de um género textual de relevância social e científica ainda pouco explorado. Para tal, foi desenvolvido o esquema de anotação Med2Story, uma extensão do Text2Story, aplicado a um corpus de 38 relatórios de nove doentes com LMA seguidos no IPO-Porto. Foram anotadas 1.859 ocorrências de eventualidades e expressões temporais e 2.156 relações temporais.

Os resultados revelaram uma predominância de relações temporais de simultaneidade (sobretudo entre estados), embora haja sequências de ordenação cronológica, que permitem determinar a evolução da doença. Os padrões de relações

temporais variam consoante o tipo de relatório, havendo menor diversidade de relações nas consultas de grupo e relatórios gerais e maior diversidade nas notas de alta.

O presente estudo contribui para: (i) a Linguística, ao caracterizar a organização temporal dos relatórios médicos em português e, em particular, ao aprofundar a semântica temporal através da descrição e explicação sistemática dos mecanismos que ancoram e relacionam eventualidades, evidenciando padrões como simultaneidade, anterioridade e inclusão; (ii) a Ciência de Computadores, ao disponibilizar recursos estruturados para o desenvolvimento de modelos de extração de informação; e (iii) a Medicina, ao sistematizar dados, identificar padrões e transformar informação não estruturada em conhecimento útil para a prática clínica e para a investigação.

Palavras-chave: narrativas clínicas; anotação temporal; anotação interdocumentos; semântica temporal; informática médica

Abstract

Medical reports contain large volumes of unstructured text, which limits their use in both clinical practice and research. Given that 70–80% of clinical data are in textual format, Natural Language Processing (NLP) is essential for the automatic extraction of information. However, the creation of high-quality corpora remains particularly challenging in less-studied languages, such as Portuguese. This gap is especially evident in diseases with a reserved prognosis, such as Acute Myeloid Leukemia (AML), where understanding the patient’s trajectory depends on reconstructing the chronology of events recorded across multiple reports. In this context, inter-document temporal analysis, capable of constructing ordered timelines, may yield relevant insights for temporal semantics and, at the same time, represent a significant advance for clinical NLP.

From a linguistic perspective, medical reports can be understood as clinical narratives since, despite their technical-scientific nature, they present sequences of eventualities (symptoms, examinations, diagnoses, treatments, and developments) that unfold over time and construct a coherent timeline. These narratives are distributed across different types of reports (group consultations, discharge notes, and general reports), which offer complementary and interconnected perspectives.

The aim of this study is to analyse the inter-document temporal organisation of clinical narratives in Portuguese, thereby contributing to the study of temporal semantics and to the characterisation of a textual genre of social and scientific relevance that remains relatively unexplored. To this end, the Med2Story annotation scheme, an extension of Text2Story, was developed and applied to a corpus of 38 reports from nine AML patients followed at IPO-Porto. A total of 1.859 occurrences of eventualities and temporal expressions and 2.156 temporal relations were annotated.

The results revealed a predominance of simultaneity relations (particularly among states and nominal events), although chronological sequences were also observed, allowing the progression of the disease to be determined. Patterns of temporal relations vary according to report type, with group consultations and general reports displaying less diversity of relations, and discharge notes showing greater diversity.

This study contributes to: (i) Linguistics, by characterising the temporal organisation of medical reports in Portuguese and, in particular, by deepening temporal semantics through the systematic description and explanation of the mechanisms that anchor and relate eventualities, highlighting patterns such as simultaneity, anteriority, and inclusion; (ii) Computer Science, by providing structured resources for the development of information extraction models; and (iii) Medicine, by systematising data, identifying patterns, and transforming unstructured information into useful knowledge for both clinical practice and research.

Key-words: clinical narratives; temporal annotation; inter-document annotation; temporal semantics; medical informatics

List of Figures

FIGURE 1 REPRESENTATION OF TIME (COMRIE, 1985, P. 2)	36
FIGURE 2 THE THREE MAIN DIVISIONS OF TIME (JESPERSEN, 1968, P. 257).....	41
FIGURE 3 THE INSERTION OF THE INTERMEDIATE "TIMES" (JESPERSEN, 1968, P. 257)	41
FIGURE 4 ASPECTUAL TYPOLOGY PROPOSED BY MOURELATOS (1981, P. 423)	76
FIGURE 5 ASPECTUAL NETWORK (MOENS, 1987, P. 61)	83
FIGURE 6 ASPECTUAL NUCLEUS (MOENS, 1987, P. 65)	84
FIGURE 7 TIMELINE OF TEMPORAL ANNOTATION SCHEMES (TAKEN FROM OLEX AND MCINNES, 2021, P.3) .	101
FIGURE 8 ATTRIBUTES OF GENERAL EVENTS IN MED2STORY	121
FIGURE 9 ATTRIBUTES OF SPECIALIZED EVENTS IN MED2STORY	122
FIGURE 10 DECISION TREE TO ASSIST THE ANNOTATION OF SPECIALISED MEDICAL EVENTS	124
FIGURE 11 ATTRIBUTES OF TEMPORAL EXPRESSIONS IN MED2STORY	125
FIGURE 12 ATTRIBUTES OF TLINKS IN MED2STORY	127
FIGURE 13 EXCERPT FROM A SYNTHETIC MEDICAL REPORT ANNOTATED ACCORDING TO THE MED2STORY SCHEME	128

List of Tables

TABLE 1 REICHENBACH’S TEMPORAL SYSTEM (WITH DASHES REPRESENTING A TEMPORAL INTERVAL AND COMMAS INDICATING SIMULTANEITY).....	43
TABLE 2 FORMAL REPRESENTATION OF TENSES IN ENGLISH ACCORDING TO KAMP AND REYLE (1993, P. 601)	53
TABLE 3 PORTUGUESE INDICATIVE TENSES WITH EXAMPLES AND CORRESPONDING ENGLISH TRANSLATIONS...	57
TABLE 4 PORTUGUESE SUBJUNCTIVE TENSES WITH EXAMPLES AND CORRESPONDING ENGLISH TRANSLATIONS	57
TABLE 5 VENDLER’S TAXONOMY (MOENS, 1987, P. 55).....	68
TABLE 6 IDENTIFICATION CRITERIA FOR STATES, ACTIVITIES, ACCOMPLISHMENTS, AND ACHIEVEMENTS (DOWTY 1979, P. 60).....	74
TABLE 7 THE NEW LABELS OF 5 VENDLERIAN CATEGORIES (MOENS, 1987, P. 57).....	81
TABLE 8 THE MAIN ASPECTUAL OPERATORS AND OPERATIONS IN EUROPEAN PORTUGUESE PROPOSED BY CUNHA (2004).....	91
TABLE 9 ASPECTUAL PROPERTIES OF ADJECTIVAL PREDICATIVE CONSTRUCTIONS (CUNHA, 1998, P.146)	92
TABLE 10 DISTRIBUTION OF MEDICAL REPORTS PER PATIENT, BY DOCUMENT TYPE AND WORD COUNT, WITH TOTAL WORD COUNT PER PATIENT	109
TABLE 11 COMPARATIVE COVERAGE OF DOMAIN-SPECIFIC AND MORPHOSYNTACTIC AND SEMANTIC FEATURES ACROSS THE TEXT2STORY, I2B2, AND MERLOT ANNOTATION SCHEMES.	112
TABLE 12 MEAN AND STANDARD DEVIATION OF THE RESULTS OBTAINED FROM THE EVALUATION OF THE SCHEMES/GUIDELINES BY THE ANNOTATORS.....	116
TABLE 13 IAA ON SPAN AND RELATION ANNOTATIONS (EXACT MATCH CRITERIA) BETWEEN ANN1, ANN2, AND THE CURATOR, BASED ON THE CURATED REFERENCE.....	117
TABLE 14 IAA SCORES ON EVENT ATTRIBUTES BETWEEN ANN1, ANN2, AND THE CURATOR, BASED ON THE CURATED REFERENCE	117
TABLE 15 IAA RESULTS FOR TIME EXPRESSION ATTRIBUTES BETWEEN ANN1, ANN2, AND THE CURATOR, BASED ON THE CURATED REFERENCE.....	118
TABLE 16 RESULTS OF IAA BETWEEN ANNOTATORS IN TLINKS AND TLINKS ATTRIBUTES	118
TABLE 17 DISTRIBUTION OF EVENT CLASSES (GENERAL EVENT) IN THE CORPUS	138
TABLE 18 DISTRIBUTION OF EVENT TYPES (GENERAL EVENT) IN THE CORPUS	140
TABLE 19 DISTRIBUTION OF VERB TENSES IN THE ANNOTATED EVENTS	141
TABLE 20 EVENT TYPE AND TLINKS	170

List of Charts

CHART 1 DISTRIBUTION OF ANNOTATION CATEGORIES (GENERAL EVENTS, SPECIALISED EVENTS, AND TEMPORAL EXPRESSIONS) IN THE CORPUS.....	136
CHART 2 DISTRIBUTION OF PART OF SPEECH IN GENERAL EVENTS	136
CHART 3 DISTRIBUTION OF SPECIALISED EVENT CLASSES IN THE ANNOTATED CORPUS	142
CHART 4 DISTRIBUTION OF PART-OF-SPEECH CATEGORIES IN THE SPECIALIZED EVENT	144
CHART 5 DISTRIBUTION OF TEMPORAL EXPRESSION TYPES IN THE ANNOTATED CORPUS	145
CHART 6 DISTRIBUTION OF TLINKS IN THE ANNOTATED CORPUS	146
CHART 7 DISTRIBUTION OF TLINKS ACROSS THE REPORTS OF PATIENT 1.....	150
CHART 8 DISTRIBUTION OF TLINKS ACROSS THE REPORTS OF PATIENT 2.....	151
CHART 9 DISTRIBUTION OF TLINKS ACROSS THE REPORTS OF PATIENT 3.....	153
CHART 10 DISTRIBUTION OF TLINKS ACROSS THE REPORTS OF PATIENT 4.....	154
CHART 11 DISTRIBUTION OF TLINKS ACROSS THE REPORTS OF PATIENT 5.....	155
CHART 12 DISTRIBUTION OF TLINKS ACROSS THE REPORTS OF PATIENT 6.....	156
CHART 13 DISTRIBUTION OF TLINKS ACROSS THE REPORTS OF PATIENT 7.....	157
CHART 14 DISTRIBUTION OF TLINKS ACROSS THE REPORTS OF PATIENT 8.....	158
CHART 15 DISTRIBUTION OF TLINKS ACROSS THE REPORTS OF PATIENT 9.....	159
CHART 16 DISTRIBUTION OF TEMPORAL RELATIONS IN GROUP CONSULTATION REPORTS.....	163
CHART 17 DISTRIBUTION OF TEMPORAL RELATIONS IN DISCHARGE REPORTS	166
CHART 18 DISTRIBUTION OF TEMPORAL RELATIONS IN GENERAL REPORTS	168

List of Abbreviations and Acronyms

AML	ACUTE MYELOID LEUKEMIA
BP	BRAZILIAN PORTUGUESE
CRPC	CORPUS DE REFERÊNCIA DO PORTUGUÊS CONTEMPORÂNEO (REFERENCE CORPUS OF CONTEMPORARY PORTUGUESE)
DRS	DISCOURSE REPRESENTATION STRUCTURES
DRT	DISCOURSE REPRESENTATION THEORY
EHR	ELECTRONIC HEALTH RECORDS
EP	EUROPEAN PORTUGUESE
IAA	INTER-ANNOTATOR AGREEMENT
IPO-PORTO	INSTITUTO PORTUGUÊS DE ONCOLOGIA DO PORTO (PORTUGUESE INSTITUTE OF ONCOLOGY OF PORTO)
LLMs	LARGE LANGUAGE MODELS
MCRs	MEDICAL CASE REPORTS
MR	MEDICAL REPORTS
NER	NAMED ENTITY RECOGNITION
NLP	NATURAL LANGUAGE PROCESSING
POS	PART OF SPEECH
TPPT	TEMPORAL PERSPECTIVE POINT
TLINKS	TEMPORAL LINKS
UMLS	UNIFIED MEDICAL LANGUAGE SYSTEM

Introduction

Electronic Health Records (EHR) contain large volumes of unstructured narrative text, which poses significant challenges for their organisation, curation, management, and effective reuse, both for clinical purposes and for research (Irrera et al., 2024, pp. 1–2). Given that an estimated 70–80% of the clinical information in EHR is text-based (Lindvall et al., 2022, p. 2), Natural Language Processing (NLP) techniques play a crucial role in automating the retrieval, processing, and extraction of relevant biomedical information (Irrera et al., 2024, p. 2). However, manual information extraction remains time-consuming and requires specialised clinical knowledge and extensive training to ensure high inter-annotator agreement (IAA). Moreover, in large-scale studies such as clinical trials, manual extraction may prove impractical, which reinforces the need for more efficient and scalable approaches (Lindvall et al., 2022, p. 2).

Even though implementing high-performance information extraction algorithms has become increasingly feasible due to major advances in NLP, the creation of high-quality annotated corpora for training and evaluating such models remains a significant challenge (Zhu et al., 2023, p. 1). Thus, the development of effective medical information extraction systems continues to depend on the availability of large, manually annotated datasets (Irrera et al., 2024, p. 2).

An additional challenge in annotating clinical data lies in the considerable heterogeneity of EHR content and writing styles across different hospitals (Zhu et al., 2023, p. 1), and even among departments within the same institution. Clinical texts are typically written in natural language, in a relatively unstructured and spontaneous manner, and cover a wide range of medical topics and concepts. During a patient's hospital stay, for instance, it is common to find different types of reports, such as admission notes and discharge summaries. Clinical texts differ significantly from non-clinical texts due to the specific nature of the domain and the frequent use of abbreviations, which increases the complexity of processing (Moharasan and Ho, 2019: 221). The [Unified Medical Language System \(UMLS\)](#) (National Library of Medicine, 2009), for example, integrates more than two million names for approximately 900.000 biomedical concepts from over 60 controlled vocabularies, along with 12 million

relationships between those concepts (Bodenreider, 2004, p. 267). Furthermore, biomedical terminology is highly complex, and certain terms may vary in meaning depending on the context in which they appear (Irrera et al., 2024, p. 2). Consequently, an information extraction system optimised for one hospital or department may encounter serious compatibility issues when applied elsewhere, often requiring extensive adaptation or the development of a new system altogether (Zhu et al., 2023, p. 1).

Another persistent problem is that most annotation schemes remain limited in scope, focusing primarily on Named Entity Recognition (NER). Moreover, the reliance on medical ontologies constrains the annotation of morphosyntactic and semantic features, highlighting the need for more comprehensive and multilingual annotation frameworks in clinical NLP (Fernandes et al., 2025b, p. 155).

From a linguistic perspective, medical reports can be understood as belonging to the broader category of clinical narratives. Medical reports may be regarded as clinical narratives because, despite their technical-scientific nature, they are structured around the exposition of events relating to the patient's clinical history. Like other types of narrative, they present a sequence of situations or eventualities — symptoms, examinations, diagnoses, treatments, outcomes —, which unfold over time and whose articulation constructs a coherent timeline. These narratives are not confined to a single document but are distributed across different types of reports, which, together, constitute the patient's record. Group consultation reports, discharge summaries, and general reports provide specific perspectives on distinct moments, which complement and interconnect in the configuration of an overall clinical narrative.

To gain a more comprehensive understanding of clinical narratives, particularly with regard to chronological information linked to the patient journey, it is essential to analyse the various types of medical reports generated throughout a patient's hospitalisation. A semantic analysis of inter-document temporal information, enabling the construction of a coherent chronological timeline of clinical events, would contribute with pertinent results within temporal semantics and represent a pioneering advancement and a valuable contribution to biomedical NLP tasks. On the one hand, the

study of the linguistics mechanisms underlying temporal organization in this type of text, a topic that remains unexplored in European Portuguese, can yield significant insights, filling a research gap and advancing knowledge in the field of semantics. On the other hand, temporal reasoning, and the extraction and interpretation of temporal information, is a crucial component of medical NLP systems (Sun, 2014, p. 2), and it is this topic that constitutes the focus of the present work.

The general aim of this study is to analyse the inter-document temporal organisation of clinical narratives in Portuguese. The relevance of this investigation to linguistics lies in the inherent complexity of how temporality is constructed and represented in medical reports. Temporal organisation, as a central dimension of semantics, mobilises a set of linguistic elements and structures — verb tenses, adverbs, temporal expressions, and temporal and discourse relations — which interact in intricate ways to configure the progression of events. Despite its importance, studies focusing on the configurational properties of medical reports remain scarce, or even non-existent, in Portuguese. By deepening the analysis of temporal semantics in clinical narratives, this work seeks not only to clarify the linguistic mechanisms that sustain temporal coherence but also to contribute to the characterisation of a textual genre of considerable social and scientific relevance, whose specificity has not yet been adequately explored.

More specifically, the proposed linguistic analysis focuses on how situations or eventualities are represented and temporally anchored in clinical discourse. It aims to identify their temporal and aspectual properties, namely the value of grammatical tense, aspectual classes, and other mechanisms of temporal anchoring, and to understand how these eventualities interrelate in the construction of the overall timeline of medical reports. This approach makes it possible to highlight the linguistic resources that underpin narrative progression and temporal coherence in this type of text.

Given the challenges described above, the following research question is proposed:

How is temporal information organised across different types of medical reports in clinical narratives?

To address this question, four main objectives are defined:

- 1) To critically analyse existing annotation schemes for the temporal annotation of clinical narratives;
- 2) To develop an extension of the Text2Story annotation scheme (Silvano et al. 2021; Leal et al., 2022) capable of representing temporal information – including events, temporal expressions, and the relations both among events and between events and temporal expressions – in medical reports in a comprehensive and informative way;
- 3) To enrich the Text2Story annotation scheme with additional attributes to improve the semantic characterisation of temporal expressions in clinical narratives;
- 4) To identify and describe the inter-document temporal properties of clinical narratives from the medical records written in Portuguese of nine patients diagnosed with Acute Myeloid Leukemia (AML) at Portuguese Institute of Oncology of Porto, Portugal (IPO-Porto).
- 5) To characterise the textual genre of medical reports, by deepening the analysis of temporal semantics in clinical narratives.

The corpus used in this study consists of 38 medical reports — comprising group consultation notes, discharge summaries, and general medical records —, containing the pseudonymised clinical histories of nine patients diagnosed with AML followed at IPO-Porto.

The structure of this thesis is as follows:

Chapter 1 discusses the concept of narrative and its evolution over time, including foundations, computational models, and medical applications. The discussion begins with the classical notion of narrative, progresses through its reinterpretation in computational contexts, and concludes with a discussion of medical reports as clinical narratives.

Chapter 2 focuses on theoretical notions of time and aspect. It begins with a discussion of the concepts of time, tense, and aspect, followed by a review of key theoretical approaches to tense. The chapter then examines tense and mood in the Portuguese verbal system and ends with an overview of major proposals on aspect.

Chapter 3 provides a literature review on clinical narratives. It begins with general considerations on annotation schemes — their foundations, development, and applications —, followed by a discussion of major proposals for the annotation of clinical narratives, with special attention to temporal annotation. The chapter concludes with a review of work on the annotation of clinical narratives in Portuguese.

Chapter 4 presents the empirical study. It defines the research problem, outlines the research questions and objectives, describes the methodology, characterises the corpus, and details the development and application of the annotation scheme. The chapter also includes an analysis and interpretation of the annotation results.

Chapter 5 offers final considerations and outlines directions for future research.

1. The Narrative: Linguistic, Computational, and Medical Perspectives

Narrative can be generically defined as the representation of events, real or fictional, through language, and more particularly through written language (Genette, 1973, p. 255). Thus, narrative can be broadly classified as literary or non-literary, oral or written, fictional or factual.

Although literary narrative, such as the novel, is often seen as the paradigm of this genre, narrative is also present in various communicative situations and contexts that extend far beyond the literary sphere. For this reason, the term “narrative” has become generalised within a wide spectrum of social sciences (Fludernik, 2011, p. 47), leading to the application of narratological paradigms to legal, media, financial, and, naturally, medical reports. This chapter explores the foundational aspects of narrative, its typological diversity within computational contexts, and its specific use in the medical domain.

The chapter is organised into three main sections. Section 1.1, “The Concept of Narrative: from Antiquity to Linguistics”, provides a historical and theoretical overview of narrative, tracing its evolution from classical philosophy to modern Linguistics. Section 1.2, “Types of Narratives in the Context of Computational Linguistics”, examines the various classifications of narrative forms and their relevance to natural language processing and information extraction. Finally, Section 1.3, “Medical Reports as Clinical Narratives”, focuses on clinical documentation as a specialised type of narrative, highlighting its structure, function, and importance for both healthcare practice, linguistics, and computational analysis.

1.1. The Concept of Narrative: from Antiquity to Linguistics

Narratives permeate various forms of human expression and represent one of the fundamental modes of interaction and communication among individuals. The narrative concept has its roots in Antiquity and has been defined and refined over time by various authors from different disciplines, including literature, philosophy, linguistics, and

computer science. The theoretical journey presented below reflects the evolution of the narrative concept, from its theorization as a form of imitation (*mimesis*) to the detailed analysis of its structures and functions in contemporary linguistics and computer science.

As previously mentioned, the concept of narrative was already outlined in the philosophical texts of Ancient Greece, particularly in the works of Plato and Aristotle. In Book III of *The Republic* (c. 375 BCE), Plato distinguishes between two modes of storytelling: simple narrative (*diagesis*), in which the narrator, referred to as the poet, directly recounts events, and narrative developed through imitation (*mimesis*), where the narrator assumes the roles of the characters, dramatizing their speech and actions (Plato¹, 2021, pp. 109-168). For Plato, narrative, especially in its mimetic form, carried ethical implications, as imitation could corrupt its audience.

Aristotle, in *Poetics* (c. 335 BCE), refined the distinction between narrative poetry and dramatic poetry, asserting that narrative (*diegematikón* or *apaggeltikón*) was one of the three genres of mimetic poetry, alongside the dramatic genre (*dramatikón* or *mimetikón*) and the mixed or common genre (*miktón* or *koinón*) (Aristotle, 2016, p. 132). For Aristotle, narrative is a form of imitation of events, with the *mythos* (myth) serving as the foundation the poet uses to craft the plot according to the principles of plausibility and necessity. Thus, the *mythos* relates to history, while the plot refers to poetry. In this sense, poetry is something more philosophical and more serious than history, for poetry tends to express the universal, while history tends to express the particular (Aristotle, 2016, p. 98).

During the late 4th and early 5th centuries, Saint Augustine, in *Confessions* (397–400 CE), explores how personal stories intertwine with the experience of time. This concept would later influence studies on narrative from both contemporary linguistic and modern narratological perspectives. In Book XI of the work mentioned above, Saint Augustine presents one of the most influential analyses of time, proposing that it is not an objective reality but a subjective experience deeply connected to the human mind.

¹The names “Plato”, “Aristotle” and “Saint Augustine” appear as “Platão”, “Aristóteles” and “Santo Agostinho” in the references, in accordance with the Portuguese translations consulted.

The author identifies three dimensions of time that correspond to narrative experience: past (*memoria*) – the time that has already been lived and is stored in memory; present (*intentio*) – the current moment of perception and action, which organises and transforms the past into discourse; and future (*expectatio*) – the time yet to come, which guides the narrative and directs it towards an end or purpose. For Saint Augustine, narrative reflects this temporal structure. The organisation of events into a narrative plot mirrors how the human mind experiences and makes sense of time, uniting past, present, and future into a comprehensible continuum (Saint Augustine, 2008, pp. 423–468). Although Saint Augustine wrote centuries before the emergence of linguistics as a formal discipline, his ideas laid the groundwork for contemporary narrative studies, particularly in approaches that connect language, time, and cognition, influencing authors such as Jean-Michel Adam. During the Middle Ages, narrative was closely linked to theology and pedagogical purposes, serving as a medium for conveying religious and moral teachings. During the Renaissance, the connection between narrative and religion began to weaken, shifting away from exclusively theological explanations and placing greater emphasis on the individuality of human experience. By the Enlightenment, narrative was regarded as a tool for organising and transmitting knowledge, with philosophers such as David Hume (2001), in *A Treatise of Human Nature* (1739–1740), and Immanuel Kant (1987), in *Critique of Pure Reason* (1781), reflecting on the relationship between causality – a central element of narrative – and the construction of human knowledge.

The rise of neoclassical standards significantly reduced the diversity of narrative strategies, and the conception of narrative was shaped to align with the neoclassical rules of narrative construction. During this period, the definition of narrative was adjusted to favour the novel as a dominant form, while many earlier narrative traditions lost prestige and were no longer deemed relevant. Genres such as romance, epic, pastoral, sacred history, fabliau, and other comic tales were excluded from the definition of narrative due to the changes brought about by the emergence of the novel (Altman, 2008, p. 4).

The late 19th and early 20th centuries were marked by attempts to systematise the understanding of narrative as a discursive structure and an organising element of human experience. In *The Interpretation of Dreams* (1899), Sigmund Freud (1999) employs narrative to comprehend the unconscious. Freud explores how personal accounts and dreams follow narrative structures, revealing internal conflicts and repressed desires.

During the 20th century, narrative became an object of interdisciplinary study, emerging as a concept explored in linguistics and computer science through the development of structural and typological models. Ferdinand de Saussure (1999), in *Course in General Linguistics* (1916), although not directly addressing the concept of narrative, laid the foundations of structuralism by emphasising the relationship between the signifier and the signified, as well as the relationship between the syntagm and the paradigm. These concepts were fundamental to the understanding of linguistic structures and had a significant influence on subsequent studies of narrative. Vladimir Propp (1968), in *Morphology of the Folktale* (1928), was a pioneer in studying Russian folktales from a functional perspective. Propp identified 31 narrative functions, recurring elements that could be combined in different stories, establishing a foundation for analysing narratives as regular and predictable systems. Propp's analysis of narrative functions made significant contributions to the advancement of computational linguistics and artificial intelligence by providing a structured model for extracting narrative patterns, thereby enabling the automated analysis of deep structures within complex datasets (Finlayson, 2016, pp. 55-56).

In the 1960s, structuralism brought new perspectives to the study of narrative. A. J. Greimas, in *Structural Semantics* (1966) (Greimas, 1977), introduced the concept of the semiotic square and proposed models for analysing the relationships between narrative elements. Greimas developed the actantial model, which describes narrative in functional roles: subject, object, sender, receiver, helper, and opponent. This model provides a powerful tool for narrative analysis by reducing the essential elements of stories to a logical structure that can be applied to various texts and genres.

Roland Barthes also played a pivotal role in structural narratology. In his essay "Introduction to the Structural Analysis of Narrative" (1966), Barthes (1975) argues that

all narratives share a common structure, regardless of their cultural or historical diversity. The author contends that the world is filled with countless forms of narratives and that there exists “a prodigious variety of genres, each of which branches out into a variety of media, as if all substances could be relied upon to accommodate man’s stories. Among the vehicles of narrative are articulated language, whether oral or written, pictures, still or moving, gestures, and or ordered mixture of all those substances” (Barthes, 1975, p. 237).

G rard Genette, in *“Boundaries of Narrative”* (1966), defined narrative as the depiction of one or more events, whether real or imaginary, conveyed through language, especially in written form (Genette, 1973, p. 255). This essay marks a foundational step in the theorisation of narratology, introducing fundamental concepts that Genette would later develop in *Figures III* (1972). Claude Bremond (1973), in the essay “The Logic of Narrative Possibilities” (1973), develops a formal approach to narrative analysis, proposing a model based on the possibilities of choices and actions available to characters within a story. Bremond argues that all narrative consists of a discourse that organises a sequence of events of human relevance into the unity of a single action. He further emphasises that temporal succession is a necessary condition for narrative to exist. In its absence, the text takes on other discursive forms — such as description, when elements are grouped based on spatial contiguity; deduction, when logical implication is at play; or lyrical effusion, when contents are linked metaphorically or metonymically. Likewise, if there is no integration of events into a coherent action, the result cannot be considered a narrative, but merely a chronology, that is, an enumeration of uncoordinated facts (Bremond, 1973, p. 114).

Still from a structuralist perspective, the work *Story and Discourse: Narrative Structure in Fiction and Film* (1978), by Seymour Chatman (2002), offers a comprehensive and interdisciplinary analysis, integrating literary and film studies, and provides a theoretical model for understanding narrative as a complex structure. The author defines narratives as structures composed of two interdependent levels. The first level is the *story*, which encompasses the narrative content, the chain of events (actions and occurrences), and the static elements, such as characters and settings. The second

level is the *discourse*, which concerns how the story is communicated. This level includes the means and modes of expression employed, whether through verbal language (oral or written), visual language (images), or performative representations (such as theatre).

In *Temps et Récit*, a seminal work published in three volumes between 1983 and 1985, Paul Ricoeur (1994) develops a profound philosophical conception of narrative, exploring its relationship with time and human experience. The notion of narrative in this work goes beyond structuralist or formalist approaches, focusing on the philosophical and existential dimensions of storytelling. Drawing on *Confessions* by Saint Augustine and Aristotle's *Poetics*, Ricoeur makes a significant contribution to narrative studies by reinforcing the intrinsic relationship between narrative and temporality.

Throughout the 20th and 21st centuries, linguistics has provided theoretical and methodological tools for exploring narrative in different contexts. William Labov and Joshua Waletzky, in *Narrative Analysis* (1967), defined narrative from a functional perspective, considering it "one verbal technique for recapitulating experience, in particular, a technique of constructing narrative units which match the temporal sequence of that experience" (Labov and Waletzky, 1967, p. 13).

In the 1980s, Jean-Paul Bronckart (1985, 1996) developed the framework of Socio-Discursive Interactionism, conceived in the continuity of the theoretical positions of Benveniste, Weinrich and Genette. Within this framework, each textual genre is organised into recurrent segments, referred to as *discursive types*. These reflect two fundamental possibilities of language use: exposition or narration, which may be either connected to (implication) or detached from (autonomy) the situation of enunciation. From the articulation of these dimensions emerge four discursive types: interactive discourse (implication and temporal conjunction), interactive report (implication and temporal disjunction), theoretical discourse (autonomy and temporal conjunction), and narration (autonomy and temporal disjunction).

Jean-Michel Adam, in *Les Textes: Types et Prototypes* (1992), was one of the first linguists to present a formal definition of narrative, describing it as a prototypical sequence characterised by a thematic unity, involving a chronological succession of events in which characters participate (Adam, 1992, p. 45-72). Gerald Prince, in *A*

Dictionary of Narratology (1987), reinforces the idea of narrative as a chronological sequence of events, defining it as “the recounting (as product and process, object and act) of one or more real or fictitious events communicated by one, two, or several (more or less overt) narratees” (Prince, 1989, p. 58).

Zacks and Tversky (2001) define narrative in terms of the temporal structure of events, drawing on various fields of research to analyse how people use event structures in perception, comprehension, planning, and action. Zhang et al. (2019) add that narratives play a crucial role in understanding social processes, particularly because they are often embedded within other narratives. In particular, a narrative may include multiple accounts presented by different individuals, who may be either directly involved or external observers. This phenomenon is especially evident in journalistic articles, where reported events often receive commentary or reflections from different perspectives.

With regard to Portuguese authors, particular attention should be given to the work of Antónia Coutinho (2008), who analyses discourse markers in European Portuguese that privilege either the order of exposition or the order of narration, thereby corresponding to different discursive types. In another study, the same author argues that every empirical text is associated with a genre, which it simultaneously adopts and adapts (Coutinho, 2007, p. 645). Silva (2006) investigates the temporal and aspectual properties of four types of textual sequences — narrative, descriptive, explicative, and argumentative — drawing on a corpus of European Portuguese. His analysis combines Vendler’s (1967) classification of situation types with the theoretical framework of Kamp and Reyle’s (1993) Discourse Representation Theory. Finally, Gonçalves and Miranda (2007) discuss the distinction between two complementary approaches, textual analysis and genre analysis, emphasising the theoretical and methodological implications of this differentiation.

Despite the variations in narrative definitions over time and across different disciplinary perspectives, a common element in all of them is the emphasis on *story-level phenomena* (also referred to as *diegesis*), meaning the structure of events unfolding in a narrative (Piper et al. 2021, p. 299). However, it is important to note that

the definition of narrative is not yet fully stabilised, remaining open to interpretation and debate. This flexibility reflects the complexity of the concept, which continues to evolve and be explored in both classical contexts and contemporary research, including *Computational Linguistics*.

In this work, narrative is considered a form of communication that involves telling a story in which events and actions are organized either sequentially or non-sequentially to convey a message or meaning.

1.2. Types of Narratives in the Context of Computational Linguistics

The study of narrative from the perspective of computing and information processing is grounded in a field known as *Computational Narratology* (Mani, 2014, p. 84). According to Mani (2014, p. 84), “Its scope includes the approaches to storytelling in artificial intelligence systems and computer (and video) games, the automatic interpretation and generation of stories, and the exploration and testing of literary hypotheses through mining of narrative structure from corpora”.

Computational Narrative Extraction falls within *Computational Narratology* and refers to a process that applies computational tools and techniques to identify, relate, and visualise narrative elements in texts. This field is considered a subdomain of Artificial Intelligence, making intensive use of various technologies: *Information Retrieval* — to facilitate users’ access to relevant information; *Text Summarisation* — to synthesise essential and complementary data within narratives; *Natural Language Processing* (NLP) — to identify, extract, and establish connections between narrative elements; and *Natural Language Generation* — to create structured text from data (Santana et al., 2023, p. 8396).

Various types of narratives from different fields of knowledge have been the focus of study within the scope of computational narratology, reflecting the growing attention devoted to the automatic modelling of narrative structure.

Within this framework, the legal domain has received particular attention. Narrative plays a central role in law, functioning as a tool for communicating the law and justifying adjudicative acts (Fludernik, 2011, p. 47). As Olson (2014, p. 371) noted, “law has been regarded as narratively based and culturally embedded”, highlighting the role linguistics

can play in understanding legal discourse. In this context, Computational Linguistics, through Natural Language Processing (NLP), has been assisting in the analysis and optimisation of legal processes, alleviating bureaucratic complexity (Zhong et al., 2020, p. 5218).

The annotation of events and temporal expressions, as well as the establishment of a timeline, has proven to be a crucial tool in predicting legal decisions in criminal cases, as demonstrated by Zhong et al. (2020). These authors discuss the importance of NLP in reconstructing chronologies in collective crimes, in order to determine the actions of each individual. Furthermore, the extraction of semantic information has also proven to be relevant in legal charge prediction. As shown by Feng et al. (2023), this task involves predicting the guilty party in new cases based on the analysis of historical information extracted from sentencing documents, aiding judges in their decisions.

News, similarly, can often take the form of a story, constituting one of the main types of narrative in the context of communicating factual information. Journalistic narratives report current events, involving one or more entities in a specific time and place (Silvano et al., 2021, p. 2) and are characterised by a relatively fixed structure that prioritises objectivity, clarity, and conciseness. Moreover, journalistic narratives often contain embedded narratives that complement or clarify the main event, and may also feature multiple accounts provided by different agents and external observers.

Most journalistic narratives incorporate the structure of the “inverted pyramid”, corresponding to a top-down organisation where the most important information is presented at the beginning of the story, followed by secondary details and additional context (Pöttker, 2003, p. 502). Zahid et al. (2019, p. 71-72) highlight that these narratives have a complex temporal structure, where events are often presented in a non-chronological order. In this context, entity recognition and temporal annotation play a fundamental role. The extraction of journalistic narratives in an automated format has been explored in projects such as *Text2Story – Extracting Journalist Narratives from Text and Representing Them in a Narrative Modeling Language*² and *StorySense*:

²<https://text2story.inesctec.pt/>

*Uncovering Deeper Layers of Narrative Understanding*³. These projects aim to develop the conceptual framework and operational pipeline to extract narratives from textual sources. They focus on the automatic processing of journalistic texts written in European Portuguese, with the goal of extracting news narratives, representing them in intermediate data structures, and making them available for subsequent media production processes (Leal et al., 2022, p. 61).

Within the scope of this project, the *Text2Story Annotation Scheme* (Leal et al., 2022; Silvano et al. 2021, 2024) was developed, a multilayer semantic annotation approach that combines morphosyntactic and grammatical data, aligned with the ISO – 24617 standards, as a crucial tool for linguistic analysis. Additionally, the *Text2Story Lusa datasets* (S. Nunes et al., 2024) were published, consisting of a collection of news articles in European Portuguese annotated according to the guidelines of this scheme.

The computational analysis of narratives faces considerable challenges, such as the need to interpret temporal structure and the ambiguity of relationships between events. However, it also offers significant opportunities, such as automating the extraction of information and improving the accessibility and organisation of large volumes of narrative data. Computational Linguistics, when dealing with such issues, continues to expand its applications across various domains, including law and journalism, providing innovative tools that facilitate the processing and understanding of complex narratives.

1.3. Medical Reports as Clinical Narratives

The relationship between narrative and medicine is deeply rooted in clinical practice, reflected both in the way healthcare professionals interpret patients' symptoms and in how the patients themselves construct and communicate their experiences of illness. In this context, Rishi Goyal, in the chapter "Narration in Medicine" of the *Handbook of Narratology*, defines narration in medicine as follows:

"Narration in Medicine is concerned with the function and analysis of the multiple narratives produced in the context of clinical care and the healing of illness. The study of medicine and narrative can be described along three general lines: narration in the medical cognition and clinical care; formal analysis

³<https://storysense.inesctec.pt/>

of patient narratives of illness; research of the uses of narrative as a clinical treatment or model for medical care.”

(Goyal, 2014, p. 406)

From this definition, three main axes that interconnect narrative and medicine can be identified. The first axis refers to the way in which doctors and other healthcare professionals process and organise clinical information through a narrative structure. Medical practice is not based solely on objective and factual data, but also on the interpretation of signs and symptoms within a coherent and sequential context. Just as a reader reconstructs the timeline of a story from scattered events, the clinician arranges the patient's complaints in a logical sequence to formulate a diagnosis and a treatment plan. In this sense, the medical report can be understood as a narrative, as it establishes a temporal progression of events, including the clinical past (personal medical history), the present of the consultation (physical examination and complementary tests), and projections for the future (prognosis and treatment plan). The patient's story is interpreted and integrated into a discourse that allows for medical decision-making.

The second axis focuses on how patients themselves construct and communicate their experiences. Illness is not just a biological event, but also a subjective experience that patients translate into words, often using metaphors and narrative structures to express the impact of the disease on their lives. The study of these narratives allows us to understand how patients attribute meaning to their condition, how they perceive their relationship with doctors, and how they emotionally cope with the diagnosis.

In medical reports, these narratives are often reconfigured and translated into technical language, adapting to the conventions of biomedical discourse. However, recognising this transformation is essential to maintaining the human and communicational dimension in medicine.

The third axis concerns the therapeutic potential of narrative in medicine. The act of telling one's own story can have a healing effect for the patient, helping them reorganise their experience and make sense of it. For the healthcare professional, understanding the illness within a narrative structure can aid in personalising treatment, improving communication between doctor and patient.

Medical reports, by documenting the evolution of the illness and the response to treatment, function as an ongoing narrative, with each new report adding chapters to the patient's clinical story. Narrative continuity allows different healthcare professionals to understand the patient's clinical journey, promoting an integrated and longitudinal approach to care.

Several studies argue that narrative plays a central role in the diagnosis and treatment of diseases. Murphy et al. (2016) state that "narrative medicine is tied intimately to the so-called linguistic turn, that is, the theoretical maneuver that identifies language as instrumental to how behavior or events are perceived". Charon (2001) also emphasizes the healing power of narratives in medicine, asserting that the effective practice of medicine requires narrative competence, that is, the ability to recognize, absorb, interpret, and act upon the stories and difficulties of others.

As discussed in section 1.1, narrative can be defined as a prototypical sequence of events characterised by a thematic unity, located in time and space, in which characters participate. In fact, medical reports fit this definition as they have a thematic unity – the patient's health condition –, a chronological sequence of events, where the past is recorded in the personal medical history, the present in the current illness history, and the future in treatment plans, and multiple characters. The protagonist of these narratives is the patient, and the clinician is the author and narrator of the story, "observing and conveying events experienced by the patient protagonist" (Brender et al., 2024, p. 1). Additionally, clinical narratives are well anchored in time (through references to admission and discharge dates) and space (references to the hospital and department where the consultation or hospitalisation took place, or where the patient was transferred).

Moreover, Brender et al. (2024) argue that recognizing clinical notes as narratives highlights the role of subjectivity, which, instead of being eliminated, should be consciously integrated into the development of Large Language Models (LLMs) to promote humanized care and awareness of biases.

In this way, understanding clinical narratives is essential for the improvement of medical practice, both in terms of communication and the integration of technologies

into healthcare. At the same time, these narratives constitute a highly relevant object of study for Linguistics, as their intricate temporal organisation poses significant challenges for the study of temporal semantics. Examining how events are temporally anchored and interrelated not only advances our understanding of linguistic features but also contributes to the linguistic characterisation of this textual genre, while providing a foundation for computational applications that support information extraction and the reconstruction of patient trajectories.

2. Temporal and Aspectual Features

The concepts of time, tense, and aspect occupy a central place in linguistic theory, particularly in the study of how languages encode temporal information. *Time* may be understood as a universal cognitive category, referring to the continuum within which events occur, while *tense* and *aspect* function as grammatical and lexical devices that allow speakers to situate and structure eventualities temporally. In this context, the term *eventualities* will be used to designate semantic units that represent situations in the world, whether real or possible, to which a linguistic expression may refer. It thus functions as a cover term for *events* and *states* (Bach, 1986, p. 62).

This chapter explores these three interrelated notions, providing an overview of key theoretical approaches to tense and aspect in the sections that follow. Section 2.1 examines the concepts of time, tense, and aspect in general terms. Section 2.2. focuses on major theoretical proposals concerning tense, while Section 2.3. addresses the tense system of European Portuguese. Finally, Section 2.4. presents the main approaches to Lexical Aspect and Aspectual Classes.

2.1. The Concept of Time, Tense, and Aspect

Time, as a conceptual category, is generally divided into three main intervals: past, present, and future. These divisions reflect the human cognitive tendency to structure and interpret events in relation to a deictic centre — typically, the moment of utterance. Conceptually, according to Comrie (1985, p. 2), time may be represented as a straight line (see Figure 1), with the past conventionally placed on the left, the future on the right, and the present marked by a point designated as the zero point.

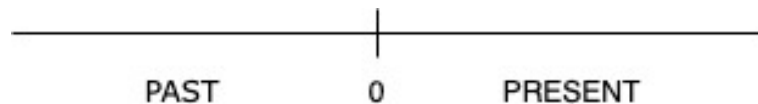


Figure 1 Representation of time (Comrie, 1985, p. 2)

Events occurring before the deictic centre are positioned to the left of this point, whereas those occurring afterwards are located to its right. When an event takes place during the duration of another process, it is temporally situated within the interval

defined by that process. This diagrammatic representation of time enables a more precise linguistic account of grammatical tense (Comrie, 1985, p. 2). In the same vein, Declerck (1991, p. 16) defines time as follows:

“From the point of view of physics, time is a unidirectional continuum, which may be represented by a line (the ‘time line’) and which consists of two parts, the past and the future, separated by the present. The present is no more than a point which divides the past from the future; it has no extension, and it continuously moves from left to right on the time line.”

(Declerck, 1991, p. 16)

Philosophical and linguistic traditions have long debated whether time is an objective feature of reality or a construct of human cognition. The representation proposed in Figure 1 is deliberately open-ended, avoiding any delimitation of the temporal line either to the left (past) or to the right (future). Although this issue bears considerable weight in philosophy, it is not the primary focus of linguistic analysis (Comrie, 1985, p. 3).

Regardless of its ontological status, time provides the conceptual foundation upon which grammatical tense and aspect in natural languages are built. Tense is a linguistic category corresponding to the grammatical encoding of time. While time belongs to the realm of conceptual cognition, tense refers to the linguistic means used to encode temporal relations, typically indicating when an event occurs in relation to the moment of utterance (Comrie, 1985, pp. 2–3).

In many languages, tense is marked morphologically through verbal inflection. Consider the following examples from English:

(1)

a. **Past:** *She lived in Porto.*

This sentence uses the simple past form “lived”, which is a morphologically inflected form of the verb *to live*.

b. **Present:** *She lives in Porto.*

The verb “lives” is inflected for the third person singular in the present tense (-s suffix).

c. **Future:** *She will live in Porto.*

English does not have a morphological future tense; instead, it uses a periphrastic construction involving the modal auxiliary *will* and the base form of the main verb (*live*).

Languages display considerable variation in their systems of tense. Some, such as English and Portuguese, possess relatively rich grammatical paradigms in this domain. Others, such as Mandarin Chinese, do not grammatically encode tense and instead rely on contextual cues and temporal adverbs to convey temporal information (Enç, 1997, p. 345).

While the notions of time and tense are relatively familiar to most people, the concept of aspect tends to be less well known. Its discussion dates back to Ancient Greece, although it was not then understood in its current form, nor treated as a category distinct from tense. Nevertheless, Greek grammarians already recognised that the difference between the Imperfect and the Aorist did not coincide with the difference between the Imperfect and the Present (Binnick, 1991, p. 135).

Despite constituting an essential component of any semantic theory, aspect remains a complex and difficult-to-define category (Cunha, 2004, p. 9). Broadly speaking, aspect conveys information about the “perspectivisation” or “focalisation” of the internal temporal structure of predications (Cunha, 2004, p. 10). According to Comrie (1976, p. 3), aspect concerns the different ways of conceiving the unfolding of a process: whether it is viewed as completed, ongoing, repeated, habitual, among other possibilities. It is, therefore, a linguistic category that focuses on the internal structure of the temporal situation described, distinguishing, for instance, whether the event has a defined endpoint or is presented as durative, iterative, or unfinished.

Consider, by way of illustration, the sentences in Portuguese in (2). In these examples, both the Present and the Imperfect of the Indicative indicate the temporal location of eventualities — present and past, respectively — yet they also operate on an aspectual level. In both cases, the reading produced is habitual, that is, it refers to a repeated or regular occurrence of the represented situation (Cunha, 2004, p. 11):

(2)⁴

- a. O doente fuma.

The patient smokes.

- b. A doente fumava

The patient used to smoke.

Although there are close links between tense and aspect, these two categories must be analysed separately, as they exhibit significant differences. Tense is a relational category used to situate eventualities with respect to other moments, such as the moment of utterance or other intervals mentioned in discourse. Aspect, on the other hand, is more autonomous and focuses on the internal structure of the eventualities, without recourse to external information. While tense views eventualities from the outside, aspect examines them from within, and is thus considered “subatomic”, as it penetrates the temporal composition of the predicate. Tense, by contrast, treats eventualities atomically — that is, as indivisible units. Accordingly, despite certain interactions between them, tense and aspect should be understood as distinct and independent semantic categories (Cunha, 2004, p. 12).

According to Dowty (1979, p. 52), aspect differs from tense in semantic terms: while tense locates an eventuality in relation to the time of speaking (for example, in the past, present, or future), aspect provides information about the internal structure of the event itself. Aspectual markers indicate, for instance, whether the speaker is referring to the beginning, middle, or end of the eventuality; whether the eventuality is a one-off or repeated occurrence; and whether it is completed or potentially still ongoing.

The distinction between time, tense, and aspect is, therefore, fundamental to understanding how languages encode temporal information. While time is a conceptual category, tense and aspect function as linguistic mechanisms that structure and organise temporal meaning. Beyond their theoretical relevance, the study of these categories has

⁴In example (2a), the present tense is used, with a habitual reading that indicates an eventuality continuing to take place in the present. In example (2b), the *Pretérito Imperfeito* (Simple Past *Imperfectum*) is used, which also conveys a habitual reading, but referring to an eventuality that used to occur in the past. However, this verb form may also allow for a progressive or durative reading in other type of structures, similar to the English construction *was smoking*.

important practical applications, particularly in fields such as machine translation and clinical text processing, where precise temporal interpretation is crucial.

2.2. Theoretical Approaches to Tense

This Section undertakes a critical analysis of some of the main theoretical approaches to the category of tense. It begins with Jespersen's (1924) pioneering account, followed by the foundational contributions of Reichenbach (1947), Comrie (1985), and Declerck (1991), concluding with the formal perspective developed by Kamp and Reyle (1993). The aim is to outline an evolutionary and comparative trajectory of the various conceptions of tense within theoretical linguistics.

2.2.1. Jespersen (1924)

The works of the Danish grammarian Otto Jespersen mark a fundamental turning point in the treatment of verbal tense during the early decades of the twentieth century. Regarded as one of the most influential figures in the study of the English language, Jespersen represents both the culmination of the classical grammatical tradition and the beginning of a modern, scientific approach to grammatical description. His research breaks with traditional models and introduces new analytical perspectives on verbal structure, the implications of which continue to shape contemporary linguistics. Many of the theoretical questions he posed remain, even today, without definitive answers (Binnick, 1991, pp. 53–54).

Jespersen may be characterised as a structuralist with a descriptivist and empiricist orientation: he sought to ground his analyses in observable data, rejecting approaches based on a priori categories. Nonetheless, he was also a universalist. In *The Philosophy of Grammar* (1924), Jespersen endeavoured to identify a set of linguistic universals — that is, generalisations applicable to all human languages. According to Jespersen, it is only through an understanding of the properties of language in general that one can adequately describe the characteristics of individual languages (Binnick, 1991, p. 54).

In the words of Binnick:

“Jespersen was able for the first time to reconcile a universal, rational system with particular facts, without at the same time either distorting the facts or trivialising the relationship between them and the theoretical concepts. He achieved this because he was able to go a long way toward reconciling the

seemingly contradictory theories of multiple past theory, Varronian tense-aspect theory, and relative tense theories, accommodating all three within a coherent, consistent theory of tenses.”

(Binnick 1991, p. 54)

One of Jespersen’s central contributions was his explicit distinction between form, function, and notional meaning, enabling him to resolve the apparent incompatibility between formal devices and semantic categories (Binnick, 1991, p. 54). In his view, a functional category may serve several purposes. The present tense, for instance, is a functional category that may encompass various notions: it can be used to speak of a universal truth, a future occurrence, or a present-time situation (Silvano, 2002, p. 8).

In pursuit of a clear, coherent, and universal functional system, Jespersen proposes a linear representation of time based on three principal divisions — past, present, and future — which correspond to the grammatical tenses of past, present, and future (Figure 2). To this basic temporal axis, he adds “intermediate” tenses, such as the *before-past* (pluperfect), *after-past* (future-in-the-past), *before-future* (pre-future), and *after-future* (post-future) (Figure 3) (Jespersen, 1968, pp. 256–257).

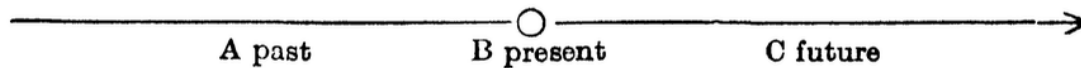


Figure 2 The three main divisions of time (Jespersen, 1968, p. 257)

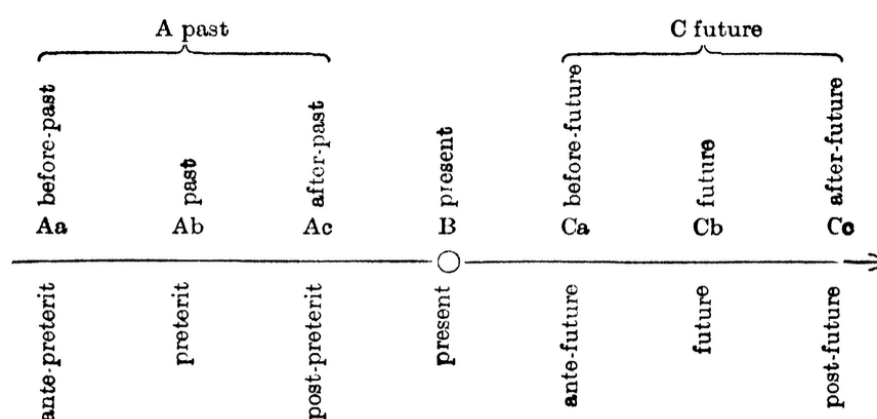


Figure 3 The insertion of the intermediate "times" (Jespersen, 1968, p. 257)

In Jespersen’s model, there are only *times*, or conceptual temporal points; grammatical verb tenses serve merely to represent these in a unidirectional manner.

Each verb tense is defined spatially in relation to the *present time*, being positioned a certain number of units to the left or right of this reference point. Thus, all verb tenses are anchored, either directly or indirectly, to the moment of utterance — the speaker's *now* — that is, from a strictly deictic perspective (Binnick, 1991, pp. 60–61).

2.2.2. Reichenbach (1947)

Hans Reichenbach's *Elements of Symbolic Logic* (1947) constitutes a fundamental milestone in the formalisation of the temporal structure of language. One of the most influential contributions of this work is the distinction between three essential temporal points: the point of utterance (*speech time*), the point of the event (*event time*), and the point of reference (*reference time*), the latter conceived as the temporal "point of view". These three points are represented by the letters S (speech), E (event), and R (reference), and their various combinations and relations are employed to characterise different verbal tenses and aspects.

The interplay among these three points allows for the systematic representation of all possible grammatical tenses. The reference time may precede, follow, or coincide with the speech time, just as the event point may occur before, after, or simultaneously with the reference point. In so-called absolute tenses — such as the present, the simple past, and the future — the points R and E coincide, whereas relative tenses are defined through the relations among R, S, and E.

Reichenbach employs the *past perfect* to illustrate how these three temporal dimensions interact:

"Let us call the time point of the token the point of speech. Then the three indications, 'before the point of speech', 'simultaneous with the point of speech', and 'after the point of speech', furnish only three tenses; since the number of verb tenses is obviously greater, we need a more complex interpretation.

From a sentence like 'Peter had gone' we see that the time order expressed in the tense does not concern one event, but two events, whose positions are determined with respect to the point of speech.

We shall call these time points the point of the event and the point of reference. In the example the point of event is the time when Peter went; the point of reference is a time between this point and the point of speech. In an individual sentence like the one given it is not clear which time point is used as the point of reference. This determination is rather given by the context of speech."

(Reichenbach, 1947, p. 288)

In this theory, the meaning of the past perfect entails reference to three distinct temporal points. Accordingly, the sentence "Peter had gone" corresponds to the

sequence E–R–S, in which the event precedes the reference time, which in turn precedes the speech time. The simple past tense (for example, “ate”), by contrast, is represented by the configuration E,R–S, indicating that the event and the reference time coincide, and both occur prior to the speech time.

The interplay between the three temporal points identified by Reichenbach — the point of speech (S), the point of reference (R), and the point of the event (E) — theoretically allows for thirteen distinct combinations. However, Reichenbach’s system accounts for only nine fundamental forms (Table 1). The author justifies this reduction in the number of possibilities on the basis of the following reasoning:

“We choose the point of speech as the starting point; relative to it the point of reference can be in the past, at the same time, or in the future. This furnishes three possibilities. Next we consider the point of the event; it can be before, simultaneous with, or after the reference point. We thus arrive at $3 \times 3 = 9$ possible forms, which we will call fundamental forms. Further differences of form result only when the position of the event relative to the point of speech is considered; this position, however, is usually irrelevant.”

(Reichenbach, 1947, p. 296)

Table 1 Reichenbach’s temporal system (with dashes representing a temporal interval and commas indicating simultaneity)

Structure	New Name	Traditional Name	Temporal Relation between E, R and S
E – R – S	Anterior Past	Past Perfect	Event precedes the reference point, which precedes speech
E, R – S	Simple Past	Simple Past	Event and reference coincide, both precede speech
R – E – S	Posterior Past	-	Event follows reference, both precede speech
R – S, E			Reference precedes speech, which coincides with event
R – S – E			Reference precedes speech, which precedes event
E – S, R	Anterior Present	Present Perfect	Event precedes speech, which coincides with reference
S, R, E	Simple Present	Present	Event, reference and speech coincide

S, R – E	Posterior Present	Simple Future	Speech and reference coincide, followed by event
S – E – R	Anterior Future	Future Perfect	Speech precedes event, which precedes reference
S, E – R			Speech and event coincide, followed by reference
E – S – R			Event precedes speech, which precedes reference
S – R, E	Simple Future	Simple Future	Speech precedes reference, which coincides with event
S – R – E	Posterior Future	-	Speech precedes reference which precedes event

This model enables a precise description of the temporal distinctions conveyed by verbal tenses, by incorporating a referential dimension that proves essential for the semantic interpretation of verbal forms. Reichenbach, thus, proposes an analysis that transcends the simple dichotomy of past, present, and future, introducing a tripartite system that accounts for both absolute and relative tenses.

This multidimensional system also accommodates progressive verbal forms, referred to as *extended tenses* in Reichenbach's terminology (1947, p. 290). These forms introduce an additional dimension related to the duration of the event. In this regard, the author observes that:

“In some tenses, an additional indication is given concerning the time extension of the event. The English language uses the present participle to indicate that the event covers a certain stretch of time.”
(Reichenbach, 1947, p. 290)

Thus, the temporal schemes of progressive forms differ from those of their non-progressive counterparts solely with respect to point E, which, in the case of progressives, is not represented as a single point on the timeline but rather as an extended interval of time.

In summary, Reichenbach's temporal model offers a systematic and rigorous representation of the temporal structure of verbal tenses, by articulating three fundamental parameters — the point of speech, the point of reference, and the point of the event — whose combinations account for both absolute and relative tenses. The

introduction of this tripartite distinction overcomes limitations inherent in linear approaches to verbal temporality, enabling a more refined account of the semantic nuances conveyed by language. Furthermore, the model's flexibility is demonstrated in its capacity to accommodate progressive verb forms, through the conceptualisation of point E as a temporal interval. This framework strengthens the analytical robustness of Reichenbach's proposal, whose relevance endures in contemporary studies of linguistic temporality.

2.2.3. Comrie (1985)

The theory of verbal tense developed by Bernard Comrie, as presented in his work *Tense* (1985), proposes a descriptive and functional approach centred on the temporal relationship between the moment of speech (S) and the point or interval in which the situation is located, referred to as the moment of the event (E). According to the author, tense constitutes a grammatical category whose primary function is to locate a situation in time relative to a reference point, which in most cases corresponds to the moment of utterance (Comrie, 1985, p. 122). This conception highlights the deictic nature of tense, emphasising its dependence on a temporal orientation centre external to the linguistic situation.

With regard to absolute tenses, Comrie identifies three fundamental temporal values, based on the binary relationship between the moment of speech (S) and the moment of the event (E) (Comrie, 1985, pp. 122–123):

Present: when the event is simultaneous with the moment of speech ($E = S$)

Past: when the event occurs before the moment of speech ($E < S$)

Future: when the event occurs after the moment of speech ($S < E$)

In addition to this basic typology, Comrie (1985) introduces the distinction between absolute and relative tenses, in line with Reichenbach's (1947) seminal framework for the temporal anchoring of verbal forms. While absolute tense establishes a direct relationship between the event and the moment of utterance, relative tense is characterised by describing the relationship between the event and a temporal reference point (R), which may not coincide with the moment of speech (Comrie, 1985,

p. 124). Thus, in the formal representation of absolute tenses, only the points S and E are involved, whereas in relative tenses, R is introduced as an intermediary.

This distinction proves particularly useful in the analysis of indirect speech structures and compound tenses. For instance, in the sentence “He said that he would leave the next day”, the event “leave” is projected into the future relative to the point of “said”, but this projection is not necessarily future with respect to the moment of utterance.

From this perspective, Comrie (1985, pp. 124–125) describes relative tenses as follows:

Relative present: E simultaneous with R

Relative past: E anterior to R

Relative future: E posterior to R

Comrie further proposes a third category — absolute-relative tenses — which simultaneously involve anchoring to the moment of utterance and locating the event in relation to a reference point that does not coincide with that moment. An example is the *pluperfect* in English, where the reference point is situated in the past (prior to the moment of speech), and the event occurs before that reference point ($E < R < S$).

The formal typology of absolute-relative tenses, as presented by Comrie (1985, pp. 125–129), includes:

Pluperfect: $E < R < S$

Future perfect: $E < R > S$

Conditional: $E > R < S$

Perfect conditional: $E < R_1 > R_2 < S$

Another fundamental feature of Comrie’s theory is the distinction between tense and aspect. While tense refers to the temporal location of a situation, aspect concerns its internal structure — for instance, whether the event is completed, ongoing, or habitual. This differentiation allows for a more precise analysis of complex verbal forms and avoids the frequent conflation of temporal and aspectual categories, which often overlap in natural languages.

Beyond the explicit grammatical encoding of tense, Comrie (1985, p. 23) also considers the importance of contextual inferences, proposing an articulation between

the conventional meaning of verbal forms and the pragmatic implicatures that may arise from them. For example, the sentence “It’s cold in here” may, in a given context, be interpreted not as a literal observation, but as an implicit request to close the window. In this case, the communicative intention is not linguistically encoded, but inferred by the interlocutor. Comrie emphasises that implicatures can be cancelled without contradiction — the speaker might say, after the window has been closed, “Please don’t close the window, I enjoy the cold”, thereby invalidating the previous inference.

This distinction is particularly relevant to temporal analysis, as the temporal value of a verbal form may arise from both its morphology and the discursive context, along with the associated inferences. Comrie notes, for example, that the interpretation of the future tense is subject to debate: for some, it constitutes a purely modal form, while others argue that, although it carries modal value, it can give rise to temporally anchored interpretations (Comrie, 1985, p. 24).

In conclusion, Bernard Comrie’s theory of verbal tense provides a clear and systematic framework for the analysis of temporal expression in natural languages, highlighting the deictic nature of tense, the significance of the distinction between absolute, relative, and absolute-relative tenses, as well as the separation between tense and aspect.

Moreover, by acknowledging the role of context and pragmatic inferences in temporal interpretation, Comrie contributes to a more comprehensive understanding of the communicative functioning of language, aligning, albeit indirectly, with a pragmatic perspective on meaning and interpretation. His theory thus represents a valuable tool not only for linguistic description but also for interdisciplinary research into time, aspect, and inference.

2.2.4. Declerck (1991)

In his work *Tense in English: Its Structure and Use in Discourse* (1991), Renaat Declerck puts forward a comprehensive and systematic theory of tense in English, characterised by a strong logical-formal orientation and careful attention to discourse-related elements. His approach seeks to address two fundamental gaps identified in previous research on verbal tense.

The first concerns the lack of a basic, methodologically sound descriptive theory that would enable an adequate classification and interpretation of empirical data. As the author himself notes, “there is not much point in developing ‘high order’ theories of tense as long as there is no basic descriptive theory to help us to classify and interpret the data” (Declerck, 1991, p. 5). In this regard, Declerck’s proposal aims to provide a rigorous descriptive foundation capable of supporting more abstract and formalised theorisation.

The second gap pertains to the absence of a satisfactory theory regarding the internal structure of tenses. While numerous theoretical proposals exist in this domain, Declerck observes that “this time it is not a gap in the sense that there is no theory – the theories abound – but in the sense that there is no satisfactory theory” (Declerck, 1991, p. 6). His work thus endeavours to develop a more precise and coherent analysis of verbal structure, one that is capable of accounting for the interpretative and functional nuances of verbal forms in English, both at the level of grammar and in their discourse realisation.

Declerck, in line with Comrie (1985) and in contrast to Reichenbach (1947) — who employs the term event — adopts the term situation to describe the temporal entities that are located in time. It is important to note, however, that although Comrie also uses the term situation in this sense, in his formal representations of verbal tenses he opts for the designation event time (E), defined as “the time point or interval which is occupied by the situation to be located in time” (Comrie, 1985, p. 122). This terminological distinction highlights differing nomenclatural choices for conceptually similar entities within the domain of temporal semantics.

Within the framework of his theory, Declerck introduces the concept of t_0 , which corresponds to the origin point of the temporal relations expressed in the sentence. This concept is inherited from the classification proposed by Lyons (1977) and may correspond either to the moment of enunciation or to the moment of decoding. Lyons (1977) defines t_0 as “the time which is the ultimate ‘origin’ of all the temporal relations expressed in the sentence, i.e., the time to which all the situations referred to in the sentence are directly or indirectly related, and which is not itself represented as

dependent on any other (more basic) time” (Declerck, 1991, p. 14). It is, therefore, a fundamental temporal reference point from which all other temporal relations within the structure of the utterance are established.

Given that his analysis centres on the concept of situation, Declerck deems it inappropriate to retain the symbol *S* (traditionally used by Reichenbach (1947) and Comrie (1985) to denote speech time), as it may lead to confusion between terms. He therefore opts to replace it with the abbreviation *TU* (time of utterance), denoting the moment of enunciation (Declerck, 1991, p. 250).

With regard to the reference time, this is defined as the temporal point from which the situation is located (time referred from), and it may be determined by the discourse context or explicitly indicated by means of a temporal adverbial (time referred to). Within this framework, Declerck distinguishes between *time of orientation* (*TO*) and *established time* (*TE*). The former refers to the temporal point relative to which the situation is situated, whereas the latter corresponds to the time explicitly specified in the utterance, typically established by an adverbial or the context (Declerck, 1991, pp. 250–251).

In certain contexts, the established time may assume the function of time of orientation (*TO*), and vice versa. In such cases, Declerck employs the term *established orientation time* (*TOE*) to denote a time which simultaneously fulfils the functions of both *TE* and contextual *TO* (Declerck, 1991, p. 252). Additionally, Declerck introduces the notion of *situation time orientation* (*situation-TO*), which corresponds to the time with which the situation is simultaneous. This is thus a specific temporal point serving as an anchor for the temporal localisation of the described situation (Declerck, 1991, p. 251).

Another essential primitive element in the formal representation of verbal tenses, according to Declerck, is the *basic orientation time* (basic *TO*, also referred to as *TO₁*). This corresponds to the orientation time that underpins the temporal structure of the verbal tense in question, functioning as the anchoring point from which the temporal relations associated with the described situation are established. In certain contexts, *t₀* may coincide with *TO₁*. However, this coincidence is not obligatory: *TO₁* may also

correspond to a temporal interval distinct from the moment of speech or writing. The examples proposed by Declerck (1991, p. 252) are the following:

(3)

a. John had left before his wife arrived.

b. (Do not leave too early, or) the newspapers will write that you had left before your wife arrived.

In both (3a) and (3b), the past tense *arrived* locates the event at a reference point (TO_2) that precedes another reference point (TO_1). In (3a), this basic TO_1 coincides with t_o ; in (3b), however, TO_1 is a time interval posterior to t_o , but functions as if it were t_o . Since the past tense expresses the same temporal scheme (*TS simul* TO_2 before TO_1) in both cases, the conclusion is that the temporal relations expressed by a tense form do not necessarily originate from t_o . Crucially, the link between TO_1 and t_o is not encoded by the tense itself.

The temporal scheme realized by *arrived* in (3b) therefore comprises only the relations *TS simul* TO_2 and TO_2 before TO_1 . The relation TO_1 after t_o is not established by the past tense, but by the surrounding context. The same reasoning applies to the form *had left*. In both (3a) and (3b), the past perfect conveys the relation *TS before* TO_2 , while the posteriority of TO_1 with respect to t_o (3b) is introduced by context rather than by the past perfect itself.

Declerck observes that ultimately, TO_1 is always related, either directly or indirectly, to t_o . Nevertheless, this connection is not grammatically encoded by the verbal tense but is rather an inference arising from the contextual interpretation of the utterance. It is, therefore, a pragmatic relation, not linguistically codified, yet essential for the understanding of temporal structures in discourse (Declerck, 1991, pp. 252–253).

In summary, Declerck's proposal is grounded in a set of fundamental notions whose articulation allows for an accurate description of temporal relations in discourse:

t_o : zero reference temporal point (time of utterance or time of decodification);

TU : time of utterance (coding time);

TS : time of the situation;

TE : established time (time established by temporal adverbial or context);

TO: time of orientation;

TOE: time that simultaneously functions as TO and TE (established orientation time);

TO₁: basic TO, the fundamental orientation time in the temporal structure of the verbal tense.

2.2.5. Kamp and Reyle (1993)

The theory of tense proposed by Hans Kamp and Uwe Reyle in *From Discourse to Logic* (1993) is situated within the broader theoretical framework of Discourse Representation Theory (DRT), a formal structure designed to represent the semantic meaning of utterances in natural discourse. This approach was initially formulated by Kamp (1981) and further developed in conjunction with Heim's contributions (1982), within the domains of formal semantics and pragmatics (Silvano, 2002, p. 44).

DRT seeks to rigorously model the temporal and referential phenomena of discourse, overcoming the limitations of classical predicate logic in representing dynamic linguistic phenomena such as anaphora, indefinite expressions, and, of particular relevance, temporality. This theory emerged from the attempt to resolve two central semantic problems: on the one hand, the issue of anaphora in sentences of the *donkey type*, such as "If Pedro owns some donkey, he beats it", where the anaphoric relationship between the indefinite expression "some donkey" and the pronoun "it" appears to conflict with the existential reading of the determiner "some"; and on the other, the challenges posed by the expression of tense and aspect, especially in languages that morphologically distinguish between different past tenses, such as the *Passé Simple* and *Imparfait* in French, or the *Pretérito Perfeito* and *Pretérito Imperfeito* in Portuguese.

As the authors themselves state:

"DRT is an approach towards natural language semantics which, some thirteen years ago, arose out of attempts to deal with two distinct problems. The first of those was the semantic puzzle that had been brought to contemporary attention by Geach's notorious 'donkey sentences' – sentences like 'If Pedro owns some donkey, he beats it', in which the anaphoric connection we perceive between the indefinite noun phrase 'some donkey' and the pronoun 'it' may seem to conflict with the existential meaning of the word 'some'. The second problem had to do with tense and aspect. Some languages, for instance French and the other Romance languages, have two morphologically distinct past tenses, a simple past (the French *Passé Simple*) and a continuous past (the French *Imparfait*). To articulate precisely what the difference between these tenses is has turned out to be surprisingly difficult."

(Kamp and Reyle, 1993, p. 1)

In the domain of temporality, Kamp and Reyle begin with the distinction between events and states, and revisit the tripartite framework proposed by Reichenbach (1947) — speech time, reference time, and event time — which is reformulated within DRT using a more operational and context-sensitive formalism.

With regard to Reichenbach's work, the authors observe the following:

"To account for this dimension, Reichenbach introduces the concept of a reference point. He defines the meaning of the tenses of the verb as each involving two temporal relations, the relation between reference time and speech time and the relation between described eventuality and reference time. For instance, the English simple past signifies according to him that the reference time lies before the speech time and that the eventuality is located at the reference time. Typically the reference time is given by the context."

(Kamp and Reyle, 1993, p. 523)

Kamp and Reyle, however, introduce an important distinction absent from Reichenbach's model: the differentiation between two types of reference points, arguing that Reichenbach employs a single term to refer to temporally distinct moments. To illustrate this distinction, the authors propose the following example, originally proposed by Reichenbach (1993, p. 594):

(4)

Fred arrived at 10. He had got up at 5; he had taken a long shower, had got dressed and had eaten a leisurely breakfast. He had left the house at 6:30.

Regarding this example, they assert that all the past perfect clauses use the moment of arrival as their reference time: "It can only be the moment of arrival, since it is the only moment between the described event and now that is represented in the context" (Reichenbach, 1993, p. 594). At the same time, each of these clauses also provides a reference time for the subsequent clause — a moment which the eventuality described in the second clause must follow or overlap with. Thus, the interpretation of the last four clauses in (3) simultaneously involves a perspectival analysis of the past perfect and the principle of narrative progression. On one hand, each of these clauses requires a reference time in the sense of narrative progression; in this case, this time shifts from one clause to the next — moving forward with the narrative. On the other hand, all these clauses equally require the moment of Fred's arrival as the reference time in the explanatory sense of the past perfect — a constant time across the four clauses, distinct from the reference time invoked by narrative progression.

The authors conclude, in this context:

“It should be clear from this discussion (i) that the analysis of certain sentences requires two reference points, and not just one; and (ii) that there are two distinct notions of reference time, which play entirely different roles. It is crucial that we keep these two notions apart. And so we must have different names for them. We propose to retain the term reference point, or Rpt, for the type of reference that explains narrative progression.”

(Kamp and Reyle, 1993, p. 594)

Thus, to account for reference times arising in the two-dimensional analysis of the past perfect, the authors introduced a second temporal interval, the temporal perspective point (TPpt). From these theoretical premises emerge two fundamental temporal relations in the description of verbal tenses. The first pertains to the relation between TPpt and the moment of utterance (n), which can assume the values +Past (when TPpt precedes the moment of utterance) or –Past (when it coincides with it). The second relation concerns the localisation of the eventuality with respect to the TPpt, encoded by the feature *Tense*, which may take the values present, past, or future. The representation of verbal tenses within DRT also incorporates the aspectual characterisation of predicates, based on the properties [$\pm$ STAT] (stative versus eventive) and [$\pm$ PERF] (with or without a resultant state).

Kamp and Reyle (1993, p. 601) propose the following formal representation of tenses for English:

Table 2 Formal representation of tenses in English according to Kamp and Reyle (1993, p. 601)

Tense	Relation between TPpt and speech time	Relation between event location time and TPpt	Aspect: stative or eventive	Aspect: with/without resulting state
Present	– PAST	pres	+ STAT	– PERF
Future	– PAST	fut	+/- STAT	– PERF
Simple Past	– PAST + PAST	past pres	+/- STAT + STAT	– PERF – PERF
Past Future	+ PAST	fut	+/- STAT	– PERF
Present Perfect	– PAST	pres	+ STAT	+ PERF
Future Perfect	– PAST	fut	+ STAT	+ PERF

Past Perfect	+ PAST	past	+/- STAT	– PERF
	– PAST	past	+ STAT	+ PERF
	+ PAST	pres	+ STAT	+ PERF
Past Future Perfect	+ PAST	fut	+ STAT	+ PERF

In Kamp and Reyle’s approach, verbal tenses are not interpreted in isolation but are integrated within Discourse Representation Structures (DRSs), which organise and accumulate semantic information as the discourse unfolds. When a sentence appears at the beginning of a discourse, it is interpreted in the absence of prior discourse context, relying solely on its syntactic structure. The construction of a DRS always entails the introduction of formal representatives for the elements of the sentence — so-called discourse referents — as well as formulae that associate each referent with the propositional content it conveys, known as DRS conditions (Kamp and Reyle, 1993, p. 63). As the authors state:

“(i) a set of discourse referents called the universe of the DRS, which will always be displayed at the top of the diagram; and

(ii) a set of DRS-conditions, typically displayed below the universe.”

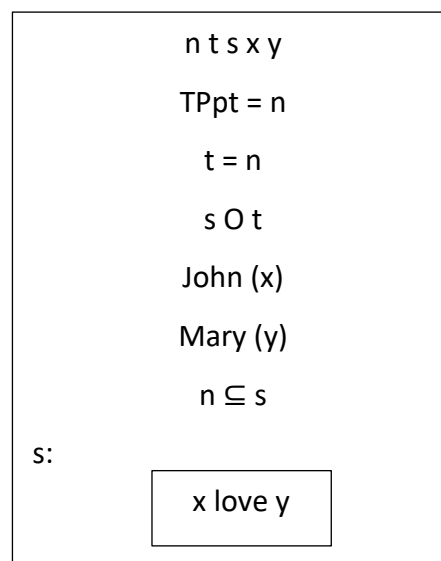
(Kamp and Reyle, 1993, p. 63)

These two components are essential in the representation of sentence (4), taken from Kamp and Reyle (1993, p. 266):

(5)

a. John loves Mary

b.



First and foremost, the aspectual class of the predicate is characterised — in this case, stative. The primary function of the verb *love* is to introduce, as a referential argument, a discourse referent s , which represents a state of affairs. This argument is subsequently linked by the present tense of the indicative verb, which asserts that the described state holds over a temporal interval that includes the moment of utterance n . Thus, the following representation is obtained: n denotes the moment of utterance, and the condition $n \subseteq s$ indicates that the state s holds at n . Also, TPpt is n , and the relation between the eventuality and the TPpt is one of inclusion

The second function of the verb is to provide a descriptive characterisation of the state represented by s , relating it to the referents of the argument phrases John and Mary, and describing it as a state consisting of the fact that John loves Mary. This descriptive information is represented by a condition of the form $s: x \text{ love } y$, where x and y represent, respectively, John and Mary (Kamp and Reyle, 1993, p. 266).

In conclusion, the theory of tense developed by Kamp and Reyle within Discourse Representation Theory constitutes a fundamental contribution to the formal representation of temporality in natural discourse. Through the articulation of discourse referents, semantic conditions, and temporal operators, DRT provides a precise modelling of the relations between utterance, reference, and eventuality, overcoming the limitations of classical logic and traditional semantic approaches. The distinction between different types of reference time, as well as the integration of the aspectual properties of predicates, allows for a detailed analysis of the temporal and narrative contrasts observable in natural languages. This perspective thus constitutes a solid foundation for understanding the temporal structure of discourse, being particularly relevant in the study of narrative texts, such as those comprising clinical reports, where the interplay between tense, aspect, and narrative progression plays a central role.

2.3. Tense and Mood in the Portuguese Verbal System

This Section provides a brief analysis of the tense system in Portuguese, with a particular focus on its interaction with verbal moods.

Three main moods are distinguished in Portuguese: the *Indicativo* (Indicative), the *Conjuntivo* (Subjunctive), and the *Imperativo* (Imperative). However, verb forms such as

the *Condicional* (Conditional) and the *Futuro* (Future), whether simple or compound, may also convey distinct modal values and are, at times, regarded as autonomous moods (Silvano, 2010, p. 114).

The Indicative and Subjunctive moods encompass various verb tenses, which enable the localisation of events in the past, present, or future. The imperative mood, in contrast, is limited to a single tense and is primarily associated with the expression of deontic modality, particularly through commands or instructions.

Verb forms in the Indicative (as well as in the Subjunctive) are finite, bearing morphological markers that indicate the person and number of the subject of the clause or sentence. These tenses may exhibit a simple morphological structure, but compound tenses may also be formed — these are constructed through the combination of the auxiliary verb *ter* (to have) with the past participle of the main verb.

The simple tenses of the Indicative mood include: the *Presente* (*eu estudo*⁵), the *Pretérito Perfeito* (*eu estudei*), the *Pretérito Imperfeito* (*eu estudava*), the *Pretérito mais-que-perfeito* (*eu estudara*), the *Futuro* (*eu estudarei*), and the *Condicional* (*eu estudaria*). The compound tenses are: the *Pretérito Perfeito Composto* (*eu tenho estudado*), the *Pretérito mais-que-perfeito Composto* (*eu tinha estudado*), and the *Futuro Composto* (*eu terei estudado*) (Oliveira, 2013, p. 514).

In the Subjunctive mood, the number of verb tenses is more limited. The simple tenses are: the *Presente* (*[que] eu estude*), the *Pretérito Imperfeito* (*[se] eu estudasse*), and the *Futuro* (*[amanhã, quando] eu estudar*). The compound tenses include: the *Pretérito Perfeito Composto* (*[que] eu tenha estudado*), the *Pretérito mais-que-perfeito Composto* (*[se] eu tivesse estudado*), and the *Futuro Composto* (*[amanhã, quando] eu tiver estudado*) (Oliveira, 2013, p. 533).

The following tables summarise the Portuguese verb tenses, with Table 3 devoted to the *Indicativo* mood and Table 4 to the *Conjuntivo* mood.

⁵All examples are given in the first person singular form of the verbs.

Table 3 Portuguese Indicative Tenses with Examples and Corresponding English Translations

Indicative Mood Tenses	Exemplification ⁶
<i>Presente</i> (Present)	<i>Estudo</i> (study)
<i>Pretérito Imperfeito</i> (Simple Past <i>Imperfectum</i>)	<i>Estudava</i> (studied)
<i>Pretérito Perfeito</i> (Simple Past)	<i>Estudei</i> (studied)
<i>Pretérito Perfeito Composto</i> (Present Perfect ⁷)	<i>Tenho estudado</i> (have been studying)
<i>Pretérito mais-que-perfeito</i> (Past Perfect)	<i>Estudara</i> (had studied)
<i>Pretérito mais-que-perfeito Composto</i> (Past Perfect)	<i>Tinha estudado</i> (had studied)
<i>Futuro</i> (Future)	<i>Estudarei</i> (will study)
<i>Futuro Composto</i> (Future Perfect)	<i>Terei estudado</i> (will have studied)
<i>Condicional</i> (Conditional)	<i>Estudaria</i> (would study)
<i>Condicional Perfeito</i> (Conditional Perfect)	<i>Teria estudado</i> (would have studied)

Table 4 Portuguese Subjunctive Tenses with Examples and Corresponding English Translations

Subjunctive Mood Tenses	Exemplification ⁸
<i>Presente</i> (Present)	<i>Estude</i> (love)
<i>Pretérito Imperfeito</i> (Simple Past <i>Imperfectum</i>)	<i>Estudasses</i>
<i>Futuro</i> (Future)	<i>Estudar</i>
<i>Pretérito Perfeito Composto</i> (Present Perfect)	<i>Tenha estudado</i>
<i>Pretérito mais-que-perfeito</i> (Past Perfect)	<i>Tivesse estudado</i>
<i>Futuro Composto</i> (Future Perfect)	<i>Tiver estudado</i>

2.3.1. The Indicative Mood: *Presente*, *Pretérito Perfeito*, and *Pretérito Imperfeito*

This subsection provides a description of the verbal tenses most frequently found in clinical narratives of the corpus under analysis: the *Presente*, the *Pretérito Perfeito*, and the *Pretérito Imperfeito* of the Indicative Mood. A theoretical characterisation of each of these tenses will be presented, outlining the contexts with which they are associated and illustrating them with representative examples.

Presente do Indicativo (Present of the Indicative)

The Present tense of the Indicative plays a crucial role in the verbal system, as it encompasses a wide range of temporal and aspectual values. In its most prototypical

⁶ All examples are given in the first person singular form of the verbs.

⁷ In the tense system of European Portuguese, there is no direct equivalent to the English Present Perfect. The *Pretérito Perfeito Composto* can sometimes appear in contexts involving states that extend into the present, similar to the Present Perfect. For a detailed discussion of the relationship between the Present Perfect and the *Pretérito Perfeito Composto*, see Silvano (2010, p. 40).

⁸ All examples are given in the first person singular form of the verbs.

use, the present conveys information that is strictly anchored in the semantic present, that is, when the *event time* coincides with the *speech time*. This interpretation typically arises in constructions with stative predicates, where the TPpt is *n* and the relation between the eventuality and the TPpt is one of inclusion (Silvano, 2010, p. 115), as illustrated in the examples below, taken from Oliveira (2003, p. 154):

(6)

- a. A criança está contente. (*The child is happy.*)
- b. A Rita tem febre. (*Rita has a fever.*)
- c. A Ana é alta. (*Ana is tall.*)
- d. A Joana é natural de Sagres. (*Joana is from Sagres.*)

When it comes to events, however, the interpretation of a real present is more restricted, usually occurring in contexts of direct reporting (7a) or in performative utterances (7b):

(7)

- a. Cristiano Ronaldo atira diretamente à baliza. (*Cristiano Ronaldo shoots directly at the goal.*)
- b. Prometo que vou ajudar-te nos trabalhos de casa. (*I promise I will help you with your homework.*)

In (7a), *atira diretamente à baliza* coincides with the speech time, which corresponds to the TPpt. Similarly, in (7b), *prometo* also overlaps with the speech time, likewise identified as the TPpt.

However, in most cases, predicates in the *Presente do Indicativo* in Portuguese do not denote a single situation coinciding with the moment of speech. More frequently, they convey habitual readings, in which a regular repetition of simple situations is described. This interpretation is often reinforced by the presence of temporal frequency adverbials (Oliveira, 2013, p. 514), as illustrated in the following examples:

(8)

- a. O João toca piano. (*João plays the piano.*) — *process*
- b. O Carlos publica um livro (todos os anos). (*Carlos writes a book (every year).*) — *culminated process*

c. A Dulce desmaia sempre que tira sangue. (*Dulce faints whenever she has blood taken.*) — *culmination*

d. O Luís espirra muito (todas as primaveras). (*Luís sneezes a lot (every spring).*) — *point*

In these examples, although the predicates are lexical events, the use of the *Presente do Indicativo* transforms them into habitual states.

In simple sentences, the verbal tense that partially overlaps with the speech time in processes, culminations, and culminated processes is the progressive present (9a–c). This periphrastic construction also introduces aspectual changes:

(9)

a. O João está a tocar piano. (*João is playing the piano.*)

b. O Carlos está a escrever um livro. (*Carlos is writing a book.*)

c. A Dulce está a desmaiar. (*Dulce is fainting.*)

d. O Luís está a espirrar. (*Luís is sneezing.*)

In the case of points (9d), the periphrasis *estar a + infinitive* generates a conflict with the punctual nature of the event, due to the progressive semantics of the construction, which presupposes duration. This conflict motivates an iterative interpretation, as in the example given, where the situation is understood as a succession of sneezes.

The *Presente do Indicativo* is also used in generic sentences, which express typical or essential characteristics of species or other types of entities (Oliveira, 2013, p. 516):

(10)

a. As larvas de vaca-loura vivem nas raízes de árvores antigas. (*Stag beetle larvae live in the roots of old trees.*)

b. O carvalho-galego é uma árvore com copa ampla e regular. (*The Galician oak is a tree with a broad, regular crown.*)

In addition, in the presence of appropriate temporal adverbials and with eventive predicates, the *Present do Indicativo* may establish a relation of posteriority with respect to the speech time, thereby acquiring a future value (11a–c) (Oliveira, 2013, p. 516):

(11)

a. Amanhã, chega o Vicente. (*Vicente arrives tomorrow.*)

b. Vou a um congresso na próxima semana. (*I am attending a conference next week.*)

c. A Sofia casa em Novembro. (*Sofia is getting married in November.*)

However, when the predicate expresses phase states⁹, a future interpretation becomes less acceptable, often requiring a broader context for that reading to be possible (12a). In the case of individual-level states¹⁰, a future interpretation is generally unacceptable (12b), whereas with stage-level states, it is considerably more natural (12c):

(12)

a. ?Amanhã, a Joana vive em Paris. (*Tomorrow, Joana lives in Paris.*)

b. #Amanhã, a Ana é inteligente. (*Tomorrow, Ana is intelligent.*)

c. Amanhã, a Luísa está em Lisboa. (*Tomorrow, Luísa is in Lisbon.*)

There is also the possibility of a past reading of the present indicative relative to the speech time, provided it occurs with appropriate temporal adverbials. This use is particularly common in certain types of historical narrative and is therefore often referred to as the *historical present*. It also appears frequently in texts reporting events of public or historical relevance (Oliveira, 2013, pp. 516–517):

(13)

a. Na madrugada de 25 de abril de 1974, forças militares ocupam pontos estratégicos em Lisboa e derrubam a ditadura do Estado Novo. (*In the early hours of 25 April 1974, military forces occupied strategic points in Lisbon and overthrew the Estado Novo dictatorship.*)

⁹Aspectual issues will be addressed in the following section. In broad terms, a distinction is drawn between *phase states* — that is, states amenable to transition into events — and *non-phase states*, which cannot be reduced to eventive interpretations.

¹⁰According to Cunha (2004, p. 83), individual-level states, by virtue of their relatively stable and permanent nature, tend to resist explicit temporal modification. When such adverbs are associated with them, the result is often semantic anomaly or a forced interpretation. By contrast, stage-level states, being linked to transient or temporally delimited situations, exhibit strong compatibility with temporal restrictions, integrating naturally into contexts that specify a temporal extent, whether implicitly or explicitly marked.

- b. Em 2020, Óscar Lopes recebe o prémio Vida Literária. (*In 2020, Óscar Lopes received the Vida Literária prize.*)

The *Presente do Indicativo* is also widely used in announcements, public information, and newspaper headlines, not only with predicates expressing states but also with eventive predicates. In such contexts, the temporal value of the present is often extended beyond the moment of enunciation, as illustrated in (14a) (Oliveira, 2013, p. 517). According to Silvano (2002), the *Presente do Indicativo* is frequently employed in journalistic texts to locate a situation that occurred in the recent past but remains relevant at the moment of enunciation. This usage thus emphasises the connection between the event and its current relevance, as exemplified in (14b):

(14)

- a. Decorre até ao final do mês o período de inscrição no doutoramento. (*The registration period for the PhD runs until the end of the month.*)
b. O governo aprova novas medidas de apoio às famílias. (*Government approves new measures to support families.*)

In sum, the *Presente do Indicativo* in Portuguese, while prototypically anchored to the speech time, displays a wide range of values, including habitual, progressive, generic, future, and historical uses, which highlight its flexibility and central role in the verbal system.

Pretérito Perfeito do Indicativo (Simple Past of the Indicative)

The *Pretérito Perfeito do Indicativo* in Portuguese is used to temporally locate situations, whether events (15a–d) or states (15e), as anterior to the speech time, as shown in the examples below:

(15)

- a. O João tocou piano. (*João played the piano.*)
b. O Carlos escreveu um livro. (*Carlos wrote a book.*)
c. A Dulce desmaiou. (*Dulce fainted.*)
d. O Luís espirrou. (*Luís sneezed.*)
e. A Joana viveu em Paris. (*Joana lived in Paris.*)

This tense is unequivocally a past tense. However, despite its terminative nature — that is, by marking the point at which an event or state is completed — it is not necessarily perfective, insofar as it does not always entail the existence of a resulting state (cf. Oliveira, 2003, p. 156). Among the examples above, only (15b) and (15c), by involving culminations, allow the inference of a consequent state, such as *O livro está escrito* (*The book is written*) or *A Dulce está desmaiada* (*Dulce has fainted*).

The *Pretérito Perfeito* can also be interpreted as expressing anteriority with respect to a future reference time, provided that this reference is introduced by an adverbial constituent. In such cases, the event occurs before the reference time but still after the moment of enunciation, as illustrated in (16) (Oliveira, 2013, p. 517):

(16)

- a. Quando o João voltar de férias daqui a dois meses, já a Ana entregou a tese há três semanas. (*When João returns from holiday in two months, Ana will already have submitted her thesis three weeks earlier.*)

In this example, the situation *entregou a tese* (*submitted her thesis*) is anterior to the future reference point (*João's return*), yet posterior to the speech time.

Furthermore, when a sequence of coordinated clauses or sequentially organised sentences occurs with verbs in the *Pretérito Perfeito*, a narrative progression is frequently constructed. In such cases, the time of each situation functions as the reference point for the following one, and the temporal order of the events tends to coincide with the order in which they are presented in the text, as proposed by Kamp and Reyle (1993):

(17)

- a. O Fernando entrou no bar, sentou-se ao balcão e pediu uma cerveja. (*Fernando entered the bar, sat down at the counter and ordered a beer.*)

In sum, the *Pretérito Perfeito* in Portuguese functions not only as a past tense locating events prior to the speech time, but also as a versatile form that may express relative anteriority and serve as a key device in the construction of narrative progression.

Pretérito Imperfeito do Indicativo (Simple Past Imperfectum of the Indicative)

The *Pretérito Imperfeito* is a verbal tense which, although semantically situated within the domain of the past, is distinguished by its marked aspectual dimension and, in certain contexts, also by its modal value (Oliveira, 2013, p. 518).

Individual-level predicates may occur with the *Pretérito Imperfeito*, taking the speech time as the TPpt, as shown in the following examples:

(18)

- a. A Joana era simpática. (*Joana was kind.*)
- b. A Luísa era professora. (*Luísa was a teacher.*)
- c. A Sílvia era natural do Brasil. (*Sílvia was from Brazil.*)

In (18a) and (18b), although the predicates denote states of long duration, they may be construed as terminable, that is, as states that ceased before or up to the moment of enunciation. By contrast, in (18c), the predicate *ser natural do Brasil* (“to be from Brazil”) expresses an unalterable characteristic of the individual, one that cannot be conceived as ceasing. A person cannot cease to be from the place where they were born. This difference in the nature of the predicates also leads to distinct inferential effects in the interpretation of the *pretérito imperfeito*. Saying *A Joana era simpática* (“Joana was kind”) or *A Luísa era professora* (“Luísa was a teacher”) suggests that, at the moment of enunciation, such characteristics or functions no longer hold, whether due to the subject’s disappearance (e.g. death) or to a change of state or occupation. In the case of (18c), the only plausible inference is that Sílvia has died (Oliveira, 2013, p. 518-519).

When applied to stage-level or eventive predicates, the *Pretérito Imperfeito* generally requires the presence of an explicit reference time, introduced either by a temporal adverbial or by a temporal subordinate clause (Oliveira, 2013, p. 519). Without such a reference point, the use of the *Pretérito Imperfeito* is inadequate in these contexts to describe situations located in the past relative to the speech time. This reference time may establish a relation of partial overlap, total overlap, or inclusion with the main event:

(19)

- a. Ontem, estava frio em Faro. (*Yesterday, it was cold in Faro.*)

b. Quando a mãe chegou a casa, o pai cozinhava o jantar. (*When the mother arrived home, the father was cooking dinner.*)

c. A professora entrou na sala. Os alunos conversavam e riam. (*The teacher entered the classroom. The pupils were talking and laughing.*)

In (19b), the event *cozinhar o jantar* (“cooking dinner”) loses its usual culmination. The mother’s arrival is included within the temporal interval of the cooking event, which may have continued thereafter. This overlap motivated the proposal of Kamp and Rohrer (1983), who, in their analysis of the imperfect in French, suggested that this tense effects a transition from event to state.

The *Pretérito Imperfeito* thus attributes duration to the situation, functioning similarly to the periphrastic progressive construction *estar a*, which likewise encodes durative or progressive aspect. In fact, when the main predicate of the clause is eventive, the use of the auxiliary (also in the *Pretérito Imperfeito*) produces a sentence that is semantically equivalent to the simple form with the lexical verb:

(20)

Quando a mãe chegou a casa, o pai estava a cozinhar o jantar.
(*When the mother arrived home, the father was cooking dinner.*)

In European Portuguese, the *Pretérito Imperfeito* may also occur in the consequent clause of a conditional construction, as an alternative to the conditional tense, as illustrated below:

(21)

a. Se tivesses ido à aula, saberias/sabias a resposta. (*If you had attended the class, you would have known/knew the answer.*)

b. Não te tinhas/terias magoado se tivesses sido mais corajoso. (*You would not have hurt yourself if you had been braver.*)

In such cases, the use of the *Pretérito Imperfeito* conveys a counterfactual modal interpretation, which in many instances approaches the value typically expressed by the conditional (Oliveira, 2013, p. 520).

Finally, the *Pretérito Imperfeito* may also assume a modal value of politeness or mitigation, a phenomenon often referred to as the *Imperfeito de Delicadeza* (cf. Oliveira, 1986; Oliveira & Lopes, 1995), as in the following example:

(22)

Agora, queria um café, por favor. (*I would like a coffee now, please.*)

In this case, the TPpt coincides with the speech time, and the use of the *Pretérito Imperfeito* serves to soften the request, imparting a more polite and less direct tone.

In sum, the *Pretérito Imperfeito* in Portuguese, while primarily a past tense, displays a rich interplay of aspectual and modal values, ranging from the attribution of durativity and backgrounding in narratives to counterfactual interpretations in conditionals and polite attenuation in interaction.

2.4. Theoretical Approaches to Aspect

This Section examines the main theoretical proposals concerning Lexical Aspect and Aspectual Classes. It begins with Vendler's (1967) classical typology, followed by the reformulations and developments put forward by Dowty (1979), Mourelatos (1981), and Moens (1987), concluding with the contributions of Cunha (1998, 2004) within the context of European Portuguese.

2.4.1. Vendler (1967)

Zeno Vendler's contribution in *Linguistics in Philosophy* (1967) was pioneering in systematising a typology of verbal predicates based on temporal and semantic properties. Vendler begins with the observation that not all verbal predicates behave in the same way when used in constructions involving the so-called continuous tense, which corresponds to the progressive aspect in English (e.g., *is running*, *was singing*) (Vendler, 1967, p. 99). This distinction allows him to classify predicates according to their compatibility with the progressive aspect: on the one hand, there are predicates that readily admit this construction; on the other, there are those for which it yields ungrammatical or semantically anomalous results.

Thus, constructions such as *John is running* or *Maria is singing* are perfectly acceptable, as they describe processes with duration and internal development. In

contrast, utterances like *John is knowing the answer* or *Maria is loving* sound odd or ungrammatical, insofar as the verbs involved express mental or emotional states, whose static and non-dynamic nature renders them incompatible with the progressive aspect. Vendler further identifies a crucial distinction between predicates such as *write a letter* and *reach the top*. In the first case, it is possible to say *I am writing a letter* at any point during the process, since the activity extends over time and can be described in terms of progression. In the second case, however, the construction *I am reaching the top* is not felicitous at just any moment of the event: it refers to an accomplishment with a well-defined culmination point, and its progressivity can only be invoked at a very specific stage in the trajectory leading to its completion (Vendler, 1967, p. 104). This distinction highlights the importance of telicity, or orientation towards an endpoint, in determining the compatibility of predicates with the progressive aspect.

Building on his initial observation regarding the compatibility of certain predicates with the progressive construction, Vendler (1967) proposes an aspectual typology that distinguishes four categories of verbal predicates — *states*, *activities*, *accomplishments*, and *achievements* — based on three fundamental parameters: duration, telicity (i.e., the presence or absence of an inherent endpoint), and dynamism. This classification captures differences in the internal temporal structure of the events described, offering a robust theoretical framework for the semantic and aspectual analysis of verbal predicates.

States refer to continuous, static situations that are not goal-oriented, as seen with verbs such as *know*, *believe*, or *love*. These predicates lack both dynamism and telicity and are therefore incompatible with the progressive construction¹¹. Moreover, they are *homogeneous*, in the sense that any temporal segment of the situation possesses the same properties as the whole. States do not express phases or subevents and do not involve any internal transition; as such, they may be characterised as predicates that merely describe a situation rather than presenting it as a process in progress. Consequently, they do not, in themselves, carry any inherent aspectual change.

¹¹As presented in Section 2.4.5, Cunha (1998) demonstrates that phase states are compatible with the progressive (e.g., *Maria is being nice*)."

Activities, by contrast, refer to dynamic and durative actions that are not oriented towards an inherent conclusion, as is the case with verbs such as *run*, *swim*, or *talk*. They are compatible with the progressive aspect, since they represent ongoing processes that unfold over time. Like states, activities are homogeneous, atelic, and cumulative — that is, the concatenation of two instances of the same type of event results in an event of the same type (*John ran for an hour and then ran for another hour* still describes an instance of running). These activities occur over a temporal interval but lack a specified endpoint, which renders them open-ended processes, indeterminate in terms of their conclusion.

Accomplishments describe events composed of a processual a that culminates in a defined result, as in *build a house* or *write a letter*. These predicates are durative and dynamic, and are characterised by telicity: they possess an inherent endpoint that marks their completion. Although they admit the progressive construction (*John is building a house*), such usage highlights the preparatory phase of the process, without necessarily implying its conclusion. Unlike activities, accomplishments are not homogeneous, since any partial segment of the event does not share the same nature as the whole. For instance, *writing a letter* implies a goal that is only achieved upon completion of the process. This class of predicates is thus associated with bounded time intervals, and it encompasses both the duration of the process and the culmination point that defines its endpoint.

Finally, *achievements* correspond to instantaneous events, without internal duration, such as *recognise*, *arrive*, or *notice*. Like accomplishments, they are telic and non-homogeneous, but differ from them in the absence of a processual phase: they occur at a single point in time. For this reason, they are generally incompatible with the progressive aspect in literal readings, although they may occasionally appear in that context with a preparatory or resultative interpretation (e.g., *He is arriving* can suggest that he is about to arrive).

Furthermore, according to the author, achievements and accomplishments share the possibility of combining with temporal adverbials that express temporality with a specific endpoint, introduced by the preposition *in* (e.g., *in an hour*).

Thus, achievements are identified with a punctual moment that marks the transition from one state to another, often implying a subsequent resultant state, even if this is not lexically expressed.

According to the author:

“By way of illustration to this section, I add four examples which demonstrate our time schemata from another angle. For activities: A was running at time *t* means that time instant *t* is on a time stretch throughout which A was running. For accomplishments: A was drawing a circle at *t* means that *t* is on the time stretch in which A drew that circle. For achievements: A won a race between *t*₁ and *t*₂ means that the time instant at which A won that race is between *t*₁ and *t*₂. For states: A loved somebody from *t*₁ to *t*₂ means that at any instant between *t*₁ and *t*₂ A loved that person. This shows that the concept of activities calls for periods of time that are not unique or definite. Accomplishments, on the other hand, imply the notion of unique and definite time periods. In an analogous way, while achievements involve unique and definite time instants, states involve time instants in an indefinite and nonunique sense.”

(Vendler, 1967, pp. 106-107)

Table 5 presents a summary of Vendler’s taxonomy as proposed by Moens (1987, p. 55):

Table 5 Vendler's taxonomy (Moens, 1987, p. 55)

Processes with successive phases		Processes without successive phases	
Homogenous	Heterogenous	Punctual	Period
Activities	Accomplishments	Achievements	States
Run, swim, push a cart, walk	Paint a picture, write a novel, read a book	Recognize, win the race, find, realize	Love, know, believe, want, resemble

This taxonomy allowed Vendler to demonstrate that the semantics of verbal predicates plays a central role in constructing the temporal and aspectual meaning of sentences. At the same time, his proposal established a fundamental distinction between grammatical aspect — morphologically marked, for example, through compound tenses — and lexical aspect, or *aktionsart*, which depends on the intrinsic semantic properties of the predicate. Vendler’s theory has had wide-reaching influence on subsequent linguistic research, giving rise to important theoretical reformulations and developments. For instance, Mourelatos (1978) suggested a reconceptualisation of Vendler’s categories as event types, while Moens (1987) proposed a more detailed event structure distinguishing phases such as preparation, culmination, and consequence. Formal semantics, particularly the Discourse Representation Theory

developed by Kamp and Reyle (1993), also incorporated Vendlerian aspectual categories into the representation of narrative eventualities.

Thus, the initial distinction between predicates that do or do not admit the progressive construction proved not only heuristic but also theoretically fruitful, enabling the foundation of a robust theory of the temporal structuring of utterances.

2.4.2. Dowty (1979)

In the work *Word Meaning and Montague Grammar*, David Dowty (1979) proposes a formal approach to lexical meaning and its integration with formal grammar, particularly within the framework of Montague Grammar. One of the central contributions of this work concerns how lexical aspect and grammatical aspect can be represented formally and compositionally.

Dowty builds on the distinction between different types of verbal predicates — namely states, activities, accomplishments, and achievements — revisiting and formalising the aspectual typology initially proposed by Vendler (1957). These aspectual types are defined based on semantic properties such as durativity, dynamism, telicity, and punctuality. Dowty's innovation lies in formalising these categories through logical operators and temporal structures, which allow the integration of aspectual notions into the compositional semantics of sentences.

From a technical standpoint, Dowty models the different types of verbs and predicates using temporal predicate logic, employing concepts such as events and time intervals to represent aspectual properties. For example, verbs denoting accomplishments are modelled as events that have an intrinsic endpoint (*telos*), whereas activities are represented as continuous events without internal temporal boundaries.

Dowty (1979, pp. 55–56) begins by proposing a distinction between stative and non-stative predicates, demonstrated through a series of linguistic tests. The following examples, taken from Dowty (1979, pp. 55–56), show that only non-stative verbs:

i. Occur with the progressive:

(23)

- a. *John is knowing the answer.
- b. John is running.
- c. John is building a house.

ii. Can appear as complements of causative verbs such as *force* and *persuade*:

(24)

- a. *John forced Harry to know the answer.
- b. John persuaded Harry to run.
- c. John forced Harry to build a house.

iii. Can occur in the imperative mood:

(25)

- a. *Know the answer!
- b. Run!
- c. Build a house!

iv. Accept agentive adverbials such as *deliberately* and *carefully*:

(26)

- a. *John deliberately knew the answer.
- b. John ran carefully.
- c. John carefully built a house.

v. Can appear in pseudo-cleft constructions with *do*:

(27)

- a. *What John did was know the answer.
- b. What John did was run.
- c. What John did was build a house.

vi. Are the only ones for which the Present Simple expresses, in an unmarked context, a real or actual present. For the other aspectual classes, this tense tends to indicate habits or frequencies:

(28)

- a. John knows the answer. [“real” present reading]
- b. John runs. [habitual reading]
- c. John recites a poem. [habitual reading]

Dowty (1979, pp. 56–58) proposes a formal distinction between activities and accomplishments, based on different semantic and combinatorial diagnostics.

i. While accomplishment verbs naturally occur with prepositional adverbials introduced by *in* (e.g., *in an hour*), but only marginally accept expressions with *for* (e.g., *for an hour*), activity verbs exclusively admit constructions with *for*-phrases:

(29)

- a. ?John painted a picture for an hour.
- b. John painted a picture in an hour.

(30)

- a. John walked for an hour.
- b. (*)John walked in an hour.

ii. Only accomplishments can occur in constructions with *take time* and *spend time*, whereas activities appear exclusively with *spend time*.

(31)

- a. John spent an hour painting a picture.
- b. It took John an hour to paint a picture.

(32)

- a. John spent an hour walking.
- b. (*)It took John an hour to walk¹².

iii. The entailments of activity verbs with expressions introduced by *for* differ from those of accomplishment verbs under the same conditions:

¹²Although (32b), and perhaps even (30b), may yield acceptable readings, *one hour* in these interpretations does not describe the duration of John's action, as it does in (29b) and (31b); rather, it seems to indicate the time that elapsed before John actually began walking (Dowty, 1979, pp. 56–57).

– If *John walked for an hour*, then at any moment within that interval it is true that *John walked* (the subinterval property).

– If *John painted a picture for an hour*, it does not follow that he was painting the picture throughout the entire period.

iv. The relationship between the progressive and the perfect also distinguishes activities from accomplishments:

– If *V* is an activity verb, then *x is (now) V-ing* implies *x has V-ed*.

– If *V* is an accomplishment verb, then *x is (now) V-ing* implies *x has not (yet) V-ed*.

v. This difference in implications also holds when the verbs occur as complements of *stop*:

(33)

a. John stopped painting the picture.

b. John stopped walking.

In (33b), it can be concluded that John actually walked. In (33a), it is only inferred that he was painting the picture — not necessarily that he finished it.

vi. Only accomplishment verbs generally occur as complements of *finish*:

(34)

a. John finished painting a picture.

b. *John finished walking.

vii. The adverb *almost* also reveals distinct behaviours:

(35)

a. John almost painted a picture.

b. John almost walked.

In (35b), it is inferred that the action did not take place; in (35a), the reading tends to be that John was painting a picture, which he may or may not have completed.

With regard to achievements, Dowty (1979, pp. 59–59) proposes a series of tests for their identification:

i. While accomplishments readily accept temporal adverbials introduced by *for* and *in*, achievements generally sound unnatural with temporal expressions introduced by *for*:

(36)

a. John noticed the painting in a few minutes.

b. ??John noticed the painting for a few minutes.

ii. The same distinction is evident in constructions with the verbs *spend* and *take*:

(37)

a. It took John a few minutes to notice the painting.

b. ??John spent a few minutes noticing the painting.

iii. The semantic implications of achievements also differ from those of accomplishments. If it is true that John painted a picture in an hour, then it follows that John was painting during that hour. However, the truth of (20a) does not imply that John was noticing the painting over the course of several minutes.

iv. Unlike accomplishment verbs, achievements are generally unacceptable as complements of the verb *finish*:

(38)

*John finished noticing the painting.

v. Similarly, achievements are unacceptable as complements of the verb *stop* (except under a habitual reading):

(39)

(*)John stopped noticing the painting.

vi. Finally, achievements rarely occur with agentive adverbs such as *attentively*, *studiously*, and the like:

(40)

??John attentively noticed the painting.

All these tests appear to be explainable by the fact that achievements combine the absence of duration with telicity (Cunha, 1998, p. 12).

Below is a summary table from Dowty (1979, p. 60) that systematises the distinction between states, activities, accomplishments, and achievements:

Table 6 Identification criteria for states, activities, accomplishments, and achievements¹³
(Dowty 1979, p. 60)

Criterion	States	Activities	Accomplishments	Achievements
Meets non-stative tests	No	Yes	Yes	?
Has habitual interpretation in simple present tense	No	Yes	Yes	Yes
<i>V for an hour, spend an hour V-ing</i>	Ok	Ok	Ok	Bad
<i>V in an hour, take an hour V-ing</i>	Bad	Bad	Ok	Ok
<i>V for an hour entails V at all times in the hour</i>	Yes	Yes	No	d.n.a.
<i>x is V-ing entails x has V-ed</i>	d.n.a.	Yes	No	d.n.a.
Complement of <i>stop</i>	Ok	Ok	Ok	Bad
Complement of <i>finish</i>	Bad	Bad	Yes	No
<i>X V-ed in an hour entails x was V-ing during that hour</i>	d.n.a.	d.n.a.	Yes	No
Occurs with <i>studiously, attentively, carefully, etc.</i>	Bad	Ok	Ok	Bad

The examples and tests proposed, although not without exceptions, provide a solid foundation for aspectual analysis, allowing for a precise formal representation of different verbal eventualities. Moreover, by articulating logical operators with temporal notions such as events and intervals, Dowty makes a decisive contribution to the consolidation of a compositional semantics that accommodates both lexical properties and the requirements of phrasal structure. Dowty's formalisation of aspect remains, to

¹³Legend: Ok = the sentence is grammatical, semantically normal; Bad = the sentence is ungrammatical, semantically anomalous; d.n.a. = the test does not apply to verbs of this class

this day, an essential reference for any theoretical or empirical approach aiming to analyse the interaction between the lexicon, time, and grammatical structure.

2.4.3. Mourelatos (1981)

In the article *Events, Processes, and States* (1981), Alexander P. D. Mourelatos proposes a semantic typology of verbal predications aimed at clarifying fundamental distinctions in the domain of aspect. Drawing on empirical observations and a theoretical foundation inspired by the philosophy of language and logic, the author seeks to systematise the diversity of English verbal predicates — distinctions which have relevant parallels in other languages, including Portuguese.

Mourelatos revisits and develops the typology first introduced by Zeno Vendler (1957), who classified verbs into four aspectual categories — states, activities, accomplishments, and achievements (Mourelatos, 1981, p. 415). However, Mourelatos proposes a reconceptualisation of this taxonomy, grouping predicates into three macro-classes: states, processes, and events. These categories are not merely classificatory but aim to capture the distinct ontological properties of the situations that predicates describe.

Mourelatos opts for this terminology because he considers it more neutral with respect to agentivity, avoiding any presupposition or bias regarding the presence of an agent in the situations described (Mourelatos, 1981, pp. 422–424).

The proposed aspectual typology is structured according to a dichotomous logic (Figure 4), which not only makes it possible to spell out the distinctive features of each class — thereby facilitating their differentiation — but also to highlight the shared properties among them through hierarchical groupings (Cunha, 1998, p. 13).

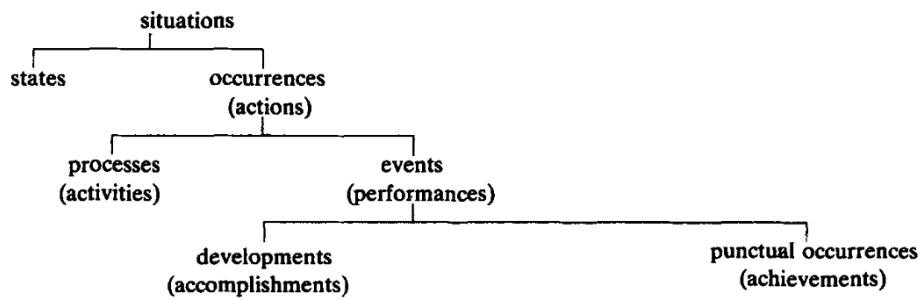


Figure 4 Aspectual typology proposed by Mourelatos (1981, p. 423)

Situations can be characterised as either states or occurrences. States are defined by their temporal homogeneity and lack of dynamism. Stative predicates, such as *know*, *believe*, or *love*, do not imply change and are typical of continuous, stable situations over time. Occurrences, on the other hand, are dynamic situations that may be either processes or events. Processes (sometimes referred to as *activities* in other approaches) correspond to ongoing situations without an inherent endpoint, such as *run*, *swim*, or *walk*. These predications are durative and dynamic, but do not necessarily culminate in a result.

Events, finally, are conceived as discrete units involving a development directed towards a closure or culmination. This class includes both *accomplishments* (such as *build a house* or *write a letter*) — which entail duration and a terminal point — and *achievements* (e.g. *reach the top*, *win the race*), which are punctual and denote an instantaneous change of state. Mourelatos emphasises that these distinctions are not merely semantic, but also have syntactic and pragmatic projections, influencing, for instance, compatibility with certain temporal adverbs.

One of the most significant contributions of Mourelatos's article is the observation that the same predicate can belong to different aspectual classes, depending on certain syntactic and semantic properties of the sentence in which it occurs. In this regard, examples presented by Cunha (1998, p. 14) illustrate the possibility of such multivalence in constructions with the verb *to sing*:

(41)

- a. Maria sings in the university choir. (habitual state)
- b. Maria sang all morning. (process)
- c. Maria sang the national anthem. (development)
- d. Maria finished singing at 5 o'clock. (punctual occurrence)

These examples point to the issue of the *polyvalence* of predicates in relation to the different aspectual classes proposed, as well as to the multiplicity of linguistic factors that enable such mobility between categories.

In order to address this issue, Mourelatos proposes that aspectual types should not be assigned to predicates as isolated lexical units, but rather to *predications* — understood as the set of relations and interdependencies established between the predicate and the other constituents of the sentence. Thus, it is the predication, as a complex linguistic expression, that should be classified in terms of aspect. This conception not only accounts for the multivalence of certain verbs, but also allows for a systematic integration of the semantic and syntactic factors that contribute to the determination of aspectual category (Cunha, 1998, p. 14).

Mourelatos, therefore, suggests that verbal predications should be analysed in terms of their internal semantic structure, with particular attention to the notion of *countability*, adapted from the domain of count and mass nouns. Accordingly, predications of the achievement and accomplishment types would be sortal and countable (i.e., they can be quantified in terms of number of occurrences), whereas states and activities would be non-sortal, or mass-like, and thus not naturally countable (Mourelatos, 1981, pp. 429–431). For instance, while *John built three houses* is perfectly acceptable, *John slept three times* requires a specific context to sound natural, since *sleep* is an activity with a mass-like nature.

In addition to the argument structure and lexical value of the verb, Mourelatos emphasises that the aspectual class of a predication is not a fixed or exclusively lexical property. On the contrary, its determination results from a dynamic interaction between multiple linguistic elements, among which the following are particularly noteworthy (Mourelatos, 1981, p. 425):

i. Semantic value of the verb

The basic aspectual feature of a predication depends to a large extent on the main verb. Verbs such as *know*, *be*, or *be acquainted with* tend to form stative predications, characterised by the absence of dynamism and temporal delimitation. By contrast, verbs such as *run* or *sing* are typically processual and atelic, while verbs like *have lunch* or *faint* tend to constitute telic events, with an inherent endpoint.

(42)

- a. Maria knows French. (state)
- b. Maria ran. (activity/process)
- c. Maria had lunch. (telic event – development)
- d. Maria fainted. (punctual occurrence)

ii. Argument structure and internal object

The presence and nature of the internal object strongly influence the telicity of a predication. A verb like *to eat* can produce an atelic predication (*eat rice*) or a telic one (*eat an apple*), depending on the quantification and specificity of the direct object.

(43)

- a. She ate rice for an hour. (atelic situation – process)
- b. She ate an apple in two minutes. (telic event – accomplishment)

iii. Temporal and adverbial modifiers

Certain adverbial modifiers — especially expressions of duration and frequency — serve as important cues in determining aspect. Adverbs such as *for an hour* tend to favour atelic interpretations, whereas expressions like *in five minutes* indicate the culmination of the event, signalling a telic reading.

(44)

- a. Pedro read the newspaper for years. (atelic – habitual state)
- b. Pedro read the newspaper for an hour. (atelic – process)
- c. Pedro read the newspaper in an hour. (telic – accomplishment)

In addition to temporal adverbs, there are locative expressions which, when combined with certain verbs, contribute to the telicity of predications that would

otherwise remain atelic. This is illustrated, for example, by the contrast between *Pedro drove*, which describes an unbounded process, and *Pedro drove from home to the university*, where the specification of the route introduces a terminal point, turning the situation into a telic development.

iv. Quantification and counting adverbials

The presence of cardinal quantifiers, such as *three times*, is compatible with telic and sortal predications. Conversely, vague modifiers like *much* or *frequently* tend to occur with atelic predications.

(45)

- a. The volcano erupted three times. (punctual, countable event)
- b. The volcano erupted frequently. (atelic, uncountable event)

v. Grammatical aspect (viewpoint aspect)

The distinction between perfect and imperfect aspect (or perfective vs. imperfective) — that is, how the event is viewed in relation to the temporal timeline — also contributes to the aspectual reading of the predication. The same predication can be interpreted as either culminated or non-culminated depending on the tense and verbal aspect.

(46)

- a. She was reading the book when the phone rang. (imperfective – ongoing process)
- b. She read the book in one day. (perfective – completed event)

vi. Tense

Verbal tenses, as bearers of aspectual features — as is the case, for example, in Portuguese — also constitute an important factor in identifying what determines the aspectual class of predications. The Simple Present, in particular, often favours habitual interpretations of the situations it describes (Cunha, 1998, p. 17).

(47)

- a. John runs the marathon. (Simple Present – habitual state)
- b. John ran the marathon. (Simple Past – accomplishment)

vii. Time

Time — understood as the system of temporal relations that can be established between a given situation and the moment of utterance (or another temporal reference point), such as past, present, or future — also plays a significant role in determining the aspectual reading of predications. Indeed, a situation that, when placed in the past, is naturally interpreted as telic, may lose that reading when framed in the present. This is because, when presented as still ongoing, it becomes impossible to confirm the occurrence of its final point, an essential element for its interpretation as a culminated event (Cunha, 1998, p. 17).

(48)

a. Yesterday, Maria wrote the letter. (telic reading – accomplishment)

b. Now, Maria writes the letter. (atelic reading – habitual state)

The tripartite model proposed by Mourelatos constitutes a significant advance in understanding the aspectual diversity of verbal predications, offering an analytical framework that goes beyond purely lexical classification and is anchored in a broader ontological perspective.

It is important to emphasise that the aspectual class of a predication does not arise exclusively from the properties of the verb, but emerges from the interaction between multiple factors: the semantic value of the verbal predicate, its argument structure, temporal modifiers, quantification elements, grammatical tense, and grammatical tense. This compositional and context-dependent approach is fundamental to a rigorous linguistic description of aspectual phenomena in natural languages.

In this respect, Mourelatos's observations play a crucial role in delimiting what Moens (1987) later terms Aspectual Network, as they pave the way for considering various linguistic mechanisms that condition and enable the transition between different aspectual categories, highlighting the dynamic and contextual nature of aspectual interpretation.

2.4.4. Moens (1987)

In his doctoral thesis *Tense, Aspect and Temporal Reference*, Moens (1987) proposes a reformulation of the classical taxonomy of aspectual classes developed by Vendler (1967), introducing a more detailed categorical structure and a terminological framework that is more transparent. This proposal is grounded in the fundamental distinction between *states* and *events*, assigning to the former the property of being *unbounded*, that is, temporal spans without a clearly defined beginning or end, and to the latter the characteristic of being *bounded*, as they exhibit a defined temporal boundary (Moens, 1987, pp. 57–58).

One of the central innovations of this model lies in the introduction of a new aspectual category, absent from Vendler’s taxonomy, which allows for a more fine-grained differentiation of so-called atomic events. Moreover, Moens entirely replaces Vendler’s terminology, which he regards as insufficiently transparent and inadequate for accurately describing the complexity of linguistic eventualities.

Within the category of events, Moens proposes a division between *extended events* and *atomic events*, thereby refining the distinction between events with successive phases (such as accomplishments) and sudden events (such as achievements). Additionally, a new contrastive dimension is introduced: the presence or absence of consequences, which enables a distinction between *telic events* (those with consequences) and *atelic events* (those without consequences). From this articulation, four main categories emerge: *processes*, *culminated processes*, *culminations*, and *points*. Table 7 presents the aspectual classes and the terminology proposed by Moens.

Table 7 The new labels of 5 Vendlerian categories (Moens, 1987, p. 57)

	Events		States
+conseq	CULMINATION <i>Recognize, spot, win the race</i>	CULMINATION PROCESS <i>Build a house, eat a sandwich</i>	<i>Understand, love, know, resemble</i>
-conseq	POINT <i>Hiccough, tap, wink</i>	PROCESS <i>Runs, swim, walk, play the piano</i>	

Processes correspond to Vendler's activities: temporally extended events lacking an inherent endpoint and, consequently, without determinate outcomes. A paradigmatic example would be *John worked in the garden*, which describes an ongoing activity. *Culminated processes* (equivalent to accomplishments), by contrast, are events that comprise a processual phase leading to a well-defined endpoint, after which a change of state occurs — the so-called consequences of the event. The utterance *John built a house* illustrates this type of eventuality particularly well: it involves a process with culmination and subsequent effects, which may, for instance, be expressed through the perfect form (*John has built a house*) (Moens, 1987, p. 58).

Within the domain of atomic events, Moens distinguishes between *culminations* and *points*. *Culminations* (e.g., *John recognised Mary*) are punctual events that themselves constitute a culmination point, yet they entail inferable consequences. *Points* — a category not addressed by Vendler — refer to instantaneous events devoid of internal structure and unaccompanied by consequences, such as *The light flashed*, whose function is simply to mark a specific moment in time.

In line with Dowty (1979) and Mourelatos (1981), Moens argues that this categorisation does not constitute a taxonomy of verbs, but rather a classification of sentence-meanings, given that aspectual class depends on the interaction among various sentence constituents: subject, object, verbal tense, temporal adverbs, among others (Moens, 1987, pp. 59–60). To illustrate this perspective, the author presents examples with the verb *to run*:

(49)

- a. John ran in the park (for a while).
- b. Today, John ran a mile (in less than four minutes).
- c. John runs for Scotland.

In example (48a), the temporal modifier *for a while* suggests an atelic reading, corresponding to a process. In (48b), the expression *in less than four minutes* marks a terminal point, allowing a telic reading, that is, a culminated process. Example (48c) corresponds to a habitual use, typically classified as a state. These examples

demonstrate the flexibility of verbal expressions regarding their aspectual classification, highlighting the need for a more dynamic and contextually sensitive model.

Moens formalises his conceptual proposal through an aspectual network (see Figure 5), which represents the possible transitions between categories depending on the sentential and extra-sentential context. This network enables the modelling, for instance, of the transition from a process to a culminated process through the addition of a culmination point. Such a transition is represented by an arrow labelled “+culmination”, indicating the introduction of an additional semantic layer associated with the event’s completion and its consequences. Conversely, transitions in the opposite direction are also anticipated, such as the suppression of the culmination point in contexts that preclude it, as in *John played the sonata for a few minutes*, which forces an atelic reading of the verbal event.

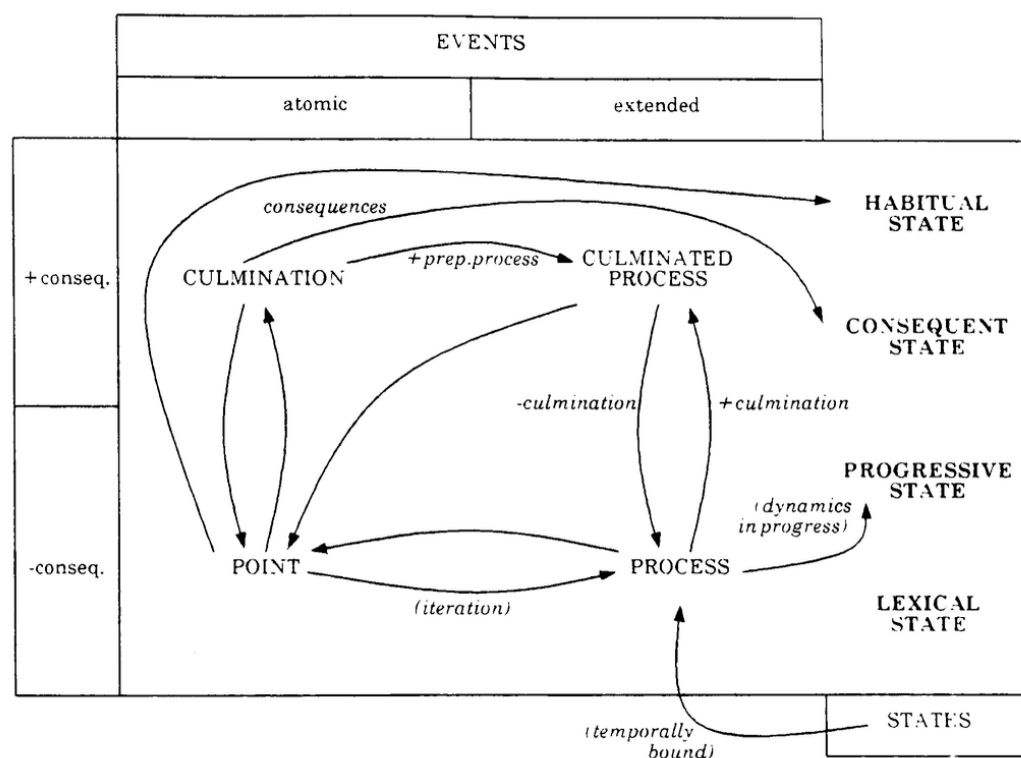


Figure 5 Aspectual Network (Moens, 1987, p. 61)

The labels used on the arrows within the network carry an instructive value, functioning as interpretative cues regarding the semantic operations involved. Markers such as “+culmination” or “–consequences” respectively signal the addition or removal

of relevant semantic components. Other unmarked labels, such as “consequences”, indicate the descriptive focus of the resulting category.

At the centre of this conceptual architecture lies the notion of the Aspectual Nucleus (see Figure 6), an entity composed of three phases: (i) the preparatory process, (ii) the culmination point, and (iii) the resultant state (Moens, 1987, pp. 64–65). The preparatory process is a durative, homogeneous, and atelic phase; the culmination point is punctual, atomic, and indivisible; the resultant state is stative and represents the consequences of the completion of a telic event. The different aspectual classes correspond to distinct configurations of this core:

- Processes: only the preparatory process; durative, homogeneous, and atelic.
- Culminated processes: comprise all three phases; durative and telic.
- Culminations: include the culmination point and the resultant state; punctual but entail consequences.
- Points: only the culmination point; atomic, punctual, and devoid of consequences.

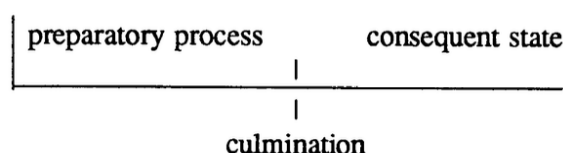


Figure 6 Aspectual Nucleus (Moens, 1987, p. 65)

Processes consist solely of a preparatory phase, which renders them durative and atelic, lacking any intrinsic culmination point. The properties of their aspectual nucleus help to explain the homogeneity and cumulativeness that characterise their typical behaviour (Cunha, 1998, p. 23).

Culminated processes inherit properties from the phases that compose them: they are durative, like processes, and telic, like culminations. The truth of a statement such as *John played a sonata* implies both the occurrence of a process (John played) and the verification of a resultant state (the sonata is played). Culminations raise a significant theoretical question: as punctual events, how can they entail consequences? A possible answer — although not developed by Moens —, proposed by Cunha (1998, p. 23), lies

in the postulation of an implicit resultant state, whose semantic activation occurs inferentially, thereby preserving the momentary nature of this category.

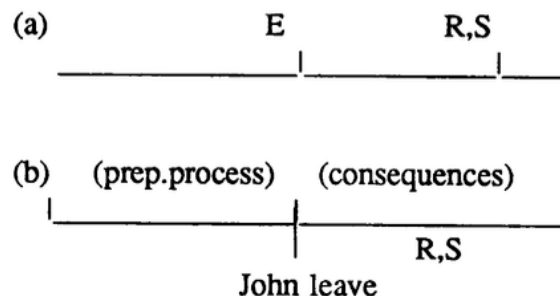
Finally, points do not present any resultant state, being purely punctual events. Examples such as *John sneezed* or *John knocked on the door* illustrate this category, with the absence of linguistic consequences being evident, as in the unacceptability of *John is sneezed* or *the door is knocked* (Cunha, 1998, p. 24).

Since all these categories partake in the Aspectual Nucleus, they may be regarded as interrelated subevents. The very structuring of the nucleus allows for the explanation of a set of typical semantic inferences associated with the different classes, as well as the observable transitions between them in various sentential contexts.

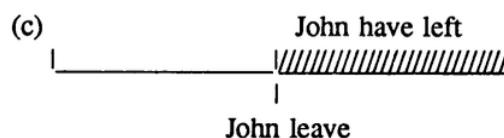
Moens (1987, pp. 65–66) further proposes the following: rather than representing the Present Perfect solely in the classical terms of Reichenbach (E, R, S) as in (50a), it may be added that the reference time (R) is, in fact, located within the phase of the consequences subsequent to the core event, as illustrated in (50b):

(50)

John has left.



In this model, the reference time may be positioned at any point within the resultant phase, since there are no constraints on the interval between the core event and R. Thus, the entire area representing the consequences constitutes a valid domain for locating R, which can be graphically represented by dashed lines, as shown in (50c).



In the case of the Present Perfect, it is further required that the reference time coincides with the speech time ($R = S$); in the Past Perfect, the reference time must precede it ($R < S$).

In sum, Moens' (1987) proposal represents an important conceptual advance in aspect theory. By combining the Vendlerian tradition with a dynamic model oriented towards the phrasal composition of meaning, it provides crucial descriptive and operational tools for the study of linguistic temporality, both in linguistics and applied domains.

2.4.5. Cunha (1998, 2004)

Within the scope of aspectual studies in European Portuguese, the works of Luís Filipe Cunha (1998, 2004) are particularly important, especially for the distinction he proposes between micro- and macro-level aspectual analysis, for his characterisation of states, and for his examination of aspectual operators.

Cunha advocates a unified conception of Aspect, discussing the traditional divisions commonly found in the literature between Grammatical Aspect, Aristotelian Aspect, and *Aktionsart*. He acknowledges the existence of different levels or planes that interact in aspectual composition. Accordingly, he proposes a distinction between microstructural phenomena — associated with the construction of aspectual classes based on distinctive features — and macrostructural phenomena, which are related to the semantic effects resulting from the application of aspectual operators and “perspectivizers” (Cunha, 2004, p. 57).

At the microstructural level, the verb and the arguments it subcategorizes convey partial but crucial information about the internal temporal properties of the eventuality. Once this information is compositionally computed, it allows for the identification of the basic aspectual category of the predication. The set of mechanisms that interact in constructing this basic situation is referred to by the author as the *microstructural aspect*.

At the macrostructural level, grammatical tenses, aspectual verbs, temporal adverbs, and other elements operate on the basic eventuality, altering its aspectual profile and giving rise to a derived type of situation. Cunha (2004, p. 62) refers to this process as

macrostructural aspect. Such transformation may be triggered either by operators, which fully convert a given input into an output of a distinct nature, or by perspectivizers, which, while modifying the focus of the base situation, partially preserve its identifying characteristics.

Based on the fundamental contributions of Kratzer (1995) and Chierchia (1995), Cunha (2004, pp. 81-85) proposes a series of diagnostic tests aimed at distinguishing two types of stative predications: individual-level states and stage-level states. This distinction is particularly relevant for the semantic analysis of stative predications, as it highlights systematic differences both in the linguistic behavior and in the aspectual value of these constructions.

Among the most pertinent criteria for this differentiation is the characteristic temporal profile of each category. Specifically, this concerns the (in)compatibility with adverbs or adverbial expressions that impose temporal restrictions on the predication with which they combine (e.g., *yesterday*, *for a week*, *since Monday until today*, among others).

According to Cunha (2004, p. 83), due to their relatively stable and permanent nature, individual-level states tend to resist explicit temporal modification, which often results in semantic anomaly or forced interpretations when such adverbs are associated with them. In contrast, stage-level states, being associated with transient or temporally delimited situations, show strong compatibility with these temporal restrictions, naturally integrating into contexts that specify a temporal extent, whether implicitly or explicitly marked.

An illustrative example of the differential behavior of the two classes with respect to temporal adverbials is the pair: *Maria is intelligent* vs. *Maria was sick yesterday*. The first sentence conveys an individual-level state (permanent and not temporally bounded), whereas the second expresses a stage-level state (transient and compatible with temporal delimitation).

Although not exhaustive, this criterion constitutes a robust diagnostic tool for the classification of stative predications, insofar as it is based on observable properties in the semantic-syntactic behavior of linguistic constructions.

Alongside the criterion of compatibility with restrictive temporal adverbials, Cunha (2004) proposes other diagnostic tests for distinguishing individual-level from stage-level states, also grounded in observable semantic-syntactic properties. These tests rest on the hypothesis that stage-level states, due to their closer anchoring to time and contextual situation, behave distinctly from individual-level states.

Firstly, only stage-level states naturally admit quantification through expressions such as *whenever*, *every time that*, among others. This type of quantification presupposes the existence of multiple temporally delimited occurrences of the eventuality described, which is only compatible with transient states. In contrast, individual-level states, due to their atemporal and permanent character, resist this type of quantification (*Whenever Maria is sick, she drinks lemon tea with honey* vs. **Whenever João is tall, he plays basketball*).

Secondly, only states unequivocally classified as stage-level exhibit difficulties in occurring with the aspectual operator *passar a* ("to start to").

Finally, stage-level states also naturally combine with punctual adverbials (such as *yesterday at 10 am*, *last Tuesday*, *at the exact moment when...*), where the temporal interval designated by the adverbial is preferably interpreted as included within the time of the described situation.

In addition to the distinctive criteria already mentioned, there are others that, albeit less directly, may prove useful for determining the stative nature of a predication (e.g., tests of agentivity).

Still with regard to states, Cunha (1998, p. 29) also questions the possibility of characterising subclasses of states, in a manner analogous to that of events, and presents Moens' (1987) proposal, which distinguishes four fundamental types of states: lexical, progressive, resultant, and habitual.

Lexical states arise from predications whose stative value results from inherent properties of certain lexical items, particularly predicates. Progressive states emerge from the application of the aspectual operator Progressive. Resultant states, in turn, are part of the Aspectual Nucleus and express, in a non-dynamic manner, the consequences associated with many culminations. Finally, habitual states derive from the iteration of

events that come to be viewed as an undifferentiated whole, forming a static continuum.

Cunha (1998, p. 31) also discusses the tests proposed by Dowty (1979) for distinguishing between states and events. The examples are revisited below:

(51)

- a. *John is being tall.
- b. *Mother persuaded John to be tall.
- c. *John, be tall!
- d. *John was deliberately tall.
- e. *What John did was be tall.
- f. John is tall. [“real” present reading]

(52)

- a. John is being generous to his colleagues.
- b. Mother persuaded John to be generous to his colleagues.
- c. John, be generous to your colleagues!
- d. John was deliberately generous to his colleagues.
- e. (Given the desperate situation), what John did was be generous to his colleagues.

While the utterances in (51) exhibit typical stative behaviour, those in (52) align well with the criteria that characterise events. The predicate in (52), although inherently stative (evidenced, for instance, by the ease with which it yields a “real” present reading, as in (52)), behaves as an event across the sentences in (52a–f), failing the stativity tests proposed by Dowty (1979). As discussed previously (cf. 2.4.4), the Aspectual Network allows for the conversion of states into processes, which is the interpretation proposed for the examples in (51).

This raises the question: why are the examples in (51), despite being structurally similar, ungrammatical? Cunha (1998, pp. 31–32) proposes that only certain states may be incorporated into the Aspectual Network and converted into processes, whereas others are precluded from doing so. It is thus possible to draw a distinction between phase states — that is, those amenable to transition into events — and non-phase

states, which cannot be reduced to eventive interpretations. This property appears to be linked to lexical features: for instance, *being tall* would be [–phase state], while *being generous to one's colleagues* would be [+phase state].

However, this distinction proves to be more complex. Consider the following example:

(53)

- a. The race is being difficult.
- b. *I persuaded the race to be difficult.
- c. *Race, be difficult!
- d. *The race was deliberately difficult.
- e. *What the race did was be difficult.
- f. (?) The race is frequently difficult.
- g. The race began to be difficult.
- h. (?) When I took part, the race was difficult.

This case does not fit neatly within Dowty's criteria for distinguishing between states and events. The question remains as to whether *being difficult* should be considered a [+phase state] or [–phase state]. As Dowty (1979) points out, all aspectual classes can be either agentive or non-agentive. The examples above show that certain diagnostic criteria for distinguishing between states and events are more closely related to agentivity than to aspectuality. However, given that non-agentive events do exist (e.g. *to rain*, *to blossom*), agentivity should not be considered a decisive factor in distinguishing between states and events. It follows, then, that certain states can behave, with respect to the relevant aspectual criteria, like (non-agentive) events (Cunha, 1998, pp. 30–31).

Cunha (1998) also offers a characterisation of certain aspectual operators frequently found in Portuguese, namely *começar a* (to begin to), *continuar a* (to continue to), *deixar de* (to cease to), *parar de* (to stop), *acabar de* (to have just), and *andar a* (to go around doing). These operators are described as linguistic elements whose principal function is to alter the perspectivation or focalisation of the situations they describe, with

significant consequences for the aspectual classification of the expressions with which they combine (Cunha, 1998, p. 103).

Table 8 presents a summary of the model proposed by Cunha, indicating the aspectual operator, the base category of eventualities with which it combines, as well as the respective input and output resulting from the operation. This systematisation allows for a clearer observation of the regularity and predictability of the aspectual effects induced by each operator, while highlighting their significance for the study of aspectual compositionality in Portuguese.

Table 8 The main aspectual operators and operations in European Portuguese proposed by Cunha (2004)

Aspectual Operator	Base Category	Input	Output
<i>Começar a</i> (to begin to)	Event and phase state	Pre-preparatory phase of state	Punctual event
<i>Continuar a</i> (to continue to)	Non-phase state	Non-phase state	Non-phase state
<i>Continuar a</i> (to continue to)	Event and phase states	Process	Process
<i>Deixar de</i> (to cease to)	Non-phase state	Non-phase state	Non-phase state (cessative)
<i>Deixar de</i> (to cease to)	Event and phase state	Process	Punctual event + cessative state
<i>Parar de</i> (to stop)	Process and culminated process	Basic process	Punctual event (+ cessative state)
<i>Acabar de</i> (to have just)	Process and culminated process	Basic process	Punctual event (+ cessative state)
<i>Andar a</i> (to go around doing)	Event and phase state	Process	Habitual or frequentative state
<i>Estar a</i> (be in the progressive aspect)	Event and phase state	Process	Progressive state

Based on this conception, the author proposes an analysis grounded in the notion of an aspectual operation, understood as the conversion of a given base aspectual category (input) into another category resulting from the application of the operator (output). This conversion can be modelled through transitions or transformations within the Aspectual Network, as outlined by Moens (1987), wherein the basic aspectual categories (states, processes, culminations, and points) are interconnected by switching pathways. Thus, each aspectual operator acts upon an eventuality with a particular base aspectual

structure, promoting a systematic transformation. For example, *começar a* tends to operate on processual predicates by introducing an initial delimitation of the event; *continuar a* (to continue to) presupposes the existence of an ongoing process; *acabar de* (to have just) recodes a culminated event as recent and completed, among other operations.

Cunha also provides a characterization of certain adjectival predicative constructions, highlighting their typical aspectual values (Table 9).

Table 9 Aspectual Properties of Adjectival Predicative Constructions (Cunha, 1998, p.146)

Adjectival Predicative Construction	Aspectual Value
<i>ser</i> ADJ	State (inherent properties of an individual)
<i>estar</i> ADJ	State (temporally limited manifestations of an individual)
<i>continuar</i> ADJ	State (temporally limited manifestation of an individual)
<i>andar</i> ADJ	Habitual or frequentative state
<i>ficar</i> ADJ	Culmination with an expressed resultant state

Based on the analysis undertaken, Cunha (2004, pp. 140–141) proposes a set of conclusions supporting the relevance of a more refined approach to stative predications in European Portuguese. The diversity of linguistic behaviors manifested by lexical states fully justifies adopting a complex subclassification based on factors such as phaseability and the distinction between predications about individuals and about “stages.” This subclassification proves particularly effective in explaining the divergences observed between predicative structures with the verbs *ser* and *estar*. Indeed, although this opposition largely reflects the distinction between individual-level and stage-level predicates, *phaseability* emerges as a decisive factor in clarifying certain linguistic phenomena whose interpretation is initially more problematic.

The analysis of various constructions involving adjectival, nominal, and prepositional predicates reveals the existence of contextual variants of the verb *estar* with specific aspectual values. For example, structures with *continuar* (“continue”) describe temporal intervals that presuppose the prior occurrence of other intervals of the same nature, whereas constructions with *andar* (“go around”, “be in the process of”) express an iterative or habitual perspective on certain types of states typical of stage-level

predicates. Noteworthy is also the linguistic behavior of predicative structures with the verb *ficar* (“become/remain”), as these allow both eventive readings and stative interpretations. Observations suggest that such configurations frequently involve a combination of a punctual event and an explicitly encoded resultant state, which confers considerable aspectual complexity.

Finally, Cunha’s proposed subclassification is likewise adequate to account for the (im)possibilities of combinatorial interactions between stative predications and progressive aspect forms, thereby offering a more precise and systematized description of the behavior of these structures within the verbal system of Portuguese.

Cunha’s analysis leads to a deeper understanding of the role of stativity in the grammar of Portuguese, revealing that this category is not confined to the aspectual characterisation of predications. On the contrary, stativity emerges as a structuring principle in the temporal organisation of discourse, decisively influencing the articulation between different events and states. This influence extends beyond the strict domain of Aspect, affecting other linguistic subsystems and highlighting the complexity of interactions between temporal and discursive categories. Thus, stativity stands out as a central element in the architecture of language, with far-reaching implications for syntactic, semantic, and pragmatic analysis.

3. Annotation of Clinical Narratives

This chapter is dedicated to the review of literature concerning the annotation of clinical narratives. Section 3.1 provides an overview of general concepts related to annotation schemes, including their theoretical foundations, stages of development, and practical applications. Section 3.2 addresses linguistic studies on clinical narratives. Section 3.3 examines the main approaches to the annotation of clinical texts. In Section 3.4, particular attention is given to proposals for the temporal annotation of clinical narratives. Finally, Section 3.5 discusses initiatives and studies related to the annotation of clinical narratives in Portuguese.

3.1. Annotation Schemes: Foundations, Development and Applications

Manual annotation constitutes one of the fundamental pillars of both linguistic research and NLP (cf. Snow et al., 2008; Flickinger et al., 2017). In addition to enabling the empirical study of linguistic phenomena, it provides essential reference labels for the training and evaluation of models across various NLP tasks (Pustejovsky and Stubbs, 2012; Pustejovsky et al., 2017; Levi and Shenhav, 2022). Beyond supporting data-driven approaches, manual annotation contributes to the formalisation of linguistic theories by offering a structured framework for their empirical validation (Hovy and Lavid, 2011).

The development of robust and coherent annotation schemes is, therefore, of critical importance. A well-designed scheme should ensure that annotation is systematic, consistent, interoperable, and comprehensive. It should also enable the rigorous representation of complex linguistic phenomena, grounded in theoretical principles, while remaining practically applicable by annotators (Beck et al., 2020).

Annotation schemes consist of formalised structures that guide the identification and labelling of linguistic or domain-specific phenomena in textual datasets. These structures include descriptive and analytical tags that, during the annotation process, are assigned to predefined linguistic units (such as words, phrases, clauses, or documents), based on specific guidelines. Such guidelines define which phenomena are to be annotated, which tags and attributes are to be used, as well as the operational instructions necessary to ensure the consistent application of the scheme (Ide, 2017).

The standardisation of the annotation process ensures that the annotated data are systematic, coherent, and interpretable by both humans and automated processing algorithms (Pustejovsky and Stubbs, 2012). To achieve this, it is essential that the annotated labels and units have clear operational definitions, thereby facilitating consensus among human annotators. In machine learning contexts, annotation schemes may also highlight relevant features associated with the labels, thus contributing to the effectiveness of the models.

Currently, annotation workflows frequently employ specialised tools that support the identification of segments, the assignment of labels, and the marking of relations between elements. These tools often include IAA metrics, which are crucial for assessing the reliability of the annotation and for supporting the more efficient development of automated systems.

Over the past decades, various annotation frameworks have been developed to account for linguistic phenomena, later serving as the basis for annotation schemes that provide structured labels and attributes for morphosyntactic analysis (Marcus et al., 1993; Marneffe et al., 2021), semantic roles (Palmer et al., 2005; Jindal et al., 2022; Baker et al., 1998), coreference (Hovy et al., 2012), temporal relations (Pustejovsky et al., 2003), and discourse relations (Mann and Thompson, 1988; Prasad et al., 2018). In parallel, multi-layer annotation schemes have been proposed to cover different linguistic levels (Basile et al., 2012; Bos et al., 2017; Silvano et al., 2021; Bonn et al., 2024), allowing for a more comprehensive representation of linguistic information.

As the demand for annotated data increases, so does the need for standardisation and interoperability. Initiatives such as ISO 24617 — Semantic Annotation Framework (ISO TC37/SC4, 2012) have encouraged the development of reusable annotation models, aiming to uniformise practices by building on existing frameworks, thereby promoting consistency and facilitating comparison across different datasets. (Ide and Romary, 2006).

In general, these schemes are designed for broad applicability, aiming to capture linguistic structure and meaning across a wide range of texts. However, certain specialised domains, such as medicine, require more tailored annotation approaches,

adapted to their specific terminological, structural, and pragmatic characteristics (Irrera et al., 2024).

3.2. Linguistic Studies on Clinical Narratives

With regard to studies on the linguistic properties of clinical narratives in EHR, it is observed that such research is scarce or even non-existent. Among the works that do address the study of linguistic properties in this domain, Lysanets et al. (2017) stand out, having analysed the stylistic features of *case reports* – not medical reports – in English, extracted from the *Journal of Medical Case Reports*. The authors identified a set of stylistic traits that distinguish case reports from other genres of medical scientific writing, namely: educational and instructive intentions, conciseness and brevity, a direct and personal tone, and the presentation of content in a narrative style. The study further demonstrated that these communicative strategies are implemented through specific lexical choices and grammatical structures, most notably the predominance of active voice sentences, the use of the past simple tense, personal pronouns, and modal verbs. Occasional occurrences of other tenses (present perfect, present simple, and future simple), as well as passive voice constructions, were also recorded, each associated with particular communicative functions within the genre under analysis.

More recently, Nickels et al. (2024) conducted a study focused on the expression of uncertainty in medical reports in English. The authors underline the central role of modality as a key resource in conveying uncertainty, documenting the different linguistic forms employed and their frequency in the corpus examined.

It should also be noted that other studies have addressed medical discourse, albeit based on corpora other than medical reports. Vihla (1993), for instance, also examined modality in medical discourse, drawing on the *Medicor* corpus in English, which comprised scientific articles, editorials, compendia, professional manuals, technical guidelines, and popular science texts. Similarly, Carter-Thomas and Rowley-Jolivet (2008) investigated the use of *if*, the prototypical operator of conditionality in English, encompassing both complete constructions (*if P, Q*) and elliptical *P-clauses*. In this case

too, the corpus did not include medical reports but rather scientific articles, conference presentations, and editorials.

In the case of European Portuguese, the writing of medical reports generally follows the methodology proposed by Weed (1968), known as the *Problem-Oriented Clinical Record*. According to this approach, the patient’s initial admission report must provide a comprehensive description organised into four sections: history of the present illness, past history (personal, family, and social), review of symptoms, and physical examination. While this methodology specifies how clinical problems should be structured and presented within the report, it does not address linguistic properties (such as verb tense usage), focusing instead on the organisation of content. That said, to the best of our knowledge, no systematic studies have yet been conducted on the linguistic properties of this textual genre in Portuguese.

3.3. Annotation of Clinical Narratives: Main Proposals

The availability of annotated clinical corpora remains quite limited (Névél et al., 2018), especially when compared to the resources available in the field of biology (Roberts et al., 2009; Cohen and Demner-Fushman, 2014; Campillos-Llanos et al., 2018). This scarcity is closely linked to the stringent ethical and legal issues surrounding the use of EHR, which contain sensitive and identifiable patient information. In order for these data to be used in research, rigorous anonymisation measures must be implemented, such as the removal of personal health identifiers or their replacement with fictitious data (Grouin and Névél, 2014; Campillos-Llanos et al., 2018).

This situation is even more critical for low-resource languages, such as Portuguese. Most research in medical NLP focuses on English-language texts (Miranda-Escalada et al., 2020), with significantly fewer studies dedicated to other languages. Nonetheless, there are notable initiatives for French (Campillos-Llanos et al., 2018), German (Becker et al., 2019), Japanese (Kawazoe et al., 2020), Chinese (Zhu et al., 2023), Spanish (Campillos-Llanos et al., 2025), Norwegian (Rama et al., 2018), and Swedish (Skeppstedt et al., 2014).

The annotation of clinical narratives requires particular attention, given the complexity of medical language and the specificity of the concepts involved. Unlike

other types of texts, clinical narratives often contain technical, fragmentary, or elliptical language, with implicit constructions and highly contextualised expressions (Moharasan and Ho, 2019: 221). These features necessitate the adoption of specialised annotation schemes capable of reliably capturing the relevant information.

Several annotation schemes have been developed with this purpose in mind, targeting specific tasks such as the identification of clinical entities (e.g., diagnosis, medications) (Sun et al., 2013a), the annotation of negation and uncertainty phenomena (Vincze et al., 2008), and the representation of temporal information (Sun et al., 2013b). The diversity of these proposals reflects not only the differing objectives of annotation tasks but also the linguistic particularities of the data involved.

As synthesised by Campillos-Llanos et al. (2018), the development of these resources has been largely driven by a range of research initiatives in collaboration with healthcare institutions. Notable examples include corpora such as those from the Mayo Clinic (Ogren et al., 2008), the Clinical E-Science Framework (CLEF) (Roberts et al., 2007), the THYME project (Styler IV et al., 2014), SHARP (Savova et al., 2012), MiPACQ (Albright et al., 2013), IxA-Med-GS (Oronoz et al., 2015), and the Harvey corpus (Savkov et al., 2016).

In terms of depth, annotation schemes applied to clinical texts are often structured into two levels (Campillos-Llanos et al., 2018: 573):

- A basic (or low-level) layer, focused on the identification of relevant textual mentions — such as symptoms, diagnosis, or medications — and their linguistic and semantic representation;
- An advanced (or high-level) layer, aimed at structuring and integrating this information in such a way that computational inferences over clinical records become possible.

Taken together, these initiatives and annotation schemes demonstrate the centrality of annotation in transforming clinical narratives into structured resources, thereby enabling a wide range of applications in digital health — from clinical decision support systems to personalised medicine and epidemiological surveillance. They also play an important role in linguistics, as they make it possible to study recurrent linguistic phenomena in this type of text as well as to characterise this textual genre.

3.4. Annotation of Clinical Narratives: Temporal Annotation

Temporal information refers to the linguistic elements that indicate the passage of time or locate eventualities at specific moments. The basic units of such information, in a computational perspective, are dates and times (e.g., “July 2025”, “10:13 am”), with all temporal expressions ultimately reducible to some combination of these units, describing when an event occurred or for how long it lasted (Olex and McInnes, 2021, p. 2).

However, such information is not always presented explicitly. It often appears embedded in natural language and is expressed in vague or implicit terms, which hinders its automatic detection and interpretation (Olex and McInnes, 2021, p. 2; Sun, 2013a: S6). According to Lim et al. (2019, p. 934), temporal information in texts typically manifests in five main forms:

1. Explicit temporal information

This includes dates and times mentioned directly in the text, such as “July 2025” or “10:13 am”.

2. Implicit temporal information

This may be further divided into:

- Globally implicit: depends on extratextual knowledge, such as historical events (e.g., “New Year’s Eve”) or prior clinical events that are not explicitly mentioned in the text. For instance, “presented with fever two days after starting treatment” — inferring the onset of the fever requires knowledge of the treatment initiation date, which is absent from the document.
- Locally implicit: relies on other temporal references within the same document. For example, “the patient fell on 3 March” followed by “reported back pain two days later” — the expression “two days later” is interpreted in relation to the previously mentioned date.

3. Relative temporal information

This refers to events anchored to another event or to the document creation time. Expressions such as “five days ago” are relative to the document

timestamp, while “one hour after taking the medication” depends on the time at which the medication was administered, even if that moment is not made explicit.

4. Vague temporal information

This includes imprecise temporal expressions that do not allow for the inference of specific dates or times. Examples include “in the early 1990s” or “the pain started around three months ago”. The latter is both relative (to the document date) and vague (due to the use of “around”).

5. Non-consumable temporal information

This refers to temporal information that is not expressed in the text but is assumed to be known, such as the document creation date. Many relative expressions are anchored to this implicit reference point.

The definition and categorisation of temporal information are essential, but they only become useful within the context of NLP if they can be formalised for computational use. To this end, the development of temporal annotation schemes, grounded in linguistic studies on temporal and aspectual semantics, is indispensable, as they enable the structured representation of such information and thereby facilitate its application in automatic temporal reasoning tasks (Olex and McInnes, 2021, p. 3). Furthermore, the temporal annotation of medical reports will also foster progress in the study of linguistic and semantic issues, for instance, the aspectual characterisation of nominal events, which are highly frequent in EHR, as well as the broader linguistic characterisation of medical reports.

Temporal annotation constitutes a specific type of representation that focuses on the interpretation of temporal information expressed in natural language. In clinical narratives, as in other narrative forms, temporal information involves the identification of eventualities, temporal expressions, and the temporal relations between these elements. This dimension plays a central role in interpretation and clinical reasoning, as it allows for an understanding of, for instance, the time of patient admission, the duration and frequency of symptoms, and the sequence in which treatments are

administered — all of which are crucial for informed medical decision-making, from diagnosis through to therapeutic choice (Sun et al., 2013a: S5).

The construction of a representation scheme proves particularly demanding, as it requires the explicit formulation of fundamental assumptions concerning the very concept of time (Augusto, 2001: 302–303). As summarised by Olex and McInnes (2021, p. 3), temporal annotation schemes have evolved considerably over the past three decades: from simplified annotations with temporal values assigned to events (as in the *Message Understanding Conferences* of the 1990s), to the introduction of temporal expressions with multiple attributes and relations (in projects such as TIDES, Ferro et al., 2001, and TimeML, Pustejovsky et al., 2003), through to adaptations for the clinical domain — notably THYME-TimeML (Styler IV et al., 2014) — and culminating in the formulation of interval- and semantics-based schemes such as SCATE (Bethard, 2016). Figure 7, taken from Olex and McInnes (2021, p. 3), presents a timeline that summarises the key milestones and characteristics of this evolution.

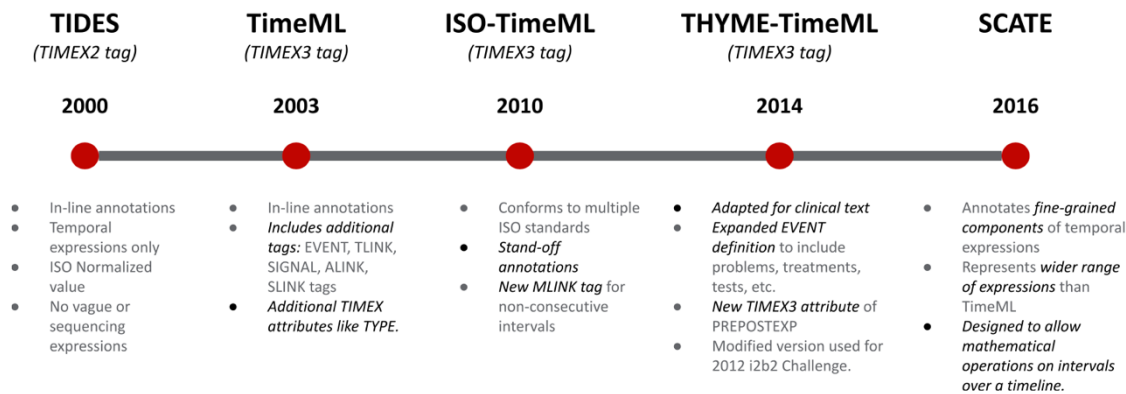


Figure 7 Timeline of temporal annotation schemes (taken from Olex and McInnes, 2021, p.3)

Despite the growing attention dedicated to medical NLP, certain subfields — such as anonymisation and the extraction of clinical concepts (e.g., pathologies or medications) — have received more focus than the analysis of temporal structures (Sun et al., 2013a: S5). This is partly due to the intrinsic complexity of the task and the scarcity of manually annotated clinical corpora containing temporal information.

In 2012, the *Informatics for Integrating Biology and the Bedside* (i2b2) project was a pioneer in making available to the scientific community the first fully anonymised clinical corpus annotated with temporal information, within the scope of its challenge on the

evaluation of temporal relations in clinical texts (Sun et al., 2013a; Sun et al., 2013b). This effort was followed by the publication of the THYME (*Temporal Histories of Your Medical Events*) corpus (Styler IV, 2014), developed for the 2015 Clinical TempEval challenge (Bethard, 2015).

The i2b2 challenge provided 310 anonymised clinical discharge summaries from the MIMIC II (Medical Information Mart for Intensive Care) database, collected at the Beth Israel Deaconess Medical Center (Johnson, 2016), with gold-standard temporal annotations. The task was organised into three components: (1) identification of temporal expressions (TIMEX) and clinically relevant events (EVENT), (2) identification of temporal relations (TLINK), and (3) end-to-end evaluation. Unlike previous tasks in general domains, the i2b2 challenge focused specifically on clinically relevant events: clinical concepts (problems, treatments, and tests), clinical departments (the mentions of the clinical departments or services where the patient was, is or will be admitted to), evidentials (words or phrases that indicate the source of information such as the word “complained” in “The patient complained about a week-long headache”), and occurrences (events such as “admit”, “transfer” or “discharge”, that affect the patient’s clinical timeline). Temporal expressions were annotated using a modified version of the THYME-TimeML scheme, including dates, times, durations, and frequencies, with absolute values normalised according to the ISO-8601 standard. The TLINKs included all possible combinations between two TIMEXes, two EVENTS, or one TIMEX and one EVENT, with relations such as BEFORE, AFTER, SIMULTANEOUS, OVERLAP, BEGUN_BY, ENDED_BY, DURING, and BEFORE_OVERLAP.

Eighteen teams officially participated, and the corpus subsequently served as the foundation for the development of various systems that propelled research in this field.

Between 2015 and 2017, Bethard et al. (2015, 2016, 2017) organised the Clinical TempEval challenges within the framework of SemEval, adapting the TempEval task structure to the clinical domain. They used the THYME corpus (Styler IV, 2014), which consists of 1.254 anonymised clinical notes and pathology reports from patients with colon and brain cancer followed at the Mayo Clinic.

The tasks remained consistent across the three editions: identification of TIMEXs, EVENTS, and TLINKs. TIMEXs included categories such as DATE (e.g., *The patient was admitted on April 23, 2014*), TIME (e.g., *The surgery began at 3 pm*), DURATION (*The patient had been experiencing headaches for two weeks*), QUANTIFIER (*The patient received chemotherapy for a total of 12 cycles*), PREPOSTEXP (e.g., *She developed a fever in the postoperative period*), and SET (*The medication should be taken every morning*). EVENTS were classified as ASPECTUAL (*The treatment began yesterday*), EVIDENTIAL (*The doctor noted signs of infection*), or N/A, with annotations for properties such as polarity and modality. TLINKs were divided into DOCTIMEREL (relations with the document creation time) — BEFORE, OVERLAP, BEFORE-OVERLAP, AFTER — and CONTAINS (relations between EVENTS and TIMEXs).

Adaptations of TimeML to the clinical domain were also developed by Galescu and Blaylock (2012), who applied the scheme to 40 discharge summaries, and by Savova et al. (2009), who proposed a version tailored to the specificities of medical narratives. The CLEF project (*Clinical E-Science Framework*) annotated 167 clinical records, although it was limited to intraphase temporal relations and relations between events and the document creation time (Roberts, 2007). More focused studies on specific phenomena include those by Irvine (2008), Bramsen (2006), and Lin (2013) which concentrated on diseases, temporal expressions, and linguistic cues.

In non-English-speaking contexts, notable contributions include Campillos-Llanos et al. (2018), who proposed a temporal annotation scheme for clinical texts in French and introduced the MERLOT corpus (*Medical Entity and Relation LIMSI annotated Text corpus*). Their approach, grounded in the TimeML framework, incorporates significant modifications — most notably, the combined annotation of temporal cues and expressions (e.g., *il y a 5 ans*), diverging from the separation mandated by the original guidelines.

More recently, Campillos-Llanos et al. (2025) introduced MEDSPANER, a *Medical Semantic Python-Assisted Named Entity Recognizer for the Spanish language*. This tool performs medical NER, medication information extraction, temporal entity annotation, and detection of negation and speculation. For temporal entities, they developed rules

by adapting HeidelTime, following the TimeML annotation scheme to identify dates, durations, frequencies, and times.

Finally, Fernandes et al. (2025b) compared temporal annotation generated by a Large Language Model with human annotation, both based on the Text2Story scheme (Silvano et al. 2021; Leal et al., 2022), using a corpus of clinical narratives in Portuguese. This study contributes to reflecting on the feasibility of automating the creation of temporal annotation schemes in specialised domains.

3.5. Annotation of Clinical Narratives in Portuguese

With regard to the Portuguese, datasets containing medical documents remain scarce, and among those that are available, grammatical annotation is typically lacking. In the case of Brazilian Portuguese (BP), Souza et al. (2019) developed a Named Entity Recognition (NER) system based on a corpus composed of various types of clinical narratives — namely, discharge summaries, outpatient records, and nursing notes — covering multiple medical specialties, with a particular focus on Nephrology, Cardiology, and Endocrinology. The study presents methods for the classification of abbreviations, diseases, procedures, and pharmaceuticals. Subsequently, Schneider et al. (2020) used the same corpus to train BioBERTpt, an NER model adapted to the biomedical language in Portuguese. Complementarily, Oliveira et al. (2022) described the development of SemClinBr, the first semantically annotated clinical corpus for Brazilian Portuguese. More recently, Rocha et al. (2023) worked with a set of 1.200 inpatient reports, manually annotated for relevant entities, with the goal of automatically extracting information concerning symptoms, diagnoses, medications, clinical conditions, tests, and treatments.

In the context of European Portuguese (EP), the available resources are even more limited. Ferreira (2011) developed MedInX, the first medical information extraction system applied to hospital discharge letters written in EP. Lamy (2018) proposed a prototype system consisting of serial modules based on NLP techniques, which enables the automatic extraction of clinical knowledge from unstructured information contained in EHR from a Portuguese hospital. Lopes et al. (2019) compiled and manually annotated a collection of clinical case texts with named entities. More recently, M. Nunes et al.

(2024) introduced MediAlbertina, the first clinical-domain language model trained specifically with data in European Portuguese. This model forms part of a family of encoders based on the DeBERTaV2 architecture, developed through continued pre-training of the Albertina models (Santos et al., 2024), made available by the PORTULAN CLARIN infrastructure, using EHR provided by a public Portuguese hospital. This study yielded the first publicly accessible medical language model in European Portuguese.

Henriques (2024) proposed an approach that leverages GPT-4o both to generate and annotate synthetic electronic health records. Leite (2024) introduced an ontology-based framework for information extraction and structuring, aimed at facilitating access to essential clinical data and supporting healthcare professionals in making informed decisions. This approach builds upon the same corpus that will be employed in the present study.

Despite these advances, existing studies have focused largely on the representation of clinical categories aligned with medical ontologies, without addressing the annotation of broader morphosyntactic and semantic information, in particular, temporal information.

4. The Study

In this study, the central research problem is the definition of the temporal organisation of inter-document clinical narratives in different types of medical reports: *consultation group reports*, *discharge reports*, and *general reports*. The guiding research question seeks to examine how temporal information is structured, represented, and interconnected within and across these documents, while also aiming to characterise this textual genre from a linguistic perspective. This dual focus will, in turn, enable the subsequent development of models capable of extracting and representing the clinical progression of patients in a systematic and structured manner.

To address this challenge, a detailed methodology was developed, as described in the following sections. First, the corpus to be analysed was defined with the selection of medical reports from the IPO-Porto.

The next step involved a critical analysis of the main temporal annotation schemes applied to clinical narratives, with the aim of identifying their strengths and weaknesses. Building on this analysis, an extended version of the Text2Story annotation scheme was created, named *Med2Story*, designed to represent temporal relations in medical documents more fully and informatively. To adapt this extension to the specific requirements of the clinical domain, additional attributes were integrated into the Text2Story framework to enrich morphosyntactic and semantic characterisation of temporal expressions and events, and domain-specific medical information.

Subsequently, the selected corpus, comprising reports of the three types mentioned above, was annotated. Finally, the study examined and characterised inter-document temporal properties, comparing the three report types to identify patterns and distinctive features.

Chapter 4 presents the methodological and analytical core of this study. It begins with a detailed description and characterisation of the data corpus (Section 4.1), followed by the development and application of the annotation scheme (Section 4.2), which includes its design and validation process, architectural specifications, and manual annotation protocols. The chapter then proceeds to the analysis and interpretation of results (section 4.3), examining event and temporal expression attributes, inter-document

temporal analysis, temporal characterisation by report type, and the identification of linguistic factors influencing temporal relation inference.

4.1. Description and Characterisation of the Data Corpus

The subcorpus to be annotated was extracted from an initial corpus consisting of 906 Medical Reports (MR), written in European Portuguese, relating to 93 patients diagnosed with Acute Myeloid Leukemia and followed at IPO-Porto. These documents, predominantly narrative in nature, describe the complete clinical course of each patient, from hospital admission through to discharge or death. AML is a cancer of the bone marrow stem cells, often with a poor prognosis, characterised by the uncontrolled proliferation of these cells and typically presenting with infection, anaemia, and haemorrhage (Shimony et al., 2023: 1).

The medical reports analysed in this study were written as an adaptation from the methodology proposed by Weed (1986), following the SOAP principles (Subjective, Objective, Assessment, and Plan) set out by the same author. Their structure is organised as follows:

- Patient Information: basic patient details (sex, age);
- Primary Concerns and Symptoms: the patient's main complaints and presenting symptoms;
- Medical, Family, and Psychosocial History: medical, family, and psychosocial history;
- Relevant Past Interventions and Outcomes: pertinent previous interventions and their respective outcomes;
- Clinical Findings: description of significant findings from the physical examination and other relevant clinical observations;
- Diagnostic Assessment: diagnostic methods employed (laboratory testing, imaging, surveys);
- Diagnosis: diagnostic formulation;
- Prognostic Characteristics: prognostic factors, where applicable;
- Therapeutic Intervention: proposed or implemented therapeutic interventions.

Prior to being made available for research purposes, all reports had undergone pseudonymisation by the originating institution. This process involved replacing hospital names with letters, concealing personal names, and modifying dates by adding a random number of days. The anonymisation key was not provided to us, thereby ensuring that patients, physicians, family members, or any other individuals mentioned could not be identified.

The corpus comprises three types of MRs:

- Discharge reports – documenting the patient’s clinical evolution from hospital admission to medical discharge;
- Group consultation reports – produced in the context of multidisciplinary consultations, in which several specialists review the patient’s medical history and current clinical and analytical status, and propose the most appropriate treatment;
- General reports – providing a comprehensive account of the patient’s clinical course up to the present time, often requested by the patient to justify their medical leave.

Given the origin of the documents, the number and type of reports vary across patients, reflecting the inherent variability of individual clinical pathways. Factors such as the number of hospitalisations, the inclusion of addenda to group consultations, or the requirement for general reports directly influence this composition.

The selection of the subcorpus for annotation followed predefined criteria. First, a maximum of 40 reports was set, deemed sufficient to ensure the feasibility of the work within the available time frame, without compromising the representativeness of the dataset. Second, the inclusion of all three types of reports was ensured to guarantee typological diversity. Third, patients with more than two and fewer than five reports were selected, allowing for inter-document annotation while avoiding excessive analytical work. Finally, preference was given to documents with a narrative character, excluding those whose content was limited to the presentation of test results or laboratory analyses.

Applying these criteria resulted in a subcorpus of 38 reports from 9 patients: 19 relating to group consultations, 16 to discharges, and 3 to general reports. The average length of the documents was 157 words, with a standard deviation of 104. Table 10 presents a detailed distribution of the types of reports per patient and their respective length. Within each patient's record, the different reports were organised and annotated in chronological order.

Table 10 Distribution of medical reports per patient, by document type and word count, with total word count per patient

Patient ID	Document Type & No.	Word Count	Total Word Count per Patient
Patient 1	Group consultation report #1	313	428
	Group consultation report #2	115	
Patient 2	Discharge report #1	114	519
	Group consultation report #1	176	
	Group consultation report #2	110	
	Group consultation report #3	52	
	General report #1	67	
Patient 3	Discharge report #1	157	685
	Discharge report #2	134	
	Discharge report #3	151	
	Discharge report #4	119	
	General report #1	124	
Patient 4	Discharge report #1	70	568
	Group consultation report #1	172	
	General report #1	326	
Patient 5	Group consultation report #1	95	353
	Discharge report #1	143	
	Discharge report #2	115	
Patient 6	Group consultation report #1	115	595
	Discharge report #1	160	
	Discharge report #2	109	
	Discharge report #3	112	
	Group consultation report #2	99	
Patient 7	Group consultation report #1	105	440
	Group consultation report #2	55	
	Group consultation report #3	79	
	Discharge report #1	115	
	Group consultation report #4	86	
Patient 8	Group consultation report #1	128	677
	Discharge report #1	193	
	Discharge report #2	124	
	Group consultation report #2	113	
	Group consultation report #3	119	
Patient 9	Discharge report #1	506	1088
	Group consultation report #1	113	
	Discharge report #2	230	
	Discharge report #3	105	

	Group consultation report #2	134	
Total	-	-	5352

The Ethics Committee of IPO-Porto authorised us to access these documents, with the project being duly framed within the management plan approved by the institute (Rb-Silva and Karimova, 2021). The examples provided in the following sections are adaptations of real sentences from the medical reports, which were previously pseudonymised, ensuring that patient identification is never possible.

4.2. Development and Application of the Annotation Scheme

This section presents the development process and practical application of the Med2Story annotation scheme, specifically designed for the temporal annotation of clinical narratives. Building on the theoretical and methodological foundations established in the preceding sections, it details the various stages involved in the creation, refinement, and implementation of the scheme.

Section 4.2.1 outlines the design and validation process, including the iterative methodology employed for its specification, testing, as well as the contributions of manual annotation to the development of the annotation scheme. Section 4.2.2 provides a comprehensive account of the scheme’s architecture and technical specifications, emphasising its conceptual alignment with ISO 24617-1 and the specific adaptations made to address the needs of the clinical domain. Finally, Section 4.2.3 describes the manual annotation protocols and procedures adopted during the application phase, including a discussion of challenging annotation cases.

4.2.1. Design and Validation Process of the Annotation Scheme

The process of creating the temporal annotation scheme for clinical narratives, designed to capture morphosyntactic, semantic, and medical domain-specific information simultaneously, was developed in four phases¹⁴.

¹⁴Part of this methodology was previously presented by Fernandes et al. (2025c).

Phase 1 – Literature review and selection of annotation schemes

In the first stage, a literature review was conducted with the aim of identifying annotation schemes capable of extracting morphosyntactic, semantic, and/or medical domain information, and which applied to languages beyond English. Three schemes were selected: i2b2, developed for annotating clinical narratives in English; MERLOT, created for annotating clinical narratives in French; and the temporal module of the Text2Story scheme, developed for annotating journalistic narratives in European Portuguese.

The selection of i2b2 and MERLOT was motivated by their specialisation in the medical domain and their proven ability to produce complex, large-scale clinical annotations with high IAA scores. Text2Story, in turn, was chosen for its comprehensiveness, interoperability, language-agnostic nature, and potential for the harmonised integration of multiple semantic layers — including referential information, semantic roles, and spatial data — although, in the present study, the focus is exclusively on its temporal module. This scheme was developed on the basis of the ISO 24617-1 standard, with its temporal layer grounded in ISO-TimeML, a widely adopted standard with proven applicability across diverse contexts, to which adaptations specific to European Portuguese were added.

Once the selection process was completed, a sample of six pseudonymised group consultation medical reports from the corpus under study was annotated. For this preliminary work, the *BRAT Rapid Annotation Tool* (BRAT), developed by Stenetorp et al. (2012), was used. This web-based application is widely employed in text annotation projects, including clinical narratives (cf. Campillos-Llanos et al., 2018; Zhu et al., 2023). BRAT was also used in the annotation of the MERLOT corpus and in the Text2Story project (Leal et al., 2022: 63).

The aim of this preliminary analysis was to identify the strengths and weaknesses of each scheme in order to build upon its strengths and address its limitations. Results showed that Text2Story was particularly effective in capturing morphosyntactic and semantic information but lacked specific labels for the medical domain. Conversely, while i2b2 and MERLOT allowed for the annotation of both grammatical and medical

information, their labels were overly general and insufficiently specialised for either domain.

Table 11 presents the results of this comparative analysis¹⁵.

Table 11 Comparative coverage of domain-specific and morphosyntactic and semantic features across the Text2Story, i2b2, and MERLOT annotation schemes¹⁶.

Frature	Text2Story	i2b2	MERLOT
Medical domain coverage	–	+	++
Morphosyntactic and grammatical domain coverage	+++	+	+
Presence of TLINK <i>before_overlap</i> (captures temporal information such as “recently”)	–	+++	+++
Presence of TLINK <i>identity</i> (captures coreference of the same event)	+++	–	–

Phase 2 – Expansion of the scheme with domain-specific categories

Following the initial evaluation, it became clear that none of the pre-existing annotation schemes could be used without substantial modifications. Since i2b2 and MERLOT proved insufficiently specific for both grammatical and medical domains, the temporal module of the Text2Story annotation scheme was adopted as the basis for an extended version, named Med2Story¹⁷.

The Text2Story scheme presents several advantages, with studies demonstrating its adaptability to different types of narratives and languages. It has already been applied to the annotation of journalistic narratives in Portuguese (Silvano et al., 2021), literary narratives in Portuguese, English, and Spanish (Cantante et al., 2024), and financial narratives in Portuguese (Leal et al., 2025). Compared to alternatives such as PropBank, Abstract Meaning Representation, and the Penn Treebank, Text2Story offers greater flexibility. The latter are closed systems, characterised by predefined structures and

¹⁵For a more detailed description of this study, see Fernandes et al. (2025a).

¹⁶Legend: – = not covered; + = partially covered; ++ = well covered; +++ = extensively covered.

¹⁷The Med2Story extension was presented in Fernandes et al. (2025a).

fixed category sets, limiting their flexibility and applicability across different domains or annotation layers. By contrast, the Text2Story scheme, built upon ISO 24617, of which ISO-TimeML is a part, offers an open and modular architecture, supporting the integration of multiple annotation layers. Furthermore, ISO 24617 was conceived as an interoperable standard, designed to accommodate diverse theoretical models and natural languages, enabling its adaptation to different linguistic and situational contexts with minimal modifications. The scheme allows for the annotation of eventualities, temporal expressions, and relations between eventualities, as well as between eventualities and temporal expressions.

In this phase, the full corpus of 906 medical reports was re-examined to identify domain-specific classes to be added to the scheme. This analysis was conducted in collaboration with a specialist haematologist from IPO-Porto, who indicated the clinically relevant information to be extracted. The definition of these categories was based on the [UMLS Metathesaurus ontology](#), which provides a systematic and internationally recognised framework. The definitions of the medical labels presented in this work were also informed by the study by Leite (2024), who, using the same corpus, proposed a preliminary set of clinically relevant categories validated by a medical specialist. Several of these categories were retained, while others were adapted or refined to better meet the objectives of the present annotation scheme.

The specific classes added were: *Sign or Symptom*, *Personal History (Past Medical History, Comorbidity or Undefined)*, *Intercurrence*¹⁸, *Examination*, *Examination Result*, *Principal Diagnosis*, *Characterisation of the Disease*, *Medical Procedure*, *Treatment*, *Drug Administration Route*, and *Treatment Response*. All these classes were approved by the specialist haematologist from IPO-Porto. Their inclusion provided the scheme with an appropriate level of specificity for the medical domain, thus addressing the limitation identified in the preliminary analysis of Phase 1.

¹⁸A condition or event that occurs unexpectedly during treatment or hospitalization for the Principal Diagnosis (Acute Myeloid Leukemia) but was not initially present (e.g., febrile syndrome).

To facilitate the annotation of these labels, a decision tree was developed to ensure consistency and accuracy in the process, minimising ambiguities and enhancing the replicability of results.

Additionally, in this phase, the TLINK relations *before_overlap* and *after_overlap*, absent from the original Text2Story scheme, were added. These relations capture temporal information, such as in “patient with asthenia, night sweats and, more recently, headaches”, where the event *headaches* is linked to *night sweats* by a TLINK *after_overlap*.

Phase 3 – Empirical validation

Once the initial version of Med2Story was defined, it was iteratively tested and refined until it was capable of representing all relevant information present in the medical records. Comprehensive annotation guidelines were produced, including detailed descriptions of each annotation stage, definitions and attributes for all labels, illustrative examples drawn from the corpus, and clarifications for complex or ambiguous cases.

In this phase, empirical validation of the annotation scheme and of the guidelines was carried out to assess their consistency, reliability, and interpretability. The guidelines were provided to two Linguistics students with prior annotation experience, who were asked to annotate five synthetic medical reports, corresponding to a single patient, specifically written for this purpose by a specialist haematologist at IPO-Porto. These reports, inspired by the structure of real documents, included one group consultation report, three discharge notes, and one general report.

The use of synthetic reports was justified by the fact that the annotation was conducted by individuals external to the project and therefore not covered by the IPO-Porto Ethics Committee’s authorisation to use real clinical data. The synthetic texts and the guidelines for the first version of Med2Story are available in our GitHub Repository¹⁹.

¹⁹ The supplementary material is available at:
<https://github.com/analuisacardosofernandes/Temporal-Structure-of-Clinical-Narratives-in-Portuguese>

Following the annotation, a curation-based evaluation strategy was implemented to further assess the validity and practical applicability of the scheme and guidelines. The curation was conducted by the author of this thesis, a student with expertise in both Linguistics and Pharmaceutical Sciences, who reviewed the annotated documents to identify frequent errors and challenges encountered by the annotators. This process made it possible to detect inconsistencies, such as the assignment of divergent labels to semantically similar events, often linked to ambiguities or insufficient clarity in the annotation guidelines.

The annotators were also asked to evaluate the scheme and its guidelines using Likert scales (1 to 5) in response to the following questions:

- 1) How clear and consistent are the guidelines for defining markables?
- 2) How effective are the guidelines for identifying and classifying events at the morphosyntactic and grammatical levels?
- 3) How well-defined and comprehensive are the tags for the medical domain?
- 4) How effective are the guidelines for identifying and classifying temporal expressions?
- 5) How accurate are the guidelines for identifying and classifying temporal relations between events?
- 6) How clear and detailed are the definitions of each tag?
- 7) How effective is the approach to resolving ambiguities?
- 8) How coherent and clear are the provided guidelines?

Table 12 presents the mean and standard deviation of the scores assigned by the annotators to each question. The results²⁰ were consistently high, and, overall, the annotators considered the scheme to be a robust and effective approach for resolving the ambiguities encountered. They also highlighted the presence of well-developed examples, with broad coverage and clear applicability. The guidelines were regarded as clear in most cases, although some areas for improvement were identified.

²⁰The results of this evaluation are presented in detail in Fernandes et al. (2025b).

Table 12 Mean and standard deviation of the results obtained from the evaluation of the schemes/guidelines by the annotators

Annotator	Evaluation	
	$\bar{x}$	σ
Annotator 1	4.1	0.7
Annotator 2	4.5	0.5

The feedback from the annotators provided insights into the main difficulties encountered during the annotation process, enabling further refinement of the scheme and guidelines. The Likert scales used can be consulted in the [GitHub Repository](#).

Subsequently, the IAA was calculated both between annotators (ANN1 and ANN2) and between each annotator and the curator. IAA is a widely used metric for assessing the consistency of annotations, providing a quantitative measure of their quality (Artstein and Poesio, 2008). High values indicate clear and effective guidelines, while low values may result from a variety of causes (Artstein, 2017; Basile et al., 2021; Bayerl and Paul, 2024), often revealing ambiguities or conceptual difficulties that require resolution.

Agreement was quantified using Cohen’s Kappa and Krippendorff’s Alpha, two well-established statistical measures for evaluating reliability (Artstein, 2017). Values closer to 1 indicate stronger agreement and, by extension, a more robust annotation scheme. Additionally, considering the curator’s annotations as the gold standard, annotation distance between each annotator and the curator was measured to assess alignment with expert judgement.

Tables 13, 14, 15, and 16 present the results of the IAA both between annotators and between annotators and curator²¹.

As shown in Table 13, the identification of text spans corresponding to events, temporal expressions, and TLINKs — including those between events, between events and temporal expressions, and between temporal expressions — achieved a substantial level of agreement.

²¹A detailed analysis of these results is provided in Fernandes et al. (2025c).

Table 13 IAA on span and relation annotations (exact match criteria) between ANN1, ANN2, and the curator, based on the curated reference

Type	Annotators	Krippendorff_alpha	Cohen_kappa
Relation	ANN1, ANN2	0.761	0.760
	ANN2, Curator	0.754	0.754
	ANN1, Curator	0.614	0.614
Span	ANN1, ANN2	0.741	0.742
	ANN2, Curator	0.910	0.910
	ANN1, Curator	0.682	0.684

Turning to the analysis of IAA for event attributes, as presented in Table 14, the results indicate substantial variability in the levels of agreement observed across the different attributes.

Table 14 IAA scores on event attributes between ANN1, ANN2, and the curator, based on the curated reference

Type	Annotators	Krippendorff_alpha	Cohen_kappa
Aspect	ANN1, ANN2	0.227	0.252
	ANN2, Curator	0.460	0.440
	ANN1, Curator	0.126	0.145
Class	ANN1, ANN2	0.568	0.566
	ANN2, Curator	0.789	0.786
	ANN1, Curator	0.769	0.767
Event	ANN1, ANN2	0.683	0.680
	ANN2, Curator	0.816	0.814
	ANN1, Curator	0.851	0.848
Polarity	ANN1, ANN2	0.606	0.606
	ANN2, Curator	0.920	0.920
	ANN1, Curator	0.608	0.607
PoS	ANN1, ANN2	0.959	0.959
	ANN2, Curator	0.889	0.889
	ANN1, Curator	1.000	1.000
Specialized Event	ANN1, ANN2	0.731	0.730
	ANN2, Curator	0.792	0.792
	ANN1, Curator	0.820	0.819
Tense	ANN1, ANN2	0.787	0.783
	ANN2, Curator	1.000	1.000
	ANN1, Curator	0.705	0.703
Vform	ANN1, ANN2	0.379	0.375
	ANN2, Curator	0.462	0.429
	ANN1, Curator	0.690	0.667

With regard to temporal spans, the results reveal considerable variation. Agreement values between annotators fall below the chance level for the category “Temporal Function”, owing to the fact that one of the annotators did not carry out this annotation.

By contrast, agreement for “Time Type” is reported as perfect or near-perfect, as shown in Table 15.

Table 15 IAA results for time expression attributes between ANN1, ANN2, and the curator, based on the curated reference

Type	Annotators	Krippendorff_alpha	Cohen_kappa
Temporal Function	ANN1, ANN2	-0.326	0.063
	ANN2, Curator	-0.389	0.049
	ANN1, Curator	0.523	0.520
Time Type	ANN1, ANN2	1.000	1.000
	ANN2, Curator	1.000	1.000
	ANN1, Curator	0.904	0.902

Table 16 presents the results of IAA for temporal relation annotations across different threshold levels. As the threshold increases from 0 to 3, both the number of matched temporal links and the proportion of those matches that show agreement on the relation type (e.g., Before, After) increase accordingly.

Table 16 Results of IAA between annotators in TLINKs and TLINKs attributes

Threshold	#TLINK matches	#matches in TLINK type	% agreement TLINK matches	% agreement matches in TLINK type	% agreement matches in TLINK type (filtered)
0	87	56	0.414	0.267	0.644
1	103	64	0.490	0.305	0.621
2	109	67	0.519	0.319	0.615
3	110	67	0.524	0.319	0.609

Finally, a detailed qualitative analysis of sources of disagreement was conducted to understand the underlying factors contributing to human variation in annotation²². The findings from this analysis informed subsequent refinements to both the annotation scheme and the supporting guidelines. Clarifications were introduced regarding the definition of markables, notably excluding whitespace, punctuation, and quantifiers, while modifiers and temporal complements were annotated separately with attributes from TIDES 2005 (Ferro et al., 2005). Additional examples were incorporated for

²²The results of this phase are presented in detail in Fernandes et al. (2025c).

recurrent lexicalised expressions, and specific mechanisms were created for abbreviations and polarity. Fields such as Value and Observations were introduced to capture complementary information. To address challenges arising from limited medical knowledge, annotators were provided with a short training resource prepared by a specialist. Interviews with annotators further identified sources of ambiguity and redundancy, leading to terminological adjustments (e.g., renaming General Event Class to General Event) and the integration of attributes into the Specialised Event category, thereby eliminating the need for dual labelling. Finally, the guidelines for inter-document annotation were clarified, including explicit rules for linking events and dates across medical reports, and new attributes were introduced for hospitalisation dates (Admission Time and Discharge Time). These refinements collectively improved the clarity, consistency, and applicability of the annotation scheme.

Phase 4 – Consolidation and refinement

The results of the previous phase formed the basis for the consolidation and refinement of Med2Story and its guidelines. This process followed the logic of the MATTER cycle (*Model, Annotate, Train, Test, Evaluate, Revise*) proposed by Pustejovsky et al. (2017), which emphasises the iterative nature of annotation scheme engineering. A central element of this cycle is the MAMA loop (*Model–Annotate–Model–Annotate*), in which the scheme is repeatedly applied, tested, and revised, allowing for the systematic identification of ambiguities, gaps, or inconsistencies, and promoting the continuous improvement of the model.

The final version of the guidelines is available in the [GitHub Repository](#).

4.2.2. Architecture and Technical Specifications of the Annotation Scheme

The Med2Story temporal annotation scheme – an extension of the Text2Story framework adapted to the clinical domain – enables the annotation of events, temporal expressions, and temporal relations, both between events and between events and temporal expressions.

As previously mentioned, this scheme is based on the ISO 24617-1 standard. In accordance with this standard, events are defined as eventualities that happen or occur,

or states/circumstances that are temporally relevant. Events may be expressed through nouns, pronouns, verbs, or adjectives. Within our annotation scheme, these eventualities may be classified as general events or specialised events. General events concern eventualities expressed in the text that are not specific to the medical domain. They include actions or situations that may be described independently of specialised technical terminology (e.g., “the patient <general event>returned<general event> home”). Specialised events, on the other hand, refer to eventualities that convey domain-specific clinical information. These are typically associated with diagnoses, procedures, treatments, examinations, symptoms, or other clinically relevant activities (e.g., “<specialised event>the biopsy<specialised event> <general event>confirmed<general event> <specialised event>leukemia<specialised event>”).

The attributes associated with general events represent their morphosyntactic and semantic properties (Figure 8), whereas specialised events additionally incorporate terminology specific to the medical domain (Figure 9). Events expressed by nouns, adjectives, prepositions, or pronouns receive only the attributes Part of Speech (PoS) and Polarity. All other attributes are applied exclusively to events expressed by verbs, as there is, to date, no consolidated literature on the aspectual classification of non-verbal events. Since medical-domain events are predominantly nominal, they are annotated only with respect to their grammatical class and polarity.

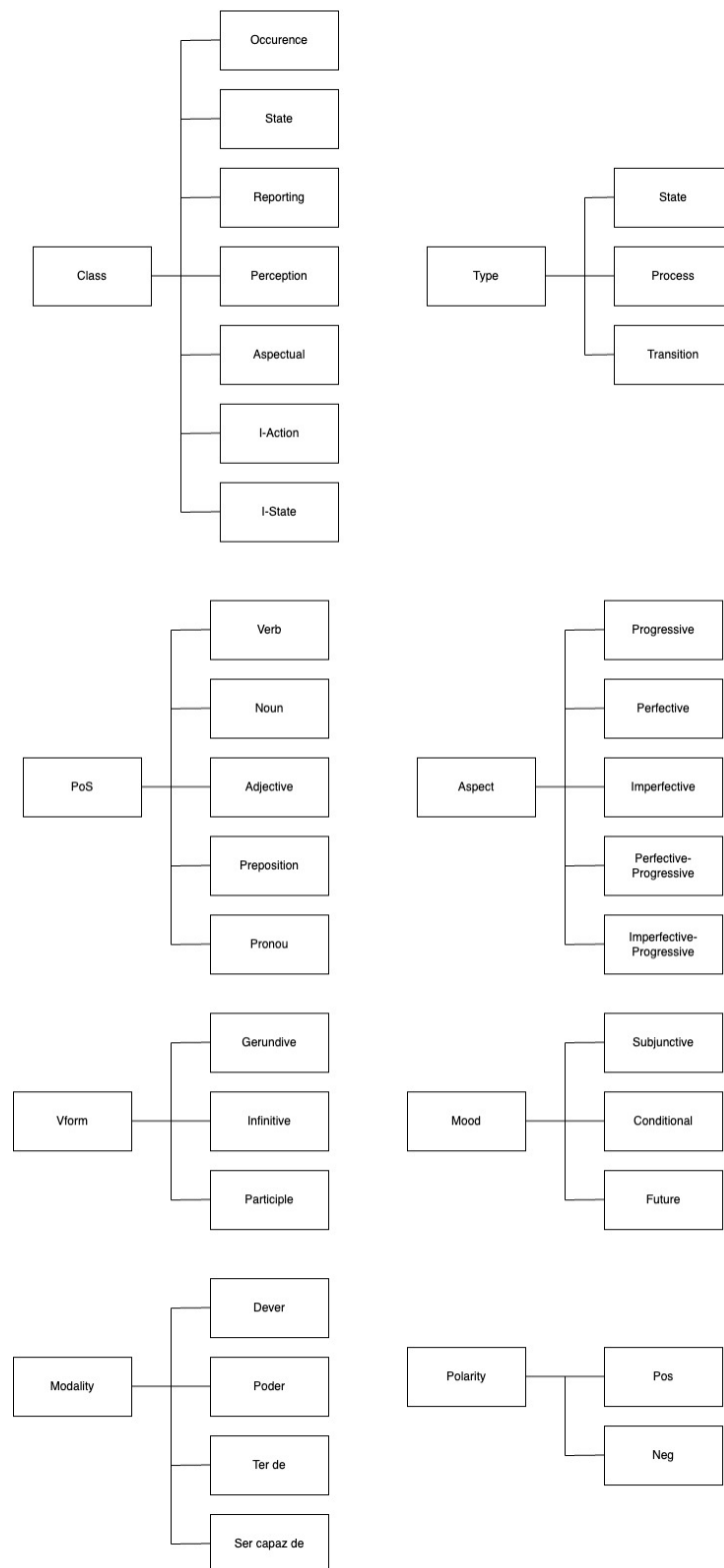


Figure 8 Attributes of General Events in Med2Story

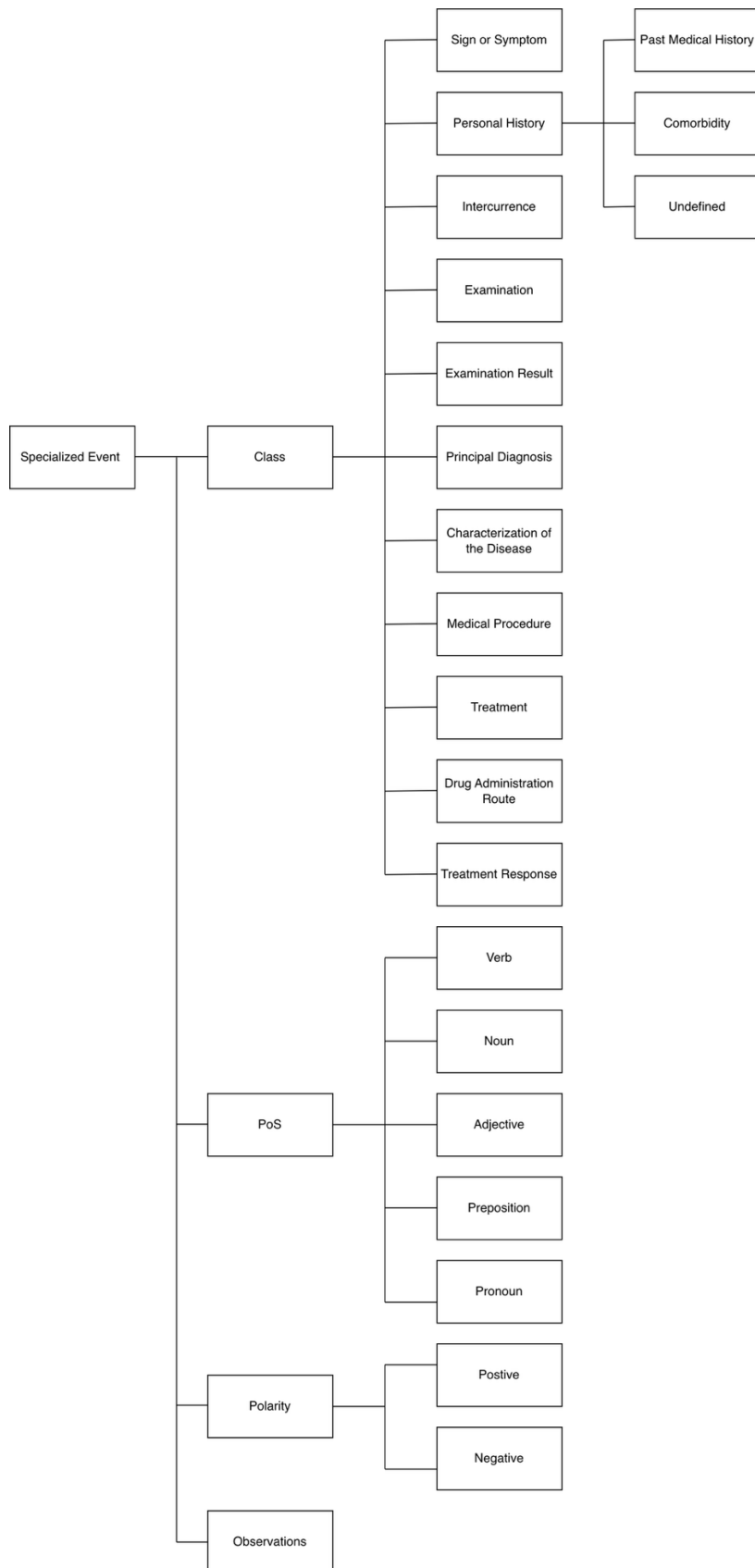


Figure 9 Attributes of Specialized Events in Med2Story

To support the selection of appropriate attributes for medical events, a decision tree was developed (Figure 10). Given that the annotation of clinical narratives requires interpreting medical terms in various contexts, the hierarchical structure of this tree guides annotators in choosing the most appropriate labels, thereby reducing inter-annotator variability. This approach proved particularly useful for both annotators with medical training and those without. For the former, familiarity with this kind of structure – widely used in clinical decision support systems (Bae, 2014) – facilitates a more intuitive and effective adoption of the scheme. For the latter, the decision tree serves as a structured guide, aiding the understanding of the annotation criteria and reducing the need for extensive prior knowledge of medical terminology. This, in turn, promotes greater standardisation of the annotation process.

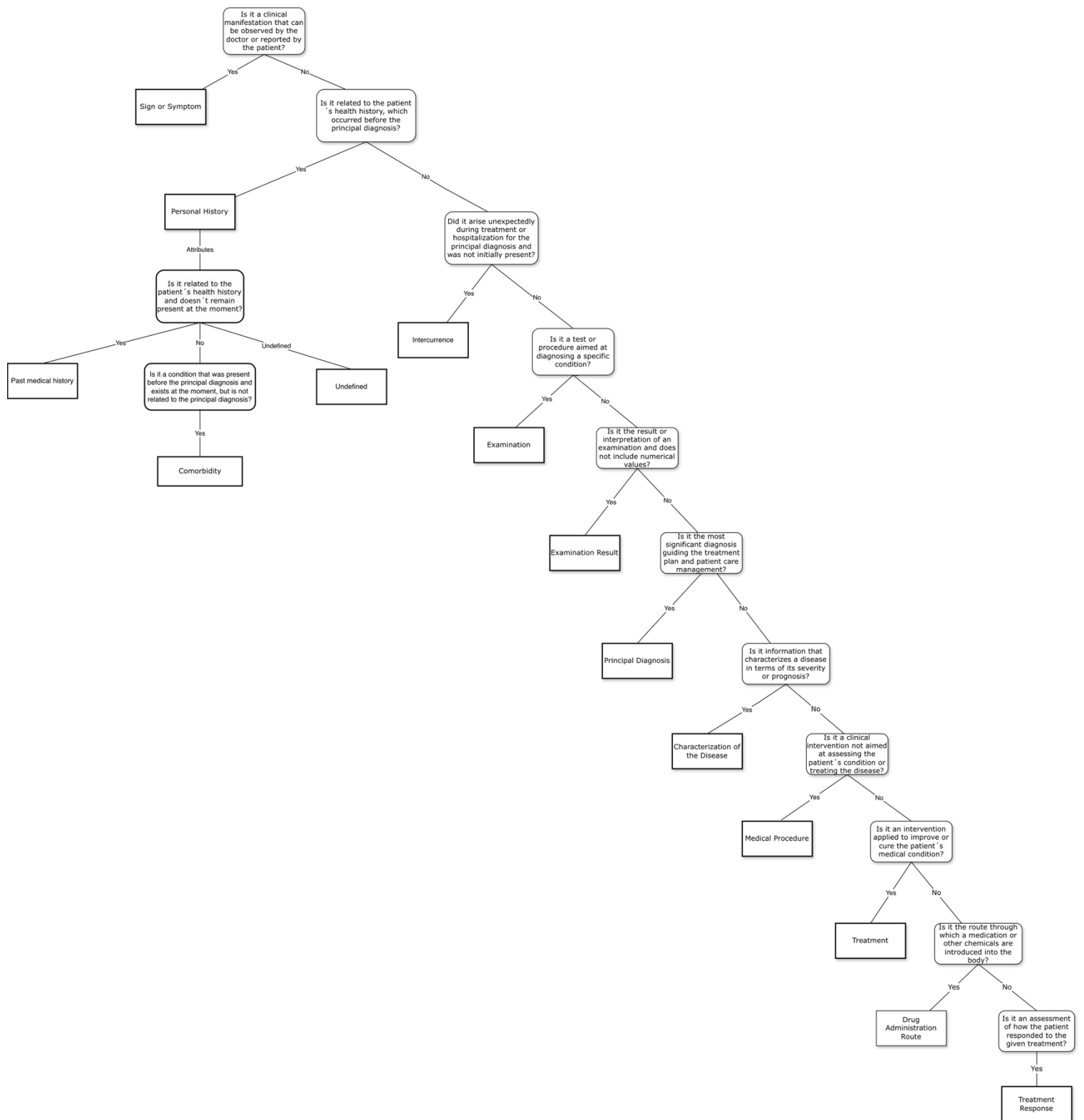


Figure 10 Decision tree to assist the annotation of specialised medical events

With regard to temporal expressions (Figure 11), these include dates, times, durations, and frequencies. When a temporal expression indicates the function of a time expression in providing a temporal anchor for other temporal expressions in the document, it receives a special attribute, which may assume one of the following values:

- DOCTIME: Refers to the date on which the medical report was created;
- AnchorTime: Specifies the point in time that serves as a reference for another temporal expression;
- Admission Time: The date on which the patient was admitted to the hospital.
- Discharge Time: The date on which the patient was discharged from the hospital.

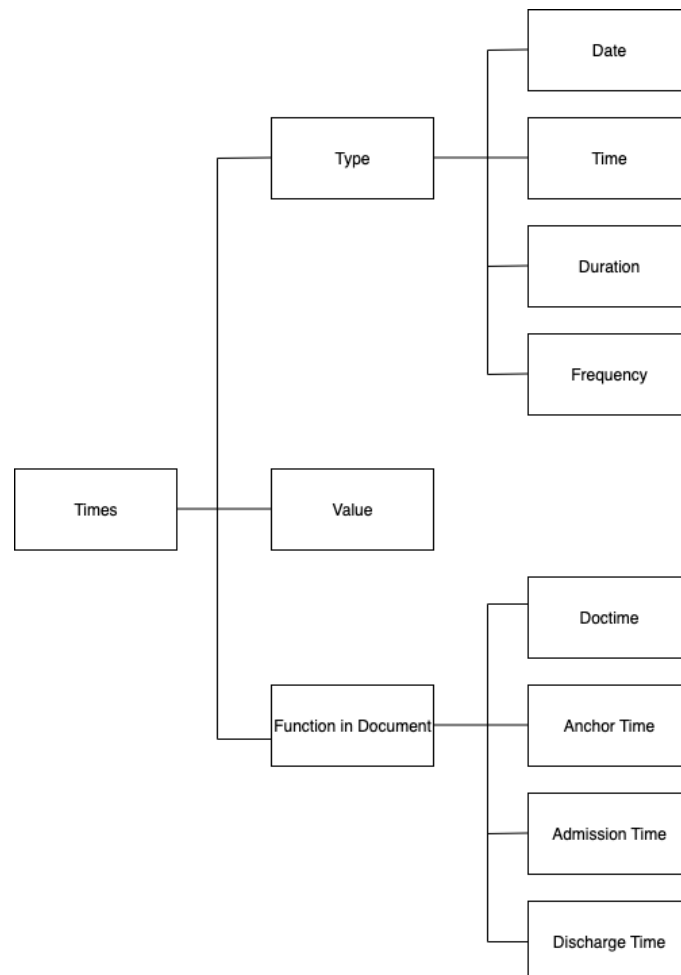


Figure 11 Attributes of Temporal Expressions in Med2Story

As for TLINKs (Figure 12), these are links that establish different temporal relations (simultaneous, after, before) between two events, two temporal expressions, or between an event and a temporal expression.

One of the innovations introduced in this work is the annotation of inter-document relations. To the best of our knowledge, only Raghavan et al. (2014) have proposed a model for cross-narrative temporal ordering of medical events, though they did not propose a systematic annotation scheme for this purpose.

In this context, the following rules were established:

- The DOCTIME (report creation date) should always be linked to both the date of the preceding report and that of the subsequent report;
- When a report is written during a hospitalisation period, its DOCTIME must be linked to both the Admission Date and the Discharge Date of the corresponding clinical episode.
- Events contained within reports should only be linked to the previous report via a TLINK_Identity, except in cases where one event mentioned but not temporally located in the previous report could be temporally anchored by an event in the subsequent one;
- Whenever possible, a TLINK was also established between the first event of a given report and the last event of the preceding one.

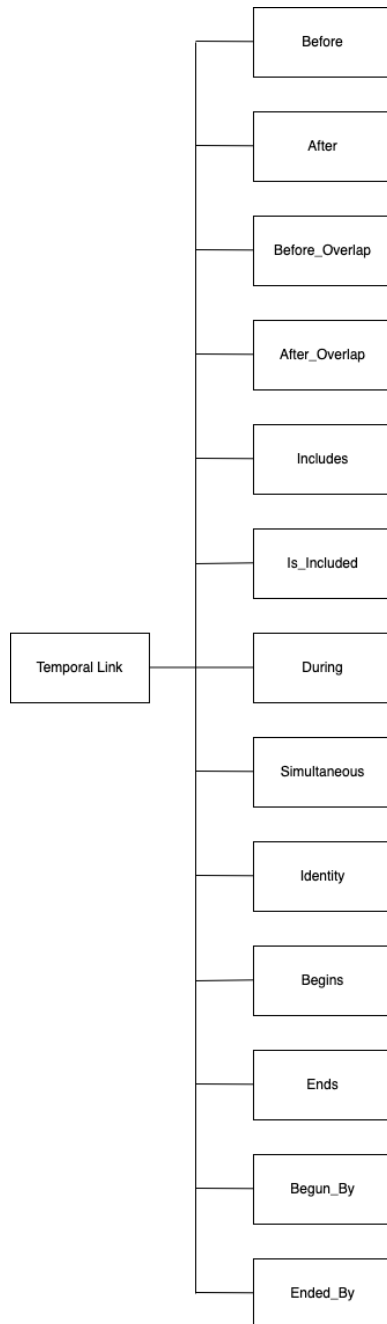


Figure 12 Attributes of TLINKs in Med2Story

(2008: 6), who demonstrate that the combination of linguistic and clinical knowledge by annotators tends to produce higher-quality annotations.

During the annotation period, weekly meetings were held with a specialist in Semantics with extensive experience in linguistic annotation tasks. In these meetings, problematic cases were discussed, ambiguities identified, and consensual solutions defined.

Below, some of the most relevant cases and the decisions made in the context of the annotation are presented and organised into three blocks: (i) issues related to event annotation, (ii) temporal expressions, and (iii) temporal relations.

(i) Event Annotation

Case 1:

(54)

“Os exames revelaram uma massa de partes moles com possível ponto de partida na parede vesical”.

(The tests revealed a soft tissue mass with a possible starting point in the bladder wall.)

Despite the absence of the modal verb “poder” (*can/may*), the segment “ponto de partida” (*starting point*) was annotated with the modality attribute “poder”, due to the presence of the adjective “possível” (*possible*), which, as stated by Oliveira and Mendes (2013), conveys a modal value of possibility. In such cases, modality is expressed adjectivally, giving the event an epistemic reading.

Case 2:

(55)

“Analiticamente será de realçar uma hiperbilirrubinémia”.

(Analytically, a hyperbilirubinaemia will be worth highlighting).

In the example under analysis, the question concerned whether the verbal expression *será de realçar* should or should not be regarded as a multi-lexical unit. The central issue lay in the possibility of its being a semi-lexicalised unit, that is, an expression partially fixed in usage and associated with a stabilised overall meaning (cf. Bacelar do

Nascimento, 2013, p. 215). In such a case, it would be justified to annotate the complete expression as a single *markable*.

The analysis led to the conclusion that it constitutes a multi-lexical unit presenting both a “short” variant (*de realçar*) and a “long” variant (*será/é de realçar*) (cf. Bacelar do Nascimento, 2013, p. 234). A search in the [Reference Corpus of Contemporary Portuguese \(CRPC\)](#) confirms the existence of several examples similar to the one under analysis, which demonstrates the productivity of the structure.

Thus, the most adequate interpretation seems to be to consider the entire expression as a multi-lexical unit, that is, the lexicalized expression *será de realçar*.

Case 3:

(56)

“Fez tratamento de quimioterapia com resposta completa”.

(*He/She underwent chemotherapy treatment with complete response.*)

In this example, the main question concerned the assignment of the aspectual class to the verbal “fez” (*underwent*). Specifically, we questioned whether this event should be classified as an occurrence of the process type or of the transition type. As mentioned in Chapter 2, occurrences of the transition type correspond to events that involve a processual phase culminating in a well-defined endpoint, after which a change of state occurs, the so-called resultant state. These events are typically compatible with adverbial modifiers such as “em x tempo” (*in x time*), whereas occurrences of the process type refer to events with temporal duration, without an intrinsic endpoint or determined results, and are more compatible with modifiers such as “durante x tempo” (*for x time*).

To clarify the classification, both types of temporal adverbials were applied to the context:

(57)

a. ?Fez tratamento de quimioterapia, em duas semanas, com resposta completa.
(*Underwent chemotherapy treatment, in two weeks, with complete response*).

b. Fez tratamento de quimioterapia, durante duas semanas, com resposta completa.

(*Underwent chemotherapy treatment for two weeks, with complete response.*)

The construction with “durante” (*for*) (57b) results better, which might initially suggest a processual reading. However, the presence of the modifier “com resposta completa” (*with complete response*), which indicates a resultant state (cf. “O tratamento ficou feito” – *The treatment was done*), led us to consider that this event should be interpreted as a transition occurrence. Indeed, the treatment is conceived here as a process leading to a change of state — the disappearance of the clinical signs of the disease — which is consistent with the criteria for transition.

Additionally, the verb “fazer” (*to undergo*), in this context, functions as a light verb, forming with its nominal complement a predicative unit equivalent to the full verb “tratar-se” (*to undergo treatment*). Thus, the verb “fez” (*underwent*) received the attributes of a transition occurrence.

Case 4:

(58)

“Tem alta com apirexia”.

(*He/She is discharged with apyrexia.*)

The question concerned whether “tem alta” (*is discharged*) should be considered a lexicalised expression (multi-lexical unit), i.e. a composite lexical unit that functions as a single item in the lexicon of the language. The methodological choice was to treat it as a composite unit.

Case 5:

(59)

“O aspirado medular mostrou 48% de blastos de fenótipo monocitoide.”

(*The bone marrow aspirate showed 48% of blasts of monocytic phenotype.*)

In this case, doubts arose regarding the aspectual classification of the eventuality expressed by the verb “mostrar” (*to show*). States are non-dynamic, durative and atelic eventualities, whereas events are dynamic and may be telic or atelic (e.g., Cunha, 2004: 20–22).

The tests proposed in the literature to distinguish states from events were applied:
(60)

a. O aspirado medular mostra 48% de blastos de fenótipo monocitoide.

(The bone marrow aspirate shows 48% blasts of monocytic phenotype.)

[Present Indicative – “real” present reading]

b. *Aspirado medular, mostra 48% de blastos de fenótipo monocitoide!

*(*Bone marrow aspirate, show 48% blasts of monocytic phenotype!)*

[Imperative – ungrammatical]

c. *O aspirado medular mostrou deliberadamente 48% de blastos de fenótipo monocitoide.

*(*The bone marrow aspirate deliberately showed 48% blasts of monocytic phenotype.)*

[Agentive adverbial]

d. *O médico persuadiu o aspirado medular a mostrar 48% de blastos de fenótipo monocitoide.

*(*The doctor persuaded the bone marrow aspirate to show 48% blasts of monocytic phenotype.)*

[Expression of agentivity]

e. *O que o aspirado medular fez foi mostrar 48% de blastos de fenótipo monocitoide.

**(What the bone marrow aspirate did was show 48% blasts of monocytic phenotype.)*

[Pseudocleft construction]

f. O aspirado medular está a mostrar 48% de blastos de fenótipo monocitoide.

(The bone marrow aspirate is showing 48% blasts of monocytic phenotype.)

[Progressive]

g.??O aspirado medular parou de mostrar 48% de blastos de fenótipo monocitoide.

(?The bone marrow aspirate stopped showing 48% blasts of monocytic phenotype.)

[Aspectual operator]

h. ?O aspirado medular acabou de mostrar 48% de blastos de fenótipo monocitoide.

(?The bone marrow aspirate has just shown 48% blasts of monocytic phenotype.)

[Aspectual operator]

The results point to a stative reading, since the predicate in question allows an interpretation as a real present, more specifically as a phase state, given its compatibility with progressive constructions. The ungrammaticality observed with the introduction of adverbials marked by agentivity, as well as its poor integration in pseudocleft constructions and its incompatibility with verbs such as “parar de” (*to stop*) and “acabar de” (*to have just*), suggests a semantic anomaly when an eventive reading is forced. These factors led us to conclude that this is a state, thus excluding the hypothesis that the predicate denotes a proper event.

Case 6:

(61)

“Atualmente ainda a aguardar revisão de lâminas da biópsia”.

(Currently still awaiting review of biopsy slides).

In this case, the main issue concerned the annotation of the expression “a aguardar” (*awaiting*), specifically its classification as progressive. ISO 24617-1 does not provide sufficiently clear criteria regarding which expressions should be annotated as progressive.

Although “a aguardar” is not, formally, a progressive, unlike “está a aguardar” (*is awaiting*), its semantic reading carries a progressive meaning. Therefore, it was decided to classify it as progressive for annotation purposes.

(ii) Annotation of Temporal Expressions

The annotation of temporal expressions was not the primary focus of the study. For the value attribute, the principles defined in ISO 24617-1 and in TIDES 2005 (Ferro et al., 2005) were adopted.

Case 1:

(62)

“Patologia osteoarticular assintomática até dezembro de 2018, altura em que inicia queixas de dor pélvica”.

(Asymptomatic osteoarticular pathology until December 2018, at which point pelvic pain complaints begin).

The question raised was whether the anaphoric expression “altura em que” (*at which point*) should be annotated as a temporal expression and, if so, which attributes it should receive. It was considered that, as it temporally locates an event, its annotation was justified. Consequently, the expression “altura em que” was marked as a temporal expression of type *date*, inheriting the attributes of its antecedent, with the *value* “2018-12”.

Case 2:

(63)

“Oorofectomia esquerda há 32 anos. [...] Oorofectomia em 1998”.

(Left oophorectomy 32 years ago. [...] Oophorectomy in 1998).

The problematic situation arose when different medical reports indicated different dates for the same event. In the first report, written in 2023, the reference “há 32 anos” (*32 years ago*) would correspond to 1991. However, a subsequent report explicitly stated that the oophorectomy had taken place in 1998.

In such cases, the explicitly stated date (1998) was assumed to be correct, and an identity link was established between “32 anos” and “1998”. The *value* assigned to the expression “32 anos” was therefore “1998”.

(iii) Annotation of TLINKs

Case 1:

(64)

“Cumpru 8 dias de antibioterapia com ceftriaxone e 5 dias de azitromicina”.

(Completed 8 days of antibiotic therapy with ceftriaxone and 5 days with azithromycin).

The main difficulty consisted of correctly associating the temporal expression “5 dias” (5 days) with the verbal event with “cumprir” (completed):

(65)

“Cumprir 8 dias de antibioterapia com ceftriaxone e cumprir 5 dias de antibioterapia com azitromicina”.

(Completed 8 days of antibiotic therapy with ceftriaxone and completed 5 days of antibiotic therapy with azithromycin).

The solution adopted was to assign two labels to the verb “cumprir”, with the same attributes, and to link them individually to the corresponding temporal expressions through the during relation:

“cumprir” (1) → during → “8 dias”

“cumprir” (2) → during → “5 dias”

4.3. Analysis and Interpretation of Results

This section presents a detailed analysis and interpretation of the results obtained from the annotation of the clinical narratives. Both quantitative and qualitative perspectives are explored, allowing for a comprehensive understanding of the temporal phenomena observed in the corpus.

First, Subsection 4.3.1 examines the attributes of events and temporal expressions annotated in the corpus. Next, Subsection 4.3.2 turns to the inter-document temporal analysis, focusing on the relationships across multiple reports for the same patient. Subsection 4.3.3 addresses the temporal characterisation by report type, identifying patterns and specificities in discharge reports, group consultation reports, and general reports. Finally, Subsection 4.3.4 investigates the linguistic factors underlying temporal relation inference.

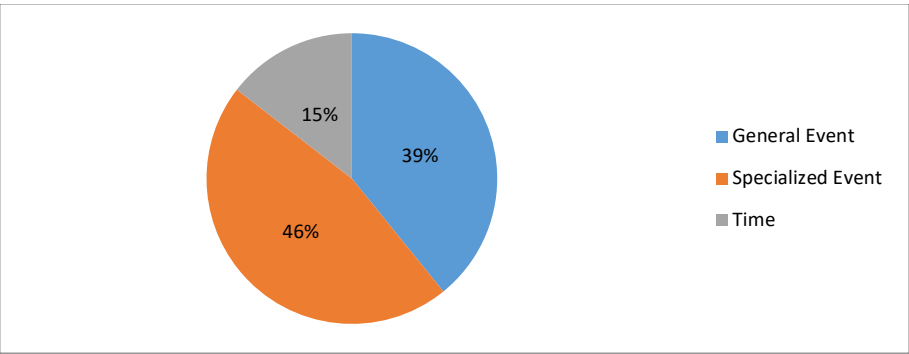
All quantitative and qualitative results obtained from the annotation can also be consulted in the [GitHub repository](#).

4.3.1. Event and Temporal Expressions Attributes in the Annotated Corpus

In this subsection, the overall results of the corpus annotation with events and temporal expressions are presented. A total of 1.859 *markables* were identified: 861

(46%) correspond to the category of *Specialised Event*, 728 (39%) to the category of *General Event*, and 270 (15%) to the category of *Time* (temporal expressions). Chart 1 displays the distribution of these categories in the annotated corpus.

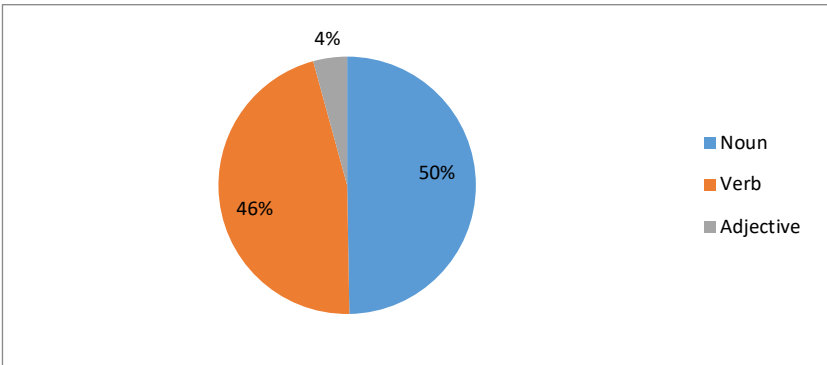
Chart 1 Distribution of annotation categories (general events, specialised events, and temporal expressions) in the corpus



General Event

With regard to *general events*, it is observed that 50% (362 events) correspond to nouns, 46% (335 events) to verbs, and 4% (31 events) to adjectives (Chart 2). A higher frequency of eventive nouns is therefore observed, which appears to be a characteristic of this type of text when compared, for example, with journalistic narratives, where eventive nouns occur less frequently (Silvano et al., 2024).

Chart 2 Distribution of Part of Speech in General Events



Concerning polarity, 96.98% of the cases (706 instances) exhibit positive polarity, whereas only 3.02% (22 instances) display negative polarity, which is practically restricted to expressions such as “sem antecedentes relevantes” (*no relevant medical history*) and “sem queixas” (*no complaints*). This result is consistent with expectations,

given that these are medical reports, in which the patient’s clinical history is predominantly described through affirmative sentences, with events expressed mainly in the positive form. Negation occurs infrequently, not only because affirmative sentences are generally more common in texts in general than negative ones, but also because of the very nature of medical reports and the events described: it is usually more informative for the physician to record what is present (e.g., findings in examinations, symptoms reported by the patient) than what is absent. Although the original Text2Story guidelines defined negative polarity only for nouns preceded by the adverb of negation “*não*” (*not*), in the Med2Story scheme, the notion of negative polarity was extended to include cases of implicit negation, such as the examples presented above.

Regarding the distribution of event classes (Table 17), 51.24% of the cases did not receive any temporal and aspectual characterisation, because this was applied solely to verbal events. As the majority of events are nominal — with the addition of a percentage of adjectives — these were not subject to temporal and aspectual classification. It should also be noted that the frequency of events classified as *none* in the temporal and aspectual attributes does not correspond exactly to the sum of nouns and adjectives in PoS. This is because, in the case of copular verbs, the annotation followed a specific rule: leave the copular verb unmarked and annotate the complement (adjective, noun, or prepositional phrase). The PoS of the complement was identified as an adjective, noun, or preposition, but the values of the TENSE/ASPECT tags were assigned based on the information provided by the copular verb. Thus, whenever the adjective or noun occurred with a copular verb, it was marked as a noun or adjective in PoS, but it inherited the aspectual class and type attributes from the copular verb.

Table 17 Distribution of event classes (General Event) in the corpus

Class	Frequency	Percentage
Occurrence	166	22.80%
State	145	19.92%
I_Action	31	4.26%
Reporting	13	1.78%
None	373	51.24%

Although the difference is not pronounced, general events are predominantly dynamic in nature, a feature typical of narrative texts, where events are used to tell a story and introduce a temporal update into the discourse (Caeneppel, 1989, p. 95) (e.g., “iniciou protocolo de indução” [*he initiated induction protocol*]). Stative events are also relatively frequent, being used to describe the patient’s condition (e.g., “quadro recente caracterizado por astenia e rectorragias” [*recent condition characterised by asthenia and rectal bleeding*]), provide personal information (e.g., “o doente tem 72 anos” [*the patient is 72 years old*]), or introduce examination results (e.g., “o aspirado medular mostrou a presença de 2% de blastos” [*the bone marrow aspirate showed the presence of 2% blasts*]).

It is also significant that reporting verbs are not very frequent, which seems to indicate that physicians do not usually report what patients tell them, at least not in the prototypical form of indirect speech introduced by a reporting verb. Patient information is presented in the section on medical history, but not as reported speech; rather, it is presented as factual data, without resorting to enunciative responsibility mechanisms. (e.g., “doente de 59 anos, com antecedentes de diabetes mellitus, diminuição da acuidade visual e etilismo crónico” [*59-year-old patient, with a history of diabetes mellitus, decreased visual acuity, and chronic alcoholism*]). The same occurs with symptoms: although these are subjective manifestations that must have been perceived and reported by the patient to the physician, they are described in an objective manner (e.g., “Instalou-se um quadro de anorexia, emagrecimento, sudorese nocturna, astenia e mialgias” [*a condition of anorexia, weight loss, night sweats, asthenia, and myalgia developed*]). The absence of indirect speech in medical discourse had already been

observed in case reports by Lysanets et al. (2017), indicating that such feature seems to be a characteristic of this textual genre.

In the corpus analysed, reporting events are associated with verbs such as “realçar” (*to emphasise*) (“analiticamente, será de realçar” [*analytically, it should be emphasised*]) and “referir” (*to note*) (“é de referir que o doente tem 90 anos” [*it should be noted that the patient is 90 years old*]). In this respect, these narratives differ from journalistic ones, where several strategies of enunciative responsibility are used and direct speech is frequently used (e.g., “a polícia referiu que aguarda mais dados relativamente ao suspeito” [*the police stated that it is awaiting further information regarding the suspect*]) (cf. Marques, 2013; Silvano et al, 2024; Fernandes, 2025). Silvano et al. (2024, p. 84) reported an average of 3.50 reporting events per news, in a total of 417 events.

Another relevant finding from the corpus analysis is that perception events were not found, which appears to be related to the absence of indirect speech and first-person reports. Events of the *I_State* class, that is, states that introduce events as arguments in an intensional context, were also absent. This seems consistent with the objectivity of the descriptions characteristic of this type of text, which avoids verbs such as “acreditar” (*to believe*), “pensar” (*to think*), “imaginar” (*to imagine*), “querer” (*to want*), or “odiar” (*to hate*), prototypically classified as *I_State*. Events of the *I_Action* class were found, but they always occurred in the same construction with “decide-se propor” (*it was decided to propose*) (e.g., “decide-se propor o doente para tratamento com eritropoetina” [*it was decided to propose the patient for treatment with erythropoietin*]).

In terms of the type of event (Table 18), attribute only assigned to verbal events, the most frequent category was *Transition* (22.66%), followed by *State* (19.92%) and *Process* (6.18%). These results further corroborate the narrative character of this textual genre, given the predominance of dynamic occurrences, which play a central role in ensuring the progression of the storyline.

Table 18 Distribution of event types (General Event) in the corpus

Type	Frequency	Percentage
Transition	165	22.66%
State	145	19.92%
Process	45	6.18%
None	373	51.24%

Concerning VForm, which was annotated exclusively in the case of non-finite forms, 76 instances of the participle were identified (e.g., “dor pélvica associada a disúria” [*pelvic pain associated with dysuria*]), 46 of the infinitive (e.g., “proposta para tratamento paliativo, por apresentar níveis inadequados de eritropoetina sérica” [*proposal for palliative treatment, due to inadequate serum erythropoietin levels*]), and 20 of the gerund (e.g., “diagnóstico prévio de adenocarcinoma, tratando-se de um estadio III-A” [*previous diagnosis of adenocarcinoma, being stage III-A*]). Finite forms, however, proved to be more frequent, with a total of 586 occurrences.

As for Mood, 2 cases of the future were recorded (e.g., “será de realçar” [*shall be emphasised*]) and 1 of the subjunctive (e.g., “propor uma nova reavaliação medular caso apresente novamente critérios” [*propose a new bone marrow reassessment if criteria are met again*]). Finally, within the domain of modality, 6 cases of *poder* (e.g., “possível ponto de partida” [*possible starting point*]; “se não existir excesso de blastos poderá ser equacionada a utilização de azacitidina” [*if there is no excess of blasts, the use of azacitidine may be considered.*) and 1 of *dever* (e.g., “deve cumprir todos os cuidados inerentes ao doente neutropénico” [*must comply with all care required for the neutropenic patient*]) were identified.

The reduced use of modal forms is closely related to both the type of text and its content. Clinical reports are expected to be as informative as possible, presenting facts or validated conclusions rather than hypotheses or descriptions of possibilities. As previously mentioned, the reports were written following an adaptation of Weed’s (1968) method, known as the Problem-Oriented Clinical Record. Regarding this method, Barreto and Paiva (2008, p. 203) clarify that “a problem may be a symptom, a sign, a syndrome, or a diagnosis; however, it is not a diagnostic hypothesis (‘suspected...’), nor

a question ('alcohol abuse?'), nor a negation ('absence of fever')". The results obtained are consistent with this methodology, since only a few instances of modality were identified (reflected in the limited occurrences of mood and modality), together with the absence of interrogative sentences and the scarcity of negative ones.

Regarding verb tense, the results are presented in Table 19.

Table 19 Distribution of verb tenses in the annotated events

Tense	Frequency	Percentage
Past	226	31.04%
Present	64	8.79%
Future	2	0.28%
None	436	59.89%

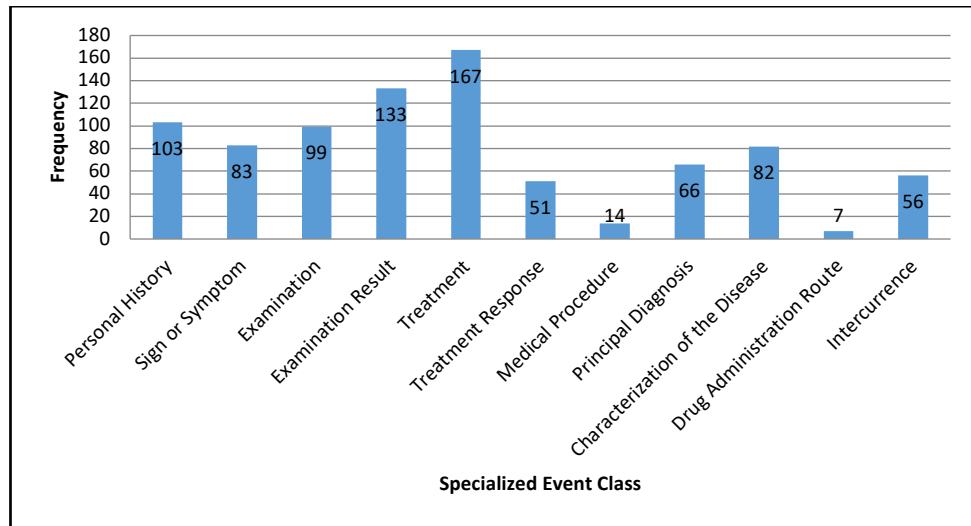
Among the events annotated for *tense*, the majority occurred in the past, which is consistent with the nature of medical reports as narratives primarily oriented towards the description of events that have already taken place. Similar findings were reported by Lysanets et al. (2017) in their analysis of the linguistic properties of medical case reports (MCRs): "It is necessary to admit that the use of simple past tense is a predominant feature of MCRs. This peculiarity results from the very nature of MCRs as narrative (that is, 'storytelling') texts: their primary aim is to give an account of past events".

In addition, 64 events were identified in the present tense (e.g., "mostra agora apenas sinais de dysplasia" [*currently shows only signs of dysplasia*]; "continua dependente de transfusão" [*remains dependent on transfusion*]), corresponding to the patient's current state. Only two instances were annotated in the future tense; however, these did not convey temporal reference, but rather epistemic modality (e.g., "será de realçar uma hiperbilirrubinemia" [*it should be noted that there is hyperbilirubinemia*]).

Specialized Event

Concerning specialised events, these accounted for the majority of the annotated instances, with their distribution shown in Chart 3.

Chart 3 Distribution of Specialised Event Classes in the annotated corpus



The predominance of *Treatment* (19.40%, 167 instances) is particularly important, reflecting the central role of therapeutic interventions in this textual genre. This was followed by *Examination Result* (15.45%, 133), *Personal History* (11.96%, 103), *Examination* (11.50%, 99), *Sign or Symptom* (9.64%, 83), *Characterisation of the Disease* (9.53%, 82), *Principal Diagnosis* (7.66%, 66), *Intercurrence* (6.50%, 56), *Treatment Response* (5.92%, 51), *Medical Procedure* (1.63%, 14), and *Drug Administration Route* (0.81%, 7).

The centrality of treatment in these texts stems from the very purpose of medical reports: all the information they contain ultimately serves to guide the physician's therapeutic decisions. Group consultation reports invariably conclude with a treatment proposal; discharge notes always include reference to treatment, given that hospitalisation itself is treatment-related (either for chemotherapy or for an intercurrent arising from therapy); and general reports integrate treatment into their retrospective overview of the patient's medical trajectory. By contrast, *Drug Administration Route* was the least frequent specialised event, occurring in only seven

instances and restricted to the specifications *intravenous*, *intrathecal*, and *oral*. This relative scarcity indicates that, although treatment is the thematic axis around which the reports are structured, the focus falls on decision-making and outcomes rather than on technical details of administration.

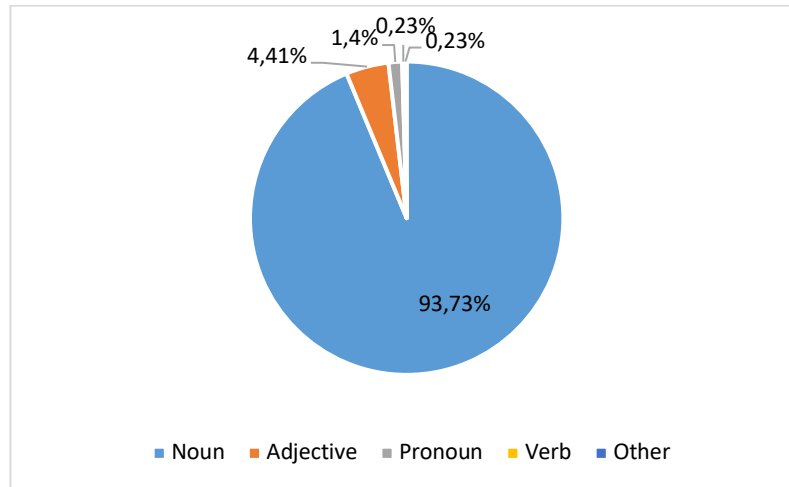
The analysis of the distribution of *PoS* categories within the *specialised events* reveals a clear predominance of nouns, which account for 93.73% of the total (807 instances).

This result confirms the centrality of nominal events in the construction of clinical narratives, since the description of the patient's medical history frequently relies on nouns to encode medical information. Such nominal structures are used to refer to diagnoses and characterisation of the diseases (e.g., “quadro clínico e analítico compatível com o diagnóstico de leucemia mieloide aguda, de cariótipo normal, risco intermédio” [*clinical and analytical findings compatible with the diagnosis of acute myeloid leukemia, with normal karyotype, intermediate risk]), symptoms (e.g., “instalou-se um quadro de cansaço, anorexia e posteriormente um síndrome febril” [*a condition of fatigue, anorexia, and later a febrile syndrome developed*]), examinations and examinations results (e.g., “um hemograma mostrou a presença de anemia, leucocitose e trombocitopenia” [*a blood test showed the presence of anemia, leukocytosis, and thrombocytopenia]), procedures (e.g., “proposta para criopreservação de óvulos” [*she was referred for oocyte cryopreservation*]), and treatments (e.g., “decide-se propor o doente para tratamento de quimioterapia de indução” [it was decided to propose the patient for induction chemotherapy treatment]).**

Adjectives emerge as the second most frequent category, with 4.41% (38 instances). Their function is mainly related to the qualification of health states or clinical results (e.g., “provável ponto de partida respiratório” [*probable respiratory point of origin*]).

The remaining categories show residual frequencies: pronouns, with 1.40% (12 instances); verbs and other categories, which include, for example, adverbs (e.g., *o paciente está bem* [*the patient is well*]), each with 0.23% (2 instances). The results are presented in Chart 4.

Chart 4 Distribution of Part-of-Speech Categories in the Specialized Event



With regard to polarity, the vast majority of events display positive polarity (836 instances, 97,20%), with only 25 cases (2,90%) showing negative polarity. Overall, this result indicates a clear preference for defining specialised events in the affirmative. Nonetheless, certain classes of Specialized Events show a higher frequency of negation, namely *Examination Result* (e.g., “sem isolamentos bacteriológicos” [*no bacteriological isolations*]; “sem lesões hepáticas focais” [*no focal liver lesions*]; “sem mutações a nível do FLT3” [*no FLT3 mutations*]), followed by *Personal History* (e.g., sem antecedentes pessoais de relevo [*no relevant personal history*]; “sem comorbilidades de relevo” [*no relevant comorbidities*]) and *Treatment Response* (e.g., “sem recuperação hematológica” [*no hematological recovery*]).

It is also worth noting that several abbreviations were used in the corpus. These were clarified during the annotation process in an open field, in order to ensure transparency of the data. Examples include: LMA (“Leucemia Mieloide Aguda” [*Acute Myeloid Leukemia*], 1 instance), RP (“Remissão Parcial” [*Partial Remission*], 1), SMD (“Síndrome Mielodisplásica” [*Myelodysplastic Syndrome*], 2), EV (“endovenoso” [*intravenous*, 1]), DM NIT (“Diabetes Mellitus não insulino-tratado” [*non-insulin-treated Diabetes Mellitus*], 1), HA (“Hipertensão Arterial” [*Arterial Hypertension*], 2), AH (“Asma Hipertensiva” [*Hypertensive Asthma*], 1), AVC (“Acidente Vascular Cerebral” [*Stroke*], 1), quimio (“quimioterapia” [*chemotherapy*], 1), fev (“Fração de Ejeção do Ventrículo Esquerdo” [*Left Ventricular Ejection Fraction*], 1) and LNH (“Linfoma Não Hodgkin” [*Non-*

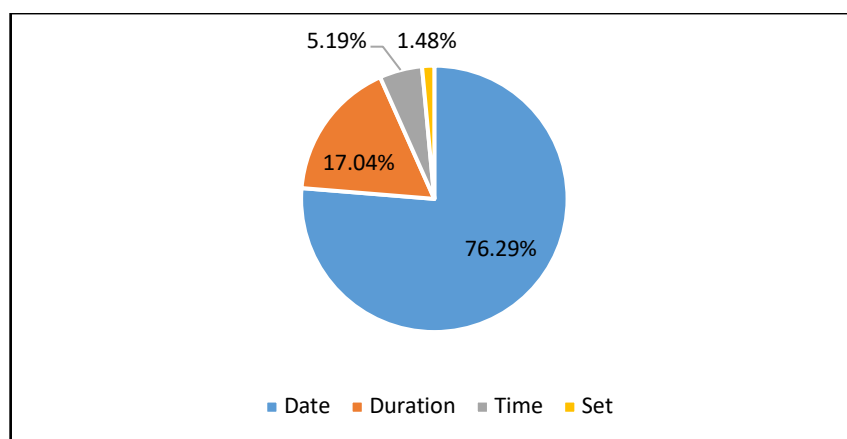
Hodgkin's Lymphoma], 1). As can be observed, the majority of the abbreviations refer to the names of diseases.

Temporal Expression

The distribution of temporal expression types reveals a clear predominance of the *Date* category (e.g., “data de registro: 21-03-2019” [*date of record: 21-03-2019*]), which accounts for 76.29% of the total (206 instances). This is followed by *Duration* (e.g., “apirexia durante 7 dias” [*apyrexia for 7 days*]) with 17.04% (46 instances), *Time* (e.g., “recebe alta hoje ao fim do dia” [*discharged today at the end of the day*]) with 5.19% (14 instances), and *Set* (e.g., “faz exame a cada dois dias” [*he undergoes an examination every two days*]) with a residual value of 1.48% (4 instances).

The results are presented in Chart 5.

Chart 5 Distribution of temporal expression types in the annotated corpus



These findings confirm that, in medical reports, references to dates and durations constitute the predominant form of temporal anchoring, to the detriment of other, more specific or generic, expressions. Dates mainly referred to dates of hospitalisation, discharge, consultations, interventions, and the beginning and end of treatments. *Durations* corresponded essentially to the length of treatments and symptoms, while *Set* referred to the frequency of medication intake.

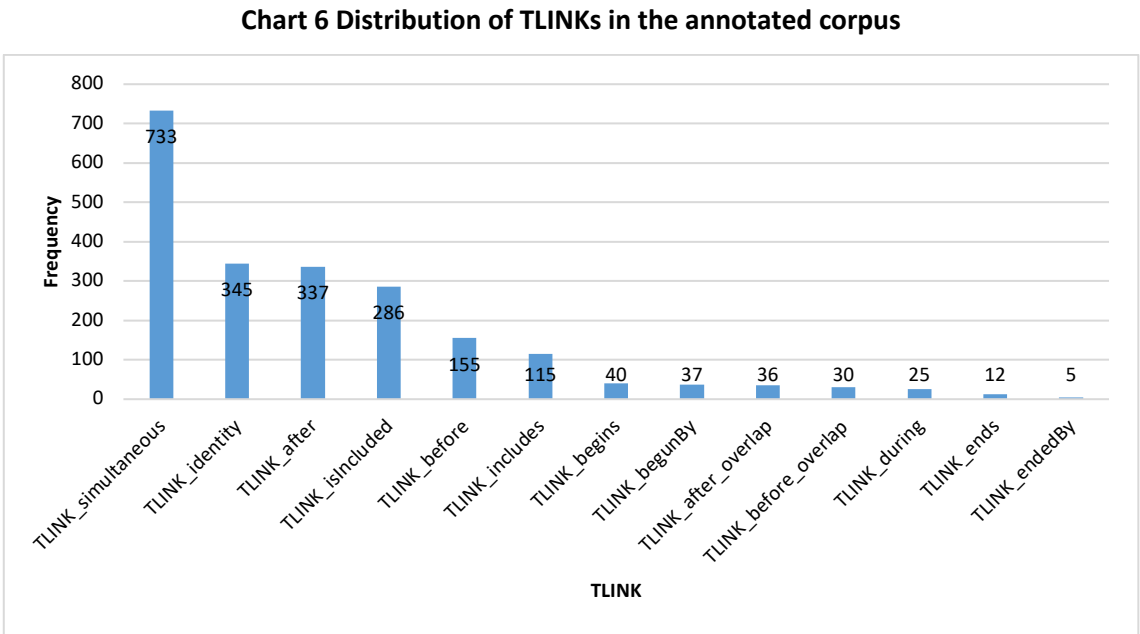
With respect to Temporal Function, it can be observed that most events did not receive any annotation regarding this label (213 instances, 78.75%). Among the annotated cases, the most frequent were *DOCTIME* with 6.65% (18 instances), followed

by *DischargeTime* and *AdmissionTime*, each with 5.91% (16 instances), and, finally, *AnchorTime*²⁴ with 2.59% (7 instances). This distribution suggests that only a small proportion of temporal expressions are directly associated with specific reference points in the clinical cycle (admission, discharge, or the document’s reference time), with the vast majority being used descriptively, without explicit Temporal Function.

TLINKs

The distribution of TLINKs in the dataset reveals clear tendencies in the way temporal structure is encoded.

The distribution of TLINKs is presented in Chart 6.



The most frequent relation is TLINK_simultaneous (733 instances), which reflects the strong presence of events occurring at the same time or being temporally indistinguishable within the context. In such cases, the events are considered close enough in time that further distinguishing their temporal boundaries does not alter the overall interpretation of the clinical narrative. For example, in “doente com antecedentes de hipertensão arterial, dislipidemia e gastrite crônica” [*patient with a*

²⁴It specifies the time that serves as a reference point. For example, in “recentemente instalou-se um quadro de febre” [*a condition of fever developed recently*], the date of publication of the report (DOCTIME) functions as the anchor time for the adverb “recentemente” [*recently*].

history of arterial hypertension, dyslipidemia, and chronic gastritis], the three conditions are linked by simultaneity, as they are co-existing elements of the patient's medical history that are temporally indistinguishable within the context. This relation was used as the default in cases where no information was available to allow for the specific temporal localisation of the eventualities. It is also worth noting that the high frequency of *TLINK_simultaneous* is consistent with the findings regarding event classes, which showed that stative events were highly frequent. This predominance of stative events naturally favors the establishment of simultaneity relations among them.

However, it is also important to note that, even if the difference is not very substantial, dynamic events constitute the most frequent category, within which simultaneity relations also predominate. The fact that a higher number of dynamic events was identified, together with a significant predominance of simultaneity relations, led us to question the extent to which medical reports can truly be regarded as clinical narratives in the more traditional sense of the term. They may indeed be considered narratives insofar as a story is told; however, it is a story in which descriptive frameworks of the patient's condition prevail.

Following *TLINK_simultaneous*, the next most frequent relation is *TLINK_identity* (345 instances), which is used whenever two situations or time expressions refer to the same temporal point. For example, in "Asymptomatic until January 2017, when pelvic pain began", "January 2017" and "began" would be linked by *TLINK_identity*. The recurrence of this relation is also connected to specific annotation rules, such as those concerning light verb constructions (e.g., "fez tratamiento" [*underwent treatment*]), which stipulate that the noun ("tratamiento" [*treatment*]) and the light verb ("fez" [*underwent*]) must be linked by a *TLINK_identity*. This recommendation, consistent with the ISO standard, ensures that although the two lexical items could in principle denote distinct events, they are treated as a single event within these constructions.

Next, with 337 instances, comes *TLINK_after*. In this case, events are presented chronologically, that is, they are described in the order in which they occurred, reflecting temporal succession. The frequency of this relation is to be expected, given that *Transition*-type events are also frequent and naturally stimulate this type of link. For

example, in “Foi internada no Hospital C e realizou uma drenagem biliar” [*She was admitted to Hospital C and underwent a biliary drainage*], the event “realizou” [*underwent*], an Occurrence of type Transition, is linked to “internada” [*admitted*], also of type Transition, through *TLINK_after*.

Relations of inclusion also occur with notable frequency, particularly *TLINK_isIncluded* (286 instances) and *TLINK_includes* (115 instances), reflecting the need to represent events that take place within the temporal scope of other events. For example, “Fez quimioterapia de indução. Como intercorrências teve 2 síndromes febris” [*She underwent induction chemotherapy. As intercurrences, she experienced two febrile syndromes*]. In this case, “intercorrências” [*intercurrences*] is included within the temporal span of the “terapia de indução” [*induction chemotherapy*]. Similarly, in “diagnóstico de LMA a 5.9.2023” [*diagnosis of AML on 5.9.2023*], “LMA” [AML] is a state that includes the diagnostic act, and the diagnosis act is included within the date 5.9.2023.

Less frequent, though still relevant, are relations such as *TLINK_before* (155 instances). These relations arise, for example, when one state is described as preceding another (e.g., “Leucemia Mieloide Aguda, secundária a síndrome mieloproliferativo” [*Acute Myeloid Leukemia, secondary to a myeloproliferative syndrome*]); in this case, “síndrome mieloproliferativo” [*myeloproliferative syndrome*] is linked to “secundária” [*secondary*] through *TLINK_before*. Variations of overlap were also identified, such as *TLINK_before_overlap* (30 instances) and *TLINK_overlap_after* (36 instances). These relations typically occur in association with the adverb “recentemente” [*recently*], as in “hiperhidrose, infecções recorrentes e recentemente dores de cabeça” [*hyperhidrosis, recurrent infections, and recently, headaches*], where “recentemente” [*recently*] is linked to “infecções recorrentes” [*recurrent infections*] by *TLINK_overlap_after*.

Finally, relations indicating precise temporal boundaries — such as *TLINK_begins* (40 instances), *TLINK_beganBy* (37), *TLINK_ends* (12), and *TLINK_endedBy* (5) — generally occur in contexts of medication intake. For example, in “iniciou tratamento a 06.04.2020” [*he began treatment on 06.04.2020*], “tratamento” [*treatment*] is linked to the date by *TLINK_begins*. Similarly, in “teve o primeiro internamento de abril a maio de

2017” [he had the first *hospitalisation* from April to May 2017], “internamento” [hospitalisation] is linked by *TLINK_begins* to “abril” [April] and by *TLINK_ends* to “maio de 2017” [May 2017]. Alongside these, *TLINK_during* (25 instances) also appears, usually in connection with expressions of treatment duration, as in “*medicada* com piperaciclina durante 7 dias” [*treated with piperacillin for 7 days*], where “*medicada*” [*treated*] is linked to “7 dias” [7 days] by *TLINK_during*. Although less frequent overall, these relations provide essential granularity in capturing the fine structure of temporal progression in clinical narratives.

4.3.2. Inter-documents Temporal Analysis of Clinical Reports

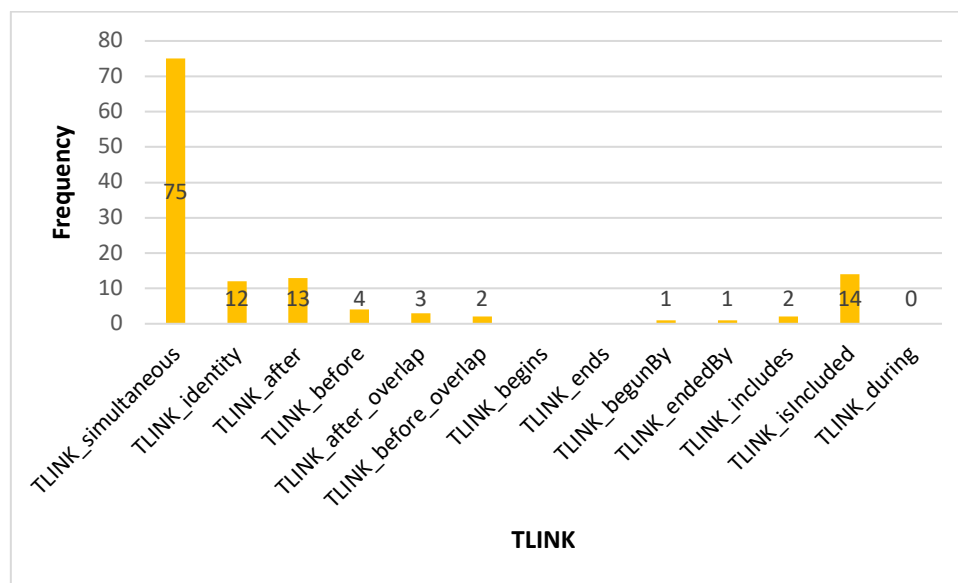
The reports for each patient were annotated following the chronological order in which they were created. Table 10 (section 4.1.) presents the types of reports that constitute each patient’s clinical record, organized chronologically. The inter-document annotation was carried out as follows: the *DOCTIME* date of report creation) was always linked to both the preceding and subsequent report *DOCTIMEs*. In cases where the *DOCTIME* coincided with the *Discharge Time*, only the latter was assigned, and it was consistently connected to both the preceding and subsequent report *DOCTIMEs* or *Discharge Times*. For example, if the first report for a patient is a group consultation with a *DOCTIME* of 17.09.2023 and the following report is a discharge report with a *Discharge Date* of 28.01.2024, this date must be linked to the *DOCTIME* of the first report by *TLINK_after*.

Furthermore, when a group consultation report or a general report was written during a hospitalization period, the *DOCTIME* of that report was linked to both the *Admission Time* and the *Discharge Time* recorded in the discharge report of the hospitalization. For example, the first report for a patient is a discharge report with an *Admission Time* of 03.06.2022 and a *Discharge Time* of 06.08.2022, and the second report is a group consultation with a *Doctime* of 05.06.2022. In that case, this date (05.06.2022) must be linked to the *Admission Time* of the previous discharge report (03.06.2022) by *TLINK_after* and to the *Discharge Time* of that same discharge report (06.08.2022) by *TLINK_before*.

Moreover, whenever possible, a TLINK was established between the first event of a given report and the last event of the preceding one. Events within a report were only linked to the previous report through a *TLINK_identity*.

Chart 7 presents the relations established across the reports concerning Patient 1, encompassing both intra-document and inter-document links. The clinical record of Patient 1 consisted of two group consultations, and a total of 127 relations were identified.

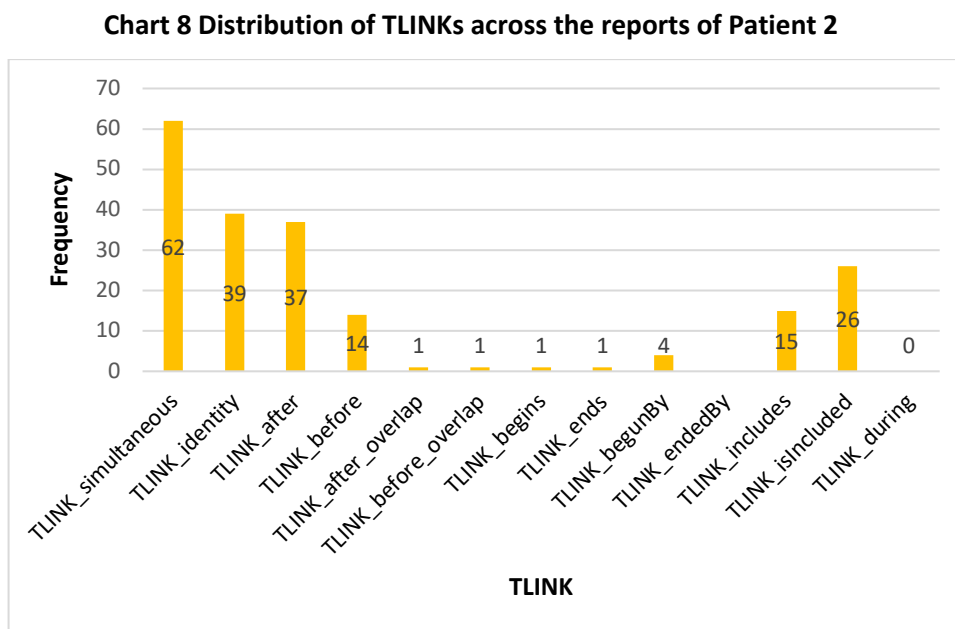
Chart 7 Distribution of TLINKs across the reports of Patient 1



With regard to inter-document annotation, the following TLINKs were established:

- (i) Two *TLINK_after* – between the first event of Group Consultation Report #2 and the last event of Group Consultation Report #1; and the *DOCTIME* of Group Consultation Report #2 and the *DOCTIME* of Group Consultation Report #1.
- (ii) Five *TLINK_identity* – between *Specialized Events* of the *Treatment* attribute (e.g., “Protocolo RCHOP” (*RCHOP protocol*) and “quimioterapia” (*chemotherapy*)); between events of the *Characterization of the Disease* attribute (e.g., “difuso” (*diffuse*)) and “difuso” (*diffuse*)); and between events of the *Principal Diagnosis* attribute (e.g., between “diagnóstico” (*diagnosis*) and “linfoma não Hodgkin” (*non-Hodgkin lymphoma*)).

Chart 8 presents the distribution of *TLINK* relations throughout the clinical record of Patient 2. The patient's record consisted of one Discharge Report, three Group Consultation Reports, and one General Report, with a total of 201 relations annotated.



With regard to inter-document annotation, the following *TLINK*s were established.

One *TLINK_after* between Discharge Report #1 and Group Consultation Report #1, a was established between the first event of Group Consultation Report #1 and the last event of Discharge Report #1. The *DOCTIME* of Group Consultation Report #1 was further linked by a *TLINK_before* to the Discharge Time of the Discharge Report #1 and by a *TLINK_after* to its Admission Time. This indicates that Group Consultation Report #1 was written during the patient's first hospitalization period. In addition, four *TLINK_identity* relations were identified between these two reports: three involving events of the *Principal Diagnosis* class and one involving an event of the *Characterization of the Disease* class.

Regarding the connections between Group Consultation Report #2 and Group Consultation Report #1, a *TLINK_before* was established between the last event of Group Consultation Report #2 and Group Consultation Report #1. This is due to the fact that Group Consultation Report #2 represents an addendum to the first report: at the end of the first group consultation, a therapeutic option was proposed (the last event of the report), whereas the first event of the subsequent report was "record", introduced

to indicate the report's registration date. Since this event occurred before the treatment, a *TLINK_before* relation was established. Moreover, seven *TLINK_identity* relations were identified: three involving events of the Treatment class, three of the Principal Diagnosis class, and one of the Characterization of the Disease class.

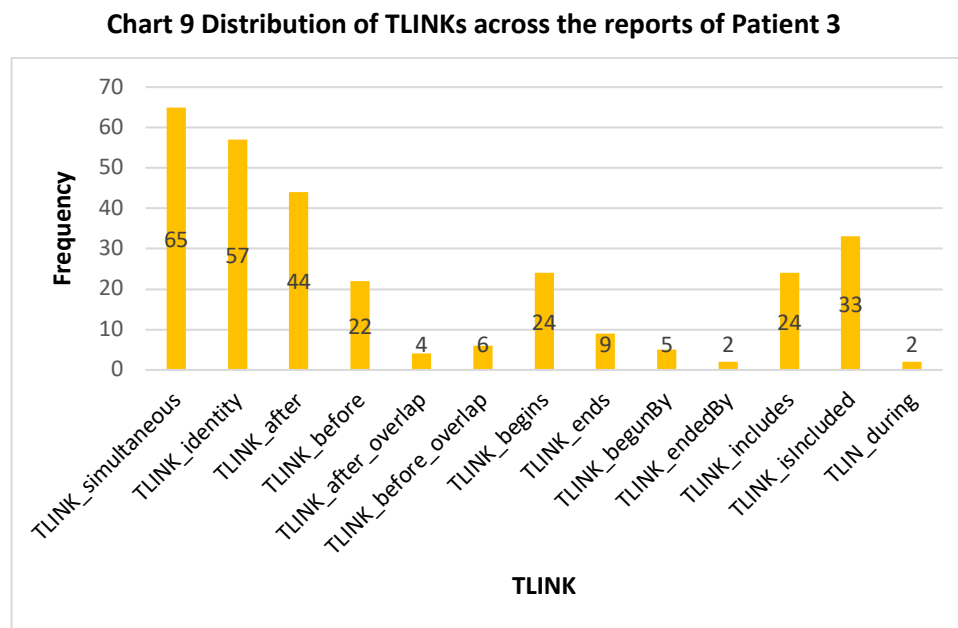
Between Group Consultation Report #3 and Group Consultation Report #2, a *TLINK_after* was established between the first event of Group Consultation Report #3 and the last event of the preceding report, for the same reasons mentioned above. With regard to *DOCTIME*, a *TLINK_after* was also established between Group Consultation Report #3 and the preceding report. Furthermore, six *TLINK_identity* relations were identified: two between events of the Principal Diagnosis class, three of the Treatment class, and one of the Characterization of the Disease class.

With regard to the relations established between General Report #1 and Group Consultation Report #3, a *TLINK_after* was identified between the *DOCTIME* of General Report #1 and the *DOCTIME* of Group Consultation Report #3.

The first event of General Report #1 was “diagnóstico” [*diagnosis*], referring to the principal diagnosis, while the last event of Group Consultation Report #3 was “inscrita” [*registered*], indicating that the patient had been registered in the service. Since the diagnosis occurred prior to the registration, the events “diagnóstico” [*diagnosis*] and “inscrita” [*registered*] were therefore linked by a *TLINK_before*.

Concerning the establishment of *TLINK_identity* relations, it is worth noting that general reports provide a synthesis of the patient's trajectory up to the moment of writing, thus including references to events reported in the four preceding documents rather than only in the immediately previous one, as had been the case so far. Accordingly, 12 *TLINK_identity* relations were identified, all involving Specialized Events belonging to the following classes: *Principal Diagnosis*, *Treatment Response*, *Examination Result*, and *Treatment*.

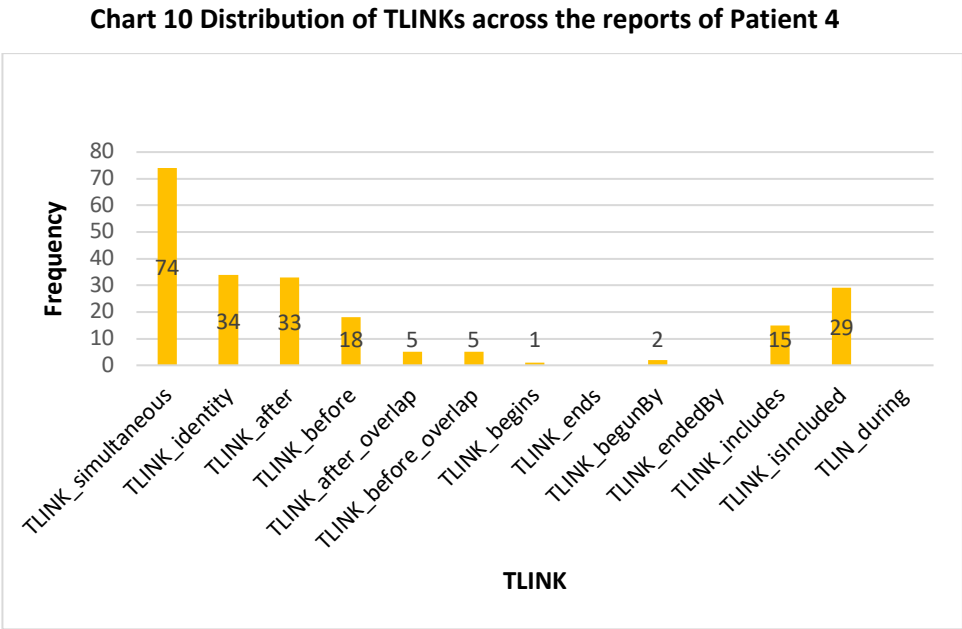
Chart 9 presents the distribution of intra-document and inter-document TLINKs across the reports that constitute the clinical record of Patient 3. In total, 297 TLINKs were identified. The patient's record consisted of four Discharge Reports and concluded with a General Report.



The relations between *DOCTIME* and *Discharge Times* followed a pattern similar to that observed in Patients 1 and 2, already described in detail. Regarding the establishment of *TLINK_identity* relations, it can be observed that this case presents, proportionally, the highest number of such links. This is explained by the fact that each discharge report included details of previous hospitalizations, thereby recovering events already described in earlier reports. Furthermore, the final General Report provided a synthesis of the patient's entire clinical trajectory up to that point, again recovering several events from preceding documents.

The events linked by *TLINK_identity* were mostly Specialized Events belonging to the classes Treatment, Principal Diagnosis, and Treatment Response. However, *TLINK_identity* relations were also observed between dates (representing, for instance, treatment start and end dates) and between some General Events (such as “admissão” [admission]). This record displayed the most diverse profile of inter-document links.

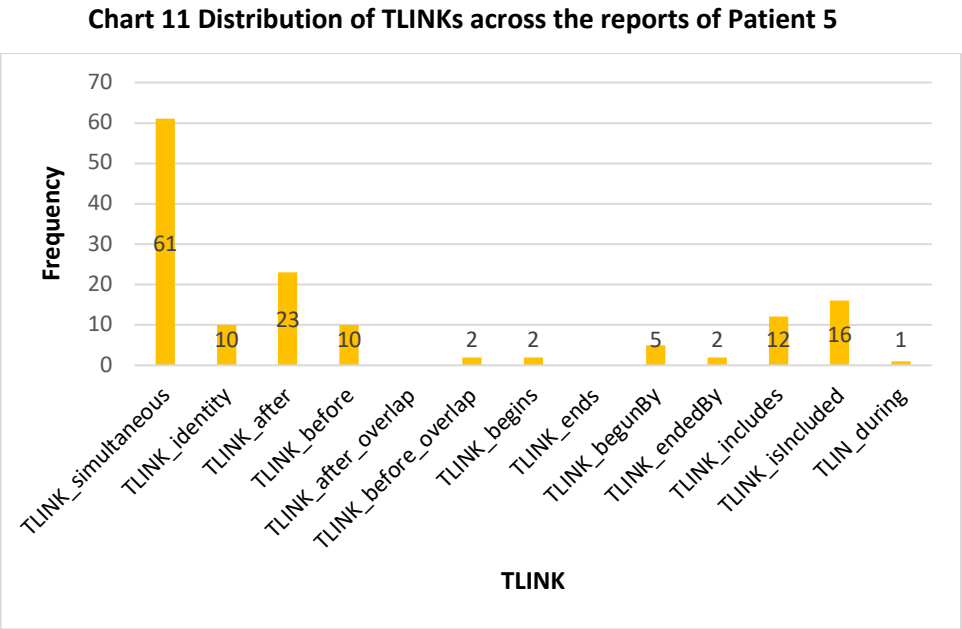
Chart 10 presents the frequency of relations in the clinical record of Patient 4. This record consisted of one Discharge Report, one Group Consultation Report, and one General Report. In total, 216 TLINKs were established.



Most of the *TLINK_Identity* relations across these reports involved temporal expressions marking the start and end dates of treatments, the beginning and end of hospitalizations, and dates of diagnoses. *TLINK_Identity* were also identified between Specialized Events belonging to the classes *Principal Diagnosis*, *Treatment*, *Examination*, and *Examination Results*.

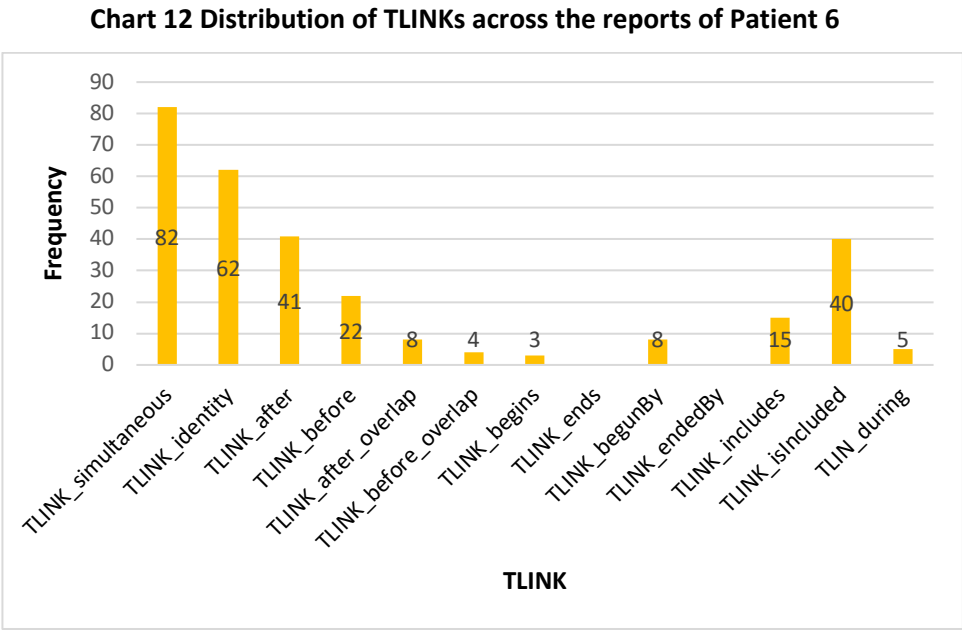
In addition, *TLINK_Identity* relations were observed between General Events from different reports, though in smaller numbers, specifically in cases such as “admissão” [*admission*] and “alta clínica” [*hospital discharge*].

Chart 11 presents the distribution of TLINKs across the reports that constitute the clinical record of Patient 5. This record consisted of one Group Consultation Report and two Discharge Reports. In total, 146 relations were established.



As confirmed in Table 10 (section 4.1.), this was the record with the lowest word count (353), which explains the smaller number of events and, consequently, of TLINKs. A total of 10 *TLINK_identity* relations across reports were identified between Specialized Events belonging to the classes *Principal Diagnosis* and *Treatment*.

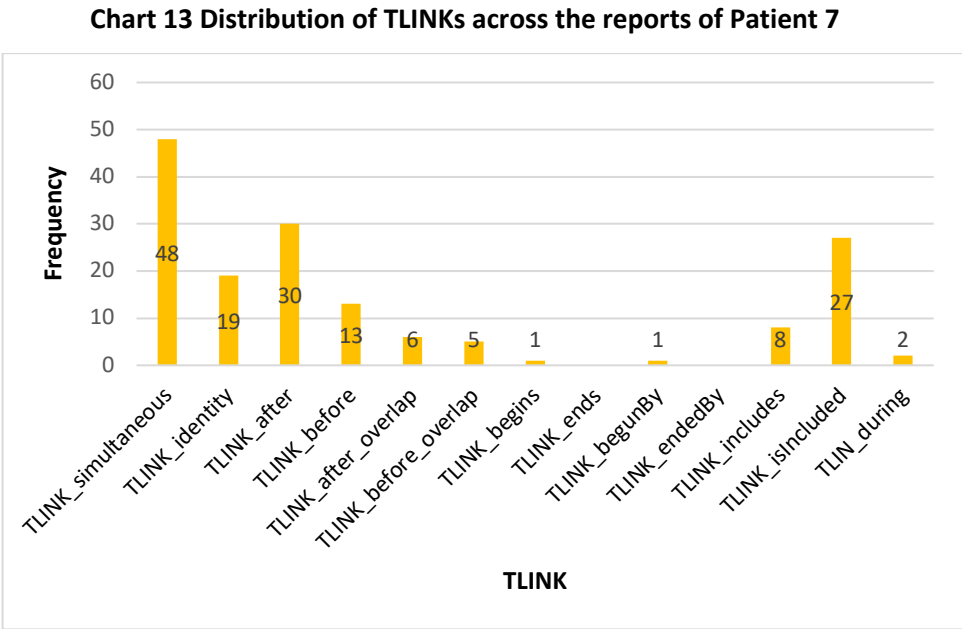
Chart 12 presents the distribution of TLINKs throughout the clinical record of Patient 6. A total of 290 relations were annotated, making this the record with the highest number of both inter-document and intra-document links, despite not being the one with the largest word count.



The record consisted of one Group Consultation Report, three Discharge Reports, and a final Group Consultation Report. Several Specialized Events were repeated across reports, particularly those belonging to the classes *Personal History*, *Principal Diagnosis*, *Characterization of the Disease*, and *Treatment*.

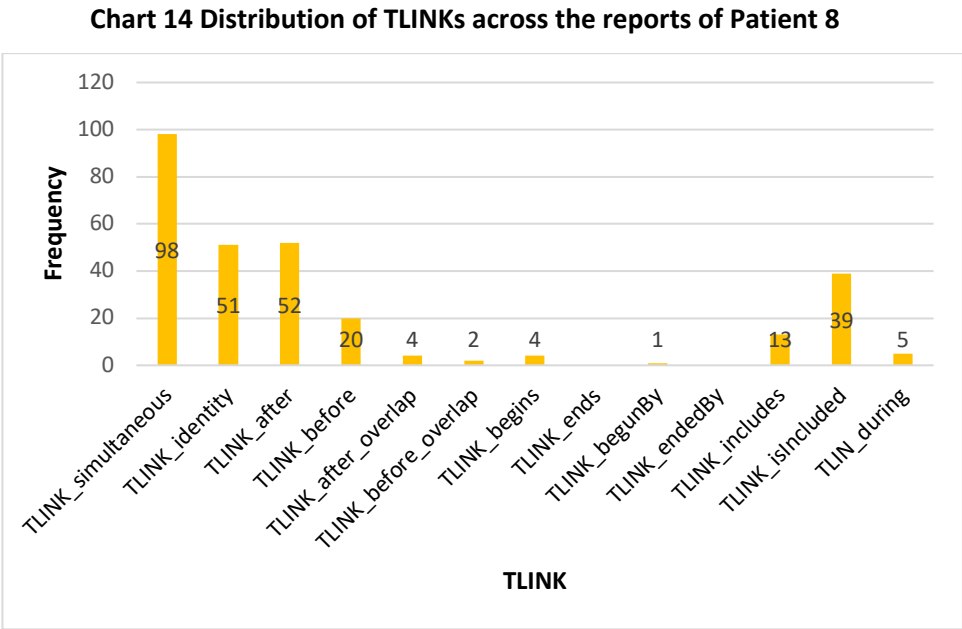
The sequence in which the reports were presented fostered the establishment of *TLINK_identity* relations: the first document was a group consultation report that already introduced several events from the patient’s clinical history, which were later repeated in the Discharge Report. The record concluded with a second Group Consultation Report, which elaborated on information previously mentioned in both the first consultation and the discharge note.

Chart 13 presents the distribution of inter-document and intra-document relations established throughout the clinical record of Patient 7. In total, 160 relations were annotated.



The patient’s record consisted of three Group Consultation Reports, one Discharge Report, and a final Group Consultation Report. The *TLINK_identity* relations were established across reports, involving Specialized Events belonging to the classes *Personal History* (e.g., arterial hypertension), *Principal Diagnosis* (e.g., AML), *Characterization of the Disease* (e.g., normal karyotype), and *Treatment* (e.g., induction chemotherapy).

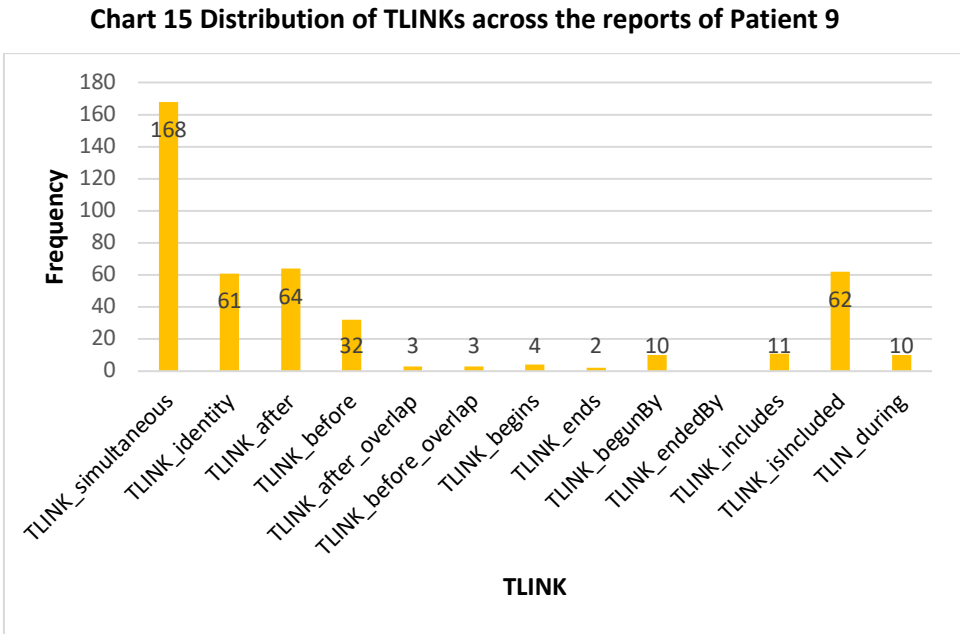
Chart 14 presents the distribution of inter-document and intra-document relations established throughout the clinical record of Patient 8. In total, 289 relations were annotated.



The clinical record of Patient 8 consisted of one Group Consultation Report, two Discharge Reports, and two additional Group Consultation Reports. Since the last two group consultations were addenda to the first, no events were repeated; instead, new information was added. This explains the relatively low number of *TLINK_identity* relations in this patient process (19).

The *TLINK_identity* relations were primarily established between Specialized Events from Discharge Reports #1 and #2 and Group Consultation Report #1, covering the classes *Personal History* (e.g., chronic alcoholism), *Treatment* (e.g., induction therapy), *Principal Diagnosis* (e.g., AML), and *Characterization of the Disease* (e.g., high risk).

Chart 15 presents the distribution of inter-document and intra-document relations established throughout the clinical record of Patient 9. In total, 431 relations were annotated.



The record of Patient 9 was the one with the highest word count, consisting of one Discharge Report, one Group Consultation Report, two additional Discharge Reports, and a second Group Consultation Report. The increased word count, compared to the other records, was due to the first Discharge Report, which was particularly long and detailed, including the patient's comorbidities, an exhaustive description of the examinations performed and their results, as well as the clinical evolution throughout the treatment.

The relations between reports were primarily established through *TLINKs_Identity* involving Specialized Events, particularly those belonging to the classes *Personal History*, *Examination*, *Examination Result*, *Principal Diagnosis*, and *Treatment*.

In general terms, the inter-document annotation was carried out by linking the *DOCTIME* and *Admission/Discharge Time* of each report through *TLINK_after/before* relations. The first event of each report was linked to the last event of the preceding one, with *TLINK_before* relations predominating. Since the final sentence of each report usually expressed a treatment expectation, and the first event of the subsequent report

was typically “record”, referring to the registration of the report itself, this registration was positioned temporally before the treatment was actually carried out.

The analysis of inter-document annotation of the nine clinical records reveals differences in the number of TLINKs established, in the types of events repeated, and in the role played by each type of report.

The total number of relations varied considerably: the lowest count was observed in Patient 5 (146 TLINKs), who also had the shortest record in terms of word count (353 words), while the highest was found in Patient 9 (431 TLINKs), whose first Discharge Report was particularly long and detailed.

Across all records, *TLINK_identity* relations were consistently present, though their relative frequency varied. Patients whose General Reports and Discharge Reports included comprehensive summaries of the clinical history (e.g., Patients 3, 6, and 9) displayed a higher number of *TLINKs* of this type, as events from previous reports were frequently reintroduced. Conversely, in records where Group Consultation Reports functioned mainly as addenda (e.g., Patient 8), the number of *TLINK_identity* relations was relatively low.

The Specialized Event classes most frequently associated with *TLINK_identity* across reports were *Principal Diagnosis*, *Treatment*, *Characterization of the Disease*, and *Personal History*, with *Examination* and *Examination Result* also playing a role in some cases. General Events such as “admission” and “hospital discharge” were likewise linked across documents. *TLINK_Identity* were also identified across documents between temporal expressions, particularly between treatment start dates and diagnosis dates.

Overall, the structure and function of the reports directly influenced the profile of relations: lengthy and detailed documents (such as comprehensive Discharge Reports, Group Consultation Reports, and General Reports) fostered the establishment of multiple *TLINK_identity* across them, while addendum reports introduced fewer new events and consequently generated fewer *TLINK_identity* with precedents reports.

It is also noteworthy that *Personal History*, *Principal Diagnosis*, and *Treatment* are categories that are frequently reiterated and reaffirmed. This phenomenon has already been described by Cohen (2013) and Raghavan (2014), who emphasise the tendency

towards copy-paste practices and the summarisation of previous information in new clinical narratives, resulting in multiple mentions of the same medical event across different documents.

4.3.3. Temporal Characterisation by Report Type

This section analyses the distribution of temporal relations identified in three distinct types of medical reports: group consultation reports, discharge reports, and general reports.

Group consultation reports are produced in the context of multidisciplinary consultations, in which several specialists review the patient's medical history, current clinical and analytical status, and propose the most appropriate treatment. These reports usually follow a standardised structure and are typically written by the same physician, which accounts for their limited stylistic variability. They generally begin with the presentation of the patient's personal history:

(66)

“Doente de 35 anos de idade, sem antecedentes relevantes e com um quadro recente caracterizado por astenia, anorexia e hipersudorese nocturna”

(Patient, 35 years old, with no relevant medical history and with a recent condition characterised by asthenia, anorexia, and nocturnal hyperhidrosis.)

This is followed by a description of the examinations performed and their results:

(67)

“Um hemograma mostrou a presença de leucocitose de 94000 com blastos, anemia e trombocitopenia. O aspirado medular mostrou 72% de blastos, cuja citometria mostrou tratar-se de fenótipo mielóide/monocitóide. No cariótipo não foram identificadas alterações”.

(A blood count revealed leucocytosis of 94,000 with blasts, anaemia, and thrombocytopenia. The bone marrow aspirate showed 72% blasts, whose cytometry indicated a myeloid/monocytoid phenotype. No abnormalities were identified in the karyotype.)

The conclusion then provides the diagnosis and characterisation of the disease:

(68)

“Quadro clínico e analítico compatível com o diagnóstico de uma leucemia mieloide aguda, risco alto”.

(Clinical and analytical findings consistent with the diagnosis of acute myeloid leukemia, high risk.)

Finally, the treatment proposal is presented:

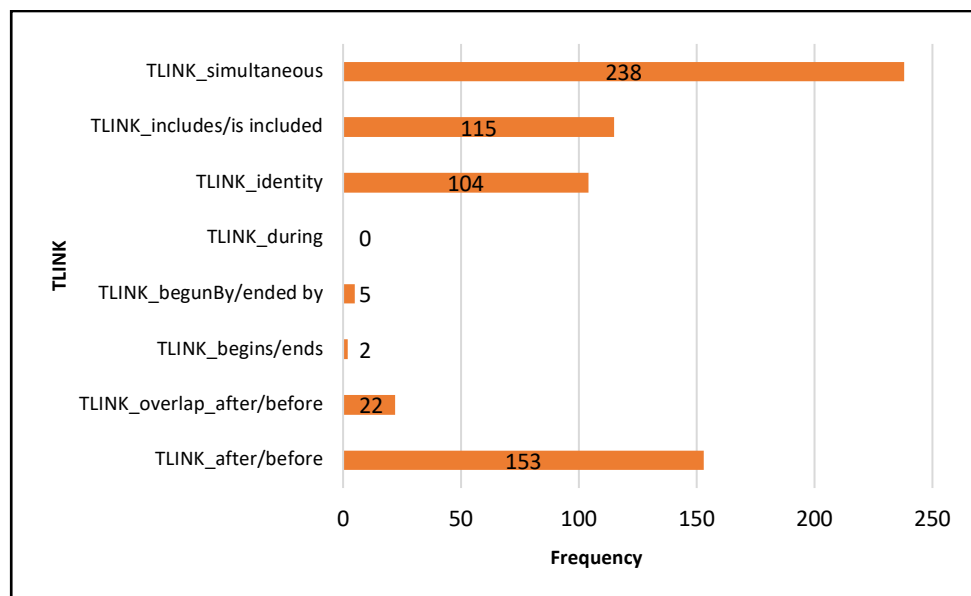
(69)

“Decide-se propor o doente para tratamento de quimioterapia de indução com Idarrubicina em associação à Citarabina, seguido de consolidação com Citarabina em alta dose e alotransplante de medula óssea em primeira remissão se dador HLA compatível”.

(It was decided to propose induction chemotherapy with Idarubicin in association with Cytarabine, followed by consolidation with high-dose Cytarabine and allogeneic bone marrow transplantation in first remission if a compatible HLA donor is available.)

With regard to the TLINKs in group consultation reports (Chart 16), there is a clear predominance of *TLINK_simultaneous* (238 occurrences; 37.25%), followed by *TLINK_after/before* (153; 23.94%), *includes/isIncluded* (115; 18.00%), and *identity* (104; 16.28%). Relations marking the beginning or end of events are minimal (*begins/ends*: 2; 0.32%; *begunBy/endedBy*: 5; 0.78%), and no occurrences of the *TLINK_during* were identified.

Chart 16 Distribution of temporal relations in group consultation reports



This predominance of simultaneity can be explained by the descriptive nature of these documents, which are intended to provide:

(i) a panoramic overview of the patient's clinical history (70):

(70)²⁵

“Doente com antecedentes de hipertensão arterial, dislipidemia, divertículos do cólon esquerdo, gastrite crónica e patologia osteoarticular”.
(Patient with a history of arterial hypertension, dyslipidemia, left colon diverticula, chronic gastritis, and osteoarticular pathology.)

²⁵All underlined events would be linked by *TLINK_simultaneous*.

(ii) the examinations performed up to the point of diagnosis (71).

(71)²⁶

“Um hemograma mostrou anemia e leucopenia. Os exames complementares para esclarecimento do quadro revelaram uma massa de partes moles”.

A blood count showed anemia and leukopenia. Additional examinations to clarify the condition revealed a soft tissue mass.)

(iii) a detailed characterization of the diagnosed condition:

(72)²⁷

“Linfoma não Hodgkin, difuso de grandes células B.”

(Diffuse large B-cell non-Hodgkin lymphoma)

In example, the *Principal Diagnosis* (non-Hodgkin lymphoma) and the *Characterization of the Disease* (diffuse) are linked by *TLINK_simultaneous*.

Since the exact chronological sequence of prior events or examinations is often not specified, these events are typically connected through simultaneity. The same applies to the principal diagnosis and its characterization, which are usually related by this type of temporal link.

Discharge reports document the patient’s clinical course from hospital admission to medical discharge. Their structure is more heterogeneous, as they are written by different physicians and because the course of each hospitalisation is more variable than the case histories described in group consultation reports. In most cases, the reason for admission is the administration of chemotherapy. These reports usually begin with the presentation of the patient’s main diagnosis and the characterisation of the disease:

(73)

“Doente com LMA de alto risco, com mutação do FLT3 e NPM1+”.

(Patient with high-risk AML, with FLT3 mutation and NPM1+.)

²⁶All underlined events would be linked by *TLINK_simultaneous*.

²⁷All underlined events would be linked by *TLINK_simultaneous*.

This is followed by a summary of the episode that led to admission:

(74)

“Iniciou QT indução (7+3) a 01-07-2021.”

(Initiated induction chemotherapy (7+3) on 01-07-2021.)

The next section reports the examinations performed during treatment, their results, and the treatment response:

(75)

“Mielograma após indução - RC sem doença residual mínima”.

(Bone marrow aspirate after induction – complete remission without minimal residual disease.)

This is followed by the description of any complications (76) and the patient's condition at discharge (77):

(76)

“Internamento decorreu sem intercorrências.”

(Hospitalisation occurred without complications.)

(77)

“À data de alta doente HD estável, apirético”.

(At discharge, the patient was haemodynamically stable and apyretic.)

In the discharge reports (Chart 17), the highest overall number of temporal relations is observed, as these are the most frequent documents and typically range from medium to long in length. The most common types of temporal relations identified are *simultaneity* (345; 28.80%), *after/before* (281; 23.46%), *includes/isIncluded* (231; 19.28%), and *identity* (210; 17.53%). There is also greater diversity in relations indicating beginning, end, and duration (*begins/ends*: 47; 3.92%; *begunBy/endedBy*: 29; 2.42%; *during*: 25; 2.09%):

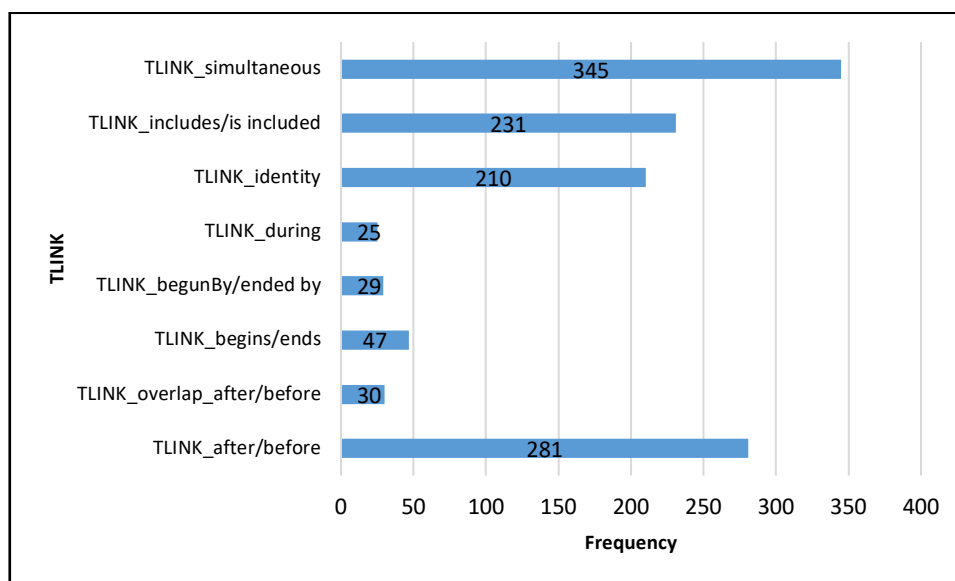
(78)

“Teve a primeira síndrome febril a 04.04.2024, tendo cumprido 7 dias de piperacilina/tazobactam e a segunda síndrome febril a 11.04.2020, tendo cumprido 7 dias de meropenem e amicacina, 14 dias de vancomicina até 29.04.2020 e 12 dias de ceftazidima e 8 dias de voriconazole”.

(The patient had the first febrile syndrome on 04.04.2024, completing 7 days of piperacillin/tazobactam, and the second febrile syndrome on 11.04.2020, completing 7 days of meropenem and amikacin, 14 days of vancomycin until 29.04.2020, 12 days of ceftazidime, and 8 days of voriconazole.)

Although simultaneity relations remain predominant, their proportion is lower than in Group Consultation Reports (37.35% → 28.80%). In this type of document, *TLINKs_after/before* become more prominent, which can be explained by the fact that the discharge report describes the progression of events during hospitalization, providing information that allows for the inference of temporal sequences (78). Moreover, discharge reports contain a higher percentage of beginning, end, and duration relations, often associated with drug administration, treatment durations, or the completion of procedures — information usually detailed only in this type of report.

Chart 17 Distribution of temporal relations in discharge reports



Finally, General Reports provide a comprehensive account of the patient's clinical course up to the present time, often requested by the patient to justify medical leave. The structure of these documents is similar to that of Group Consultation Reports. They usually begin with the patient's personal history, the main diagnosis, and the characterisation of the disease:

(79)

Doente de 36 anos, sem antecedentes pessoais de relevo até junho de 2021, altura em que foi diagnosticado com LMA de alto risco, com cariótipo normal, mutação do FLT3 e NPM1 positivo”.

(Patient, 36 years old, with no relevant personal history until June 2021, when he was diagnosed with high-risk AML, with normal karyotype, FLT3 mutation, and NPM1 positive.)

This is followed by a summary of the treatments already administered and the patient's response:

(80)

“Fez indução com 7+3 (Idarrubicina em associação à Citarabina), com resposta completa, seguida de duas consolidações com Citarabina em alta dose”.

(He underwent induction with 7+3 (Idarubicin in association with Cytarabine), achieving complete response, followed by two consolidations with high-dose Cytarabine.)

The report then describes the patient's current condition:

(81)

“Aguarda identificação de dador HLA compatível para alotransplante de medula óssea”.

(Awaiting identification of a compatible HLA donor for allogeneic bone marrow transplantation)

Finally, provides the justification for issuing the report:

(82)

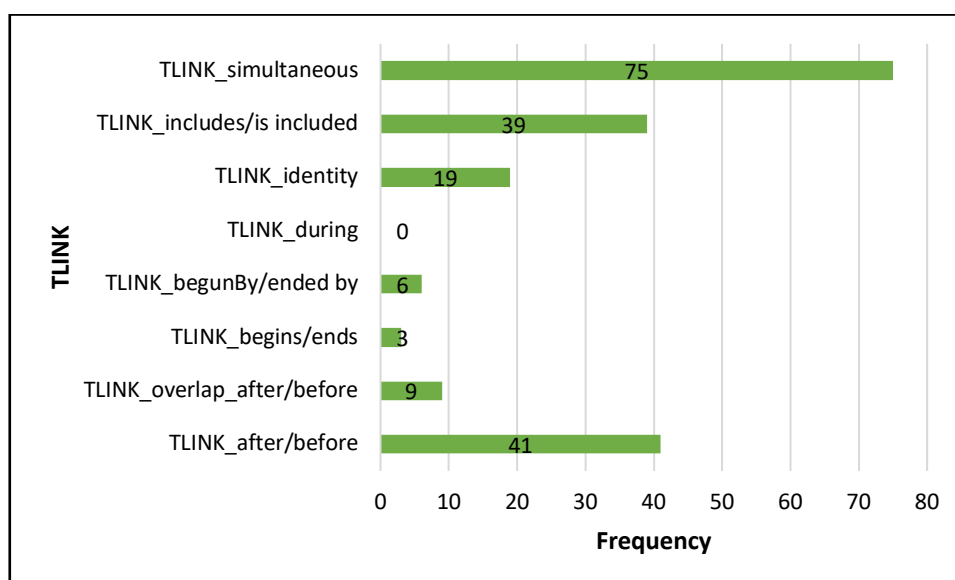
“Passo o presente relatório, a pedido do doente, para ser presente a junta médica. 10-01-2022”.

This report is issued, at the patient's request, to be presented to the medical board. 10-01-2022.)

Unlike Discharge Reports, these documents do not provide details regarding events that occurred during hospitalisation or any intercurrents. Similar to Group Consultation Reports, they present a more general overview of the patient's history, with particular focus on the diagnosis of AML.

General reports (Chart 18) display a lower overall number of temporal relations — due both to the smaller availability of this type of document, despite the fact that those available were relatively long — with simultaneity predominating (75; 39.06%), followed by after/before (41; 21.35%), includes/isIncluded (39; 20.32%), and identity (19; 9.90%).

Chart 18 Distribution of temporal relations in general reports



Overall, Discharge Reports emerge as the most diverse in terms of temporal relations. Although they also display a high proportion of simultaneity, inclusion, after/before, and identity relations, they stand out for additionally containing duration relations, which typically describe the length of a treatment. Relations of begins/ends and begun-by/ended-by relations are rare in Group Consultation Reports. These relations typically occur in connection with the start or end of a medication regimen — information that does not usually appear in group consultation reports.

4.3.4. Identification of Linguistic Factors in Temporal Relation Inference

In general terms, the analysis of temporal relations indicated that the most frequent relation across all reports, and consequently throughout the corpus, was *TLINK_simultaneous*. This relation typically occurred between different personal history events:

(83)

“Doente de 59 anos, com antecedentes de diabetes mellitus, diminuição da acuidade visual e etilismo crónico”.

(59-year-old patient, with a history of diabetes mellitus, decreased visual acuity, and chronic alcoholism.)

Between examinations and their results:

(84)

“Um hemograma mostrou a presença de leucocitose de 94,000 com blastos, anemia e trombocitopenia. O aspirado medular mostrou 72% de blastos, cuja citometria mostrou tratar-se de fenótipo mieloide/monocitoide. No cariótipo não foram identificadas alterações”.

(A blood count revealed leucocytosis of 94,000 with blasts, anaemia, and thrombocytopenia. The bone marrow aspirate showed 72% blasts, whose cytometry indicated a myeloid/monocytoid phenotype. No abnormalities were identified in the karyotype.)

And between the principal diagnosis and the characterisation of the disease:

(85)

“Doente com LMA de alto risco, com mutação do FLT3 e NPM1+.”

(Patient with high-risk AML, with FLT3 mutation and NPM1+.)

In these cases, the underlined events were linked by simultaneity to the previous underlined event in the example.

Simultaneity appears to be closely related to the notion of duration. States and Processes are inherently durative; Transitions may or may not be, since this category subsumes two aspectual types: Accomplishments, which are durative, and Achievements, which are non-durative (cf. Vendler, 1957). Simultaneity readings are

particularly associated with three types of TLINKs: *TLINK_Is_Included*, *TLINK_Includes*, and *TLINK_Simultaneous* (Silvano et al., 2024, p. 84).

Table 20 presents the distribution of different TLINKs in relation to Event Type for the most frequent TLINKs in the corpus.

Table 20 Event Type and TLINKs²⁸

TLINK	Simultaneous			Includes			Is_Included			Identity			Before			After		
Type of Report	GE-GE	GE-SE	SE-SE	GE-GE	GE-SE	SE-SE	GE-GE	GE-SE	SE-SE	GE-GE	GE-SE	SE-SE	GE-GE	GE-SE	SE-SE	GE-GE	GE-SE	SE-SE
None, State	40	70	112	3	2		5	3					7	2		8	5	
None, Transition	12	36		5	7		6				1		5	2		22	21	
Non, Process	4	24		1			1	2						1		4	2	
None, None	40	80	412	2	37	74	1	10	132	40	7	246	60	7		31	16	
Transition, Transition	1			1			1				1		3			26		
State, Transition	11			3									1			1		
State, State	6										1							
Process, Transition	1			1												5		
Process, State	1																	

TLINK_Simultaneous was most often observed between nominal events (that had not been assigned an aspectual classification) (532 cases), between nominal events and states (222 cases), and between nominal events and processes (28 cases). There were also 48 cases between nominal events and transitions. In the case of *TLINK_Is_Included* and *TLINK_Includes*, the majority occurred between nominal events (133 cases for *includes* and 143 cases for *Is_Included*). Given the high frequency of nominal events, links between two aspectually classified events were rare, most often occurring between a nominal event and a verb, or between two nominal events.

The second most frequent relation was *TLINK_Identity*, applied whenever two events refer to the same occurrence. This result was expected. As explained in the previous

²⁸ Legend: GE – General Event; SE – Specialized Event

subsections, inter-document links tended to privilege *TLINK_Identity*, since several events were repeated across successive reports. The majority of *TLINK_Identity* were established between two nominal events belonging to the *Specialised Event*.

By contrast, after/before relations were relatively infrequent compared to simultaneity. This characteristic appears to be typical of this genre of text and differs significantly from journalistic texts, where after/before relations are, following identity, the most frequent (Silvano, 2025, p. 84). Their presence nevertheless indicates temporal succession. Such TLINKs occurred, for instance, between the *DOCTIMES* of different reports, and in cases such as the following:

(86)

“O doente apresentou o primeiro episódio de síndrome febril em 04/04/2024, tendo completado 7 dias de piperacilina/tazobactam, e o segundo episódio de síndrome febril em 11/04/2020, com a realização de 7 dias de meropenem e amicacina, 14 dias de vancomicina até 29/04/2020, 12 dias de ceftazidima e 8 dias de voriconazol”.

(The patient had the first febrile syndrome on 04.04.2024, completing 7 days of piperacillin/tazobactam, and the second febrile syndrome on 11.04.2020, completing 7 days of meropenem and amikacin, 14 days of vancomycin until 29.04.2020, 12 days of ceftazidime, and 8 days of voriconazole.)

In example (69), “second febrile syndrome” is linked to “first febrile syndrome” by *TLINK_after*. Overall, while chronological succession is also frequently encoded, it appears less prevalent than simultaneity.

With regard to grammatical features, notably Part of Speech, the majority of simultaneity relations were established between a noun and a verb (49 cases between two *General Events*, 115 cases between one *General Event* and one *Specialised Event*) or between two nouns (77 cases between one *General Event* and one *Specialised Event*, 224 cases between two *Specialised Events*, and 25 cases between two *General Events*). Nominal events therefore appear to favour simultaneity relations.

As for Tense, the results did not allow for robust conclusions, as most verbs occurred in the *Pretérito Perfeito*, and the small number of occurrences in other tenses precluded meaningful comparison.

In terms of *Specialised Events*, the most frequent *TLINK_Identity* relations were between two Treatment events (70 cases), between two Personal History events (42 cases), between two Principal Diagnosis events (36 cases), and between two Examination Result events (35 cases). Regarding simultaneity, the most frequent cases were between two Personal History events (35 cases), between Principal Diagnosis and Characterisation of the Disease (31 cases), between two Characterisation of the Disease events (31 cases), between Examination and Examination Result (30 cases), and between two Sign or Symptom Events (27 cases).

In conclusion, the analysis of temporal relations across the corpus highlights the predominance of *TLINK_simultaneous*, which appears to be a defining feature of clinical narratives. Simultaneity relations are particularly frequent among nominal events, although *TLINK_before/after* relations also occur. Further research into the aspectual properties of nominal events is required in order to gain a deeper understanding of the temporal relations within this domain.

TLINK_Identity relations are likewise common, reflecting the tendency for events from previous reports to be reiterated in subsequent ones. Instances of temporal progression and succession, marked by *TLINK_after/before*, are also present; however, their overall frequency remains comparatively low, and they are especially rare when contrasted with other textual genres, such as journalism.

5. Final Considerations and Perspectives

Medical reports contain large volumes of unstructured textual information, which constrains their systematic use both in clinical practice and in research. It is estimated that between 70% and 80% of clinical data are recorded in text (Lindvall et al., 20022, p.2) making NLP indispensable for the automatic extraction of relevant knowledge. However, the development of high-quality corpora remains a major challenge, particularly in less-studied languages such as Portuguese. This limitation is especially critical in diseases with a poor prognosis, such as AML, where understanding the patient’s clinical trajectory depends on reconstructing the chronology of events documented across multiple reports.

In this context, inter-document temporal analysis — by enabling the organisation and integration of dispersed information into coherent and ordered timelines — provides a valuable contribution both to the development of temporal semantics and to the advancement of clinical NLP. On the one hand, the study of the linguistic mechanisms that structure temporal organisation in clinical narratives — an area still scarcely explored in European Portuguese — helps to fill a scientific gap and expand knowledge in the field of semantics. On the other hand, temporal reasoning — involving the extraction, interpretation, and integration of chronological information — constitutes a core component of biomedical NLP systems (Sun, 2014, p. 2).

The central research question of this study concerns how temporal information is organised across different types of medical reports that constitute clinical narratives. To address this question, a series of interconnected steps was undertaken, beginning with a theoretical foundation, followed by the creation of linguistic and computational resources, and culminating in the empirical analysis of data.

The object of study was defined as a subcorpus extracted from an initial set of 906 medical reports written in European Portuguese, relating to patients diagnosed with Acute Myeloid Leukemia and followed at IPO-Porto. These documents, predominantly narrative in nature, describe each patient’s clinical course from hospital admission through to discharge or death, and comprise three types of reports: discharge reports, group consultation reports, and general reports. This documentary diversity required

theoretical reflection on the very notion of narrative, tracing its evolution from classical antiquity to contemporary approaches in computational linguistics, and justifying the relevance of considering medical reports as narratives.

The next step was to delineate the theoretical framework for temporal categories. The main proposals on tense were revisited (Jespersen, 1924; Reichenbach, 1947; Comrie, 1985; Declerck, 1991; Kamp and Reyle, 1993), aspect (Vendler, 1967; Dowty, 1979; Mourelatos, 1978; Moens, 1987; Cunha, 1998, 2004), and the verbal system of Portuguese (tense and mood). These references were essential for formulating the principles that guided the temporal annotation of the corpus.

Additionally, a critical review of existing annotation schemes for clinical narratives was conducted, including those covering Portuguese. From this analysis, it was concluded that, although not specifically designed for the medical domain, the Text2Story scheme (based on ISO 24617) was capable of capturing morphosyntactic and semantic information in a highly comprehensive manner. Building on this review, our aim was to develop an extension of the Text2Story scheme capable of representing temporal information in medical reports. To achieve this aim, a four-phase methodology was adopted: (1) selection and testing of existing schemes (i2b2, MERLOT and Text2Story) on a pilot subcorpus to identify their strengths and weaknesses; (2) enrichment of Text2Story with domain-specific attributes, drawing on the UMLS Metathesaurus, the work of Leite (2025), and validation by a haematologist at IPO-Porto, resulting in the Med2Story scheme; (3) empirical validation of Med2Story through the annotation of synthetic clinical reports by external annotators, including IAA analysis and error curation; (4) consolidation of the scheme and annotation of a subcorpus of 38 reports (9 patients).

These phases led to the development of the Med2Story scheme, which enables the annotation of morphosyntactic, semantic, and domain-specific medical information. A total of 38 reports corresponding to 9 patients were annotated, comprising group consultation reports, discharge reports, and general reports.

The annotation of this subcorpus yielded 1.859 annotated markables: 861 (46%) corresponding to specialised events, 728 (39%) to general events, and 270 (15%) to

temporal expressions. A total of 2.156 temporal links were established, with simultaneity relations predominating, followed by identity, before/after, and inclusion. The analysis by report type showed that discharge reports are the most complex, with a greater diversity of temporal relations, whereas group consultation reports and general reports tend to favour simultaneity and inclusion.

Several further patterns were identified. A higher frequency of eventive nouns was observed, which appears to be a defining feature of this textual genre. Regarding polarity, 96.98% of the General Events and 97.10% of the Specialized Event exhibited positive polarity. General Events were predominantly dynamic in nature, consistent with narrative texts. Reporting verbs were found to be infrequent, suggesting that physicians rarely reproduce patients' own accounts. Notably, perception events were absent from the corpus. The reduced use of modal forms reflects the nature of these types of reports: clinical reports are expected to be as informative as possible, presenting validated facts and conclusions rather than hypotheses or possibilities. As for tense, most events occurred in the past, in line with the retrospective character of medical narratives.

Within Specialised Events, the most frequent class was Treatment. Among temporal expressions, the category Date clearly predominated. The distribution of Temporal Links further revealed systematic tendencies in temporal structuring: *TLINK_simultaneous* was the most frequent relation (733 instances), reflecting the prevalence of events occurring at the same time or being temporally indistinguishable in context. *TLINK_simultaneous* was most often observed between nominal events, between nominal events and states, and between nominal events and processes. The results seem to indicate that these specialised nominal events could have some features that favour simultaneity readings. However, the combination of two nominal events is also the most frequent in *TLINK_after* and *TLINK_before*. Further research about this type of events is required.

TLINK_identity most frequently occurred between two Treatment events, between two Personal History events, between two Principal Diagnosis events, and between two Examination Result events.

The main contributions of this study are threefold: (i) the development of the Med2Story annotation scheme, which captures morphosyntactic, semantic, and medical information; (ii) the creation of an annotated dataset of clinical narratives in European Portuguese; and (iii) the temporal characterisation of different types of medical reports and of the patient’s clinical process that these reports collectively constitute.

The Med2Story scheme thus represents a significant contribution across multiple domains. From a linguistic perspective, it enables the temporal characterisation of Portuguese medical reports, thereby advancing our understanding of this textual genre. From a computational perspective, it provides a structured resource for training models for medical information extraction. From a clinical perspective, it promotes the systematisation of data, the identification of patterns, and the transformation of unstructured information into structured data of value for research and medical practice.

Nevertheless, several limitations must be acknowledged: (i) the difficulty of aspectually classifying nominal events, given the scarcity of theoretical studies; (ii) the impossibility of publishing the annotated corpus for ethical reasons; (iii) the restriction of annotation to the temporal layer, excluding other relevant dimensions such as referential entities (locations, people, genes) or quantification (laboratory results); and (iv) the highly time-consuming nature of temporal annotation, requiring significant investment of time and specialised expertise. Future research should extend the scheme to include these additional layers and explore automatic annotation methods, thereby enhancing the robustness and applicability of the results.

In summary, this study contributes to the understanding of inter-document temporal organisation in clinical narratives in European Portuguese, emphasising the importance of integrating theoretical linguistics, manual annotation, and the requirements of the medical domain. By combining these perspectives, it takes an important step towards transforming clinical information into linguistic and computational resources with both scientific and practical applications.

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