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Short Paper

Reflections on AI-Assisted Character Design for Data-Driven Medical Stories

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Abstract

Data-driven storytelling has experienced significant growth in recent years to become a common practice in various application areas, including healthcare. Within the realm of medical narratives, characters play a pivotal role in connecting audiences with data and conveying complex medical information in an engaging manner that may influence positive behavioral and lifestyle changes on the part of the viewer. However, the process of designing characters that are both informative and engaging remains a challenge. In this paper, we propose an AI-assisted pipeline for character design in the context of data-driven medical stories. Our iterative pipeline blends design sensibilities with automation to reduce the time and artistic expertise needed to develop characters reflective of the underlying data, even when that data is time-oriented as in a cohort study.

CCS Concepts

• ***Narrative Visualization*** → *Character Design; AI Image Generation;*

1. Introduction

Data-driven storytelling is an increasingly popular strategy across various domains, including healthcare, conveying nuanced medical details in an engaging manner to both professionals and patients. Characters can help to enhance an audience's emotional connection with the narrative and data [NBB*20, MWS*23]. Yet, crafting compelling characters remains demanding, involving creativity, extensive research, and technical skills. AI tools offer the potential to revolutionize this process.

AI tools like Midjourney [Mid] and Leonardo AI [Smi] generate imagery based on natural language user input, known as *prompts*. Sourcing broad media types, e.g., illustrations, designs, and photographs, from across the web, these and similar AI tools produce art ranging from highly stylized to photorealistic. Applied to character design, *prompt engineering* may help train the generative model to develop character traits and variations through query phrases, style specification, or providing relevant context about the character [LYF*23]. However, AI-generated imagery is not flawless—human characters may have extra limbs or other anatomical distortions. A designer's input is necessary to steer the process, combining their skills and creativity with the rapid iterability that these AI tools enable.

A standard character design pipeline for a healthcare-centered story can be broken down into four key phases. In the *research phase*, the artist collects information on the story topic, including the mechanism of disease, demographics, and psycho-social factors of people most often affected by the disease or condition in question. In the *concept phase*, the artist integrates this information in a series of exploratory sketches to develop a character that could resonate with the audience and represent key aspects of the condition, including adding animation to bring more life to the character. Feedback from stakeholders leads to a *refinement phase* where character details and traits are further dialed in, culminating in the character's *launch* into the finalized story.

In this paper, we propose a *semi-automated pipeline* for AI-assisted character design for use in medical stories, with a case study to demonstrate an application of our pipeline. An authentic character is designed in tune with audience sensitivities and ethical considerations. We reflect on these considerations in the design process, how AI can facilitate or hinder, and where a human user is necessary to steer the design process, and opportunities for future work in prompt engineering to design human characters supporting data-driven medical stories.

2. Related Work

Our semi-automated character design pipeline for medical stories is rooted in principles and research within traditional storytelling and narrative medical visualization. We discuss related approaches and concepts in this section.

Character-Based Storytelling in Entertainment. Characters enhance a story's narrative, particularly in the media and entertainment industry, with the gaming sector leading character-driven storytelling research and innovation. For instance, Cavazza et al. [CCM02] focus on the dynamic interaction of autonomous char-

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acters. More recently, Mariani et al. [MC*19] and Sheldon [She22] investigated character-driven storytelling. Mariani et al. focus on a design process aiming at interesting characters.

Narrative Medical Visualization. Narrative visualization blends storytelling with data visualization to craft data-driven stories [LRIC15]. In medicine, storytelling adapts to healthcare's unique challenges, employing diverse data while respecting patient privacy and senstivities [MGS*22]. Medical data stories frequently appear in news and health media. The methods for crafting these stories are an ongoing topic in narrative medical visualization research [GSG*21, GMF*21], which explores how visualization can facilitate physician-patient interaction and motivate care [GJ21]. McCurdy et al. [McC16] employed visual storytelling for patients to express health issues, using a timeline-based template to show symptom extent and duration. So et al. [SBŠ*20] introduced an AI tool generating narrative medical visuals from social media posts on conditions like diabetes, based on the 'bio-psycho-social model' encompassing medical, psychological, and social factors [G*17]. These stories merge emotions, societal impact, and symptoms. Meuschke et al. [MGS*22] established a template for crafting data-driven disease stories for patients and the general public.

Characters in Narrative Medical Visualization. Kleinau et al. [KSM*22] applied a template in a case study to enhance engagement and knowledge retention through structure, personalization, characters, and metaphors. Building on this, Mittenentzwei et al. [MGM*23] studied the effects of narrative genres (slideshow and scrollytelling) in disease communication for usability and aesthetics. In another study, they examined the impact of different story protagonists on engagement and memorability [MWS*23]. Limited research explores AI-guided character design, especially for medical data narratives. Our work delves into character design for medical stories, exploring AI's role in this process.

3. Semi-Automated Character Design Pipeline

In this section, we discuss our semi-automated character design pipeline to support data-driven medical stories, illustrated in Fig. 1. Our pipeline begins with *data extraction*, followed by *name assignment* and *design of physical appearance*, then *character animation*. Throughout this section, we include a running example of the pipeline with the development of a female patient character recovered from Non-alcoholic fatty liver (NAFL), a common liver condition impacting 14–30 % globally which can be a precursor for liver disease [KRP*22]. We extracted this character from *Study of Health in Pomerania* (SHIP), an epidemiological database located in North-Eastern Pomerania dedicated to identifying disease risk factors [KGL*15]. Three data subsets were recorded in time steps of five years: *SHIP-0* (1997–2001), *SHIP-1* (2002–2006), and *SHIP-2* (2008–2012).

3.1. Extract Character from Data

High-quality longitudinal data are a crucial basis for story development and our character design process, such as the longitudinal epidemiological SHIP dataset noted at the beginning of this section. For character extraction from the dataset, we propose a query filtering scheme with two criteria sets. **Hard criteria** are inclusive to candidates that embody the core medical message and align with the narrative's intent, i.e., a call to action for positive lifestyle changes. Criteria include candidates whose profiles align with disease risk factors, and who have overcome a critical health issue with a reduction in risk factors over time. **Soft criteria** are inclusive to candidates with demonstrated outstanding lifestyle factor improvements or risk factor reduction. Background knowledge of disease risk and recovery factors are necessary to identify these criteria.

Algorithm 1 shows our hard and soft criteria for extracting the female patient character recovered from NAFL. The **hard criteria** fall into three groups, focusing on variables strongly correlated with NAFL as identified from previous SHIP studies [IHW*12]:

1. Diagnose-related variables: For the diagnosis of NAFL, only subjects with a *fatty liver* and *without alcohol problems* were considered.
2. Demographic variables, i.e., *gender*, *age*, *family status*, *education*, and *occupation* to give context and history to the character.
3. Risk factors or lifestyle-related variables, e.g., *waist-to-height ratio*, *BMI*, *alcohol consumption*, *physical activity*.

Soft criteria identified those participants with positive lifestyle changes: *weight loss*, *exercise*, *smoking cessation*, and *reduced alcohol consumption*.

Algorithm 1 Extract character (case study example)

$Candidates\_hardcriteria \leftarrow subjects\ S\ where$
```
(stea_s0 = 1 and stea_s2 = 0) and
(alcproblem_s0 = 0) and (overweight = True) and
(weight-loss = True) and (physact_s2 = 1) and
(smoking_s2 = 0 | 1)
```
where :
```
overweight: if (whtr_s0 > 0.5) then True
weight-loss: if (som_tail_s0 > som_tail_s2)
then True
```
$Candidate\_softcriteria \leftarrow Candidates\_hardcriteria\ where\ s\ maximizes\ the\ following\ conditions$:
```
(whtr_s0 > 0.5 and whtr_s2 < 0.5) or
(som_bmi_s0 > 25 and som_bmi_s2 < 25) or
(som_bmi_s0 > som_bmi_s2) or (physact_s0 = 0 and
physact_s2 = 1) or (alkligt_s0 > alkligt_s2) or
(LFV_s0 > LFV_s2)
```

Legend: *s0*, *s1*, and *s2* refer to data subsets SHIP-0/-1/-2 recorded at five-year intervals. ***Variables:*** *stea* = steatosis hepatis (fatty liver), *physact* = physical activity, *smoking* = 0 (non-smoker); 1 (ex-smoker), *whtr* = waist-to-height ratio, *som_bmi* = body mass index, *alkligt* = alcohol in g per day, *LFV*=liver function values: Triglycerides, ALAT, GGT, ASAT (indicators for liver health, e.g., high dietary fat intake, liver inflammation or damage).

3.2. Name Character

The character naming step of our pipeline is designer-driven. To protect patient privacy, designers must choose a *fictitious* combination of first and last name. This decision involves a thoughtful evaluation of multiple factors. First, it is vital to choose names that resonate with the target audience and are appropriate to the cultural context of the story. Authenticity and appropriateness to the setting and time period are key considerations. It is important to research the *frequency* of names in the character's birth *country* during that

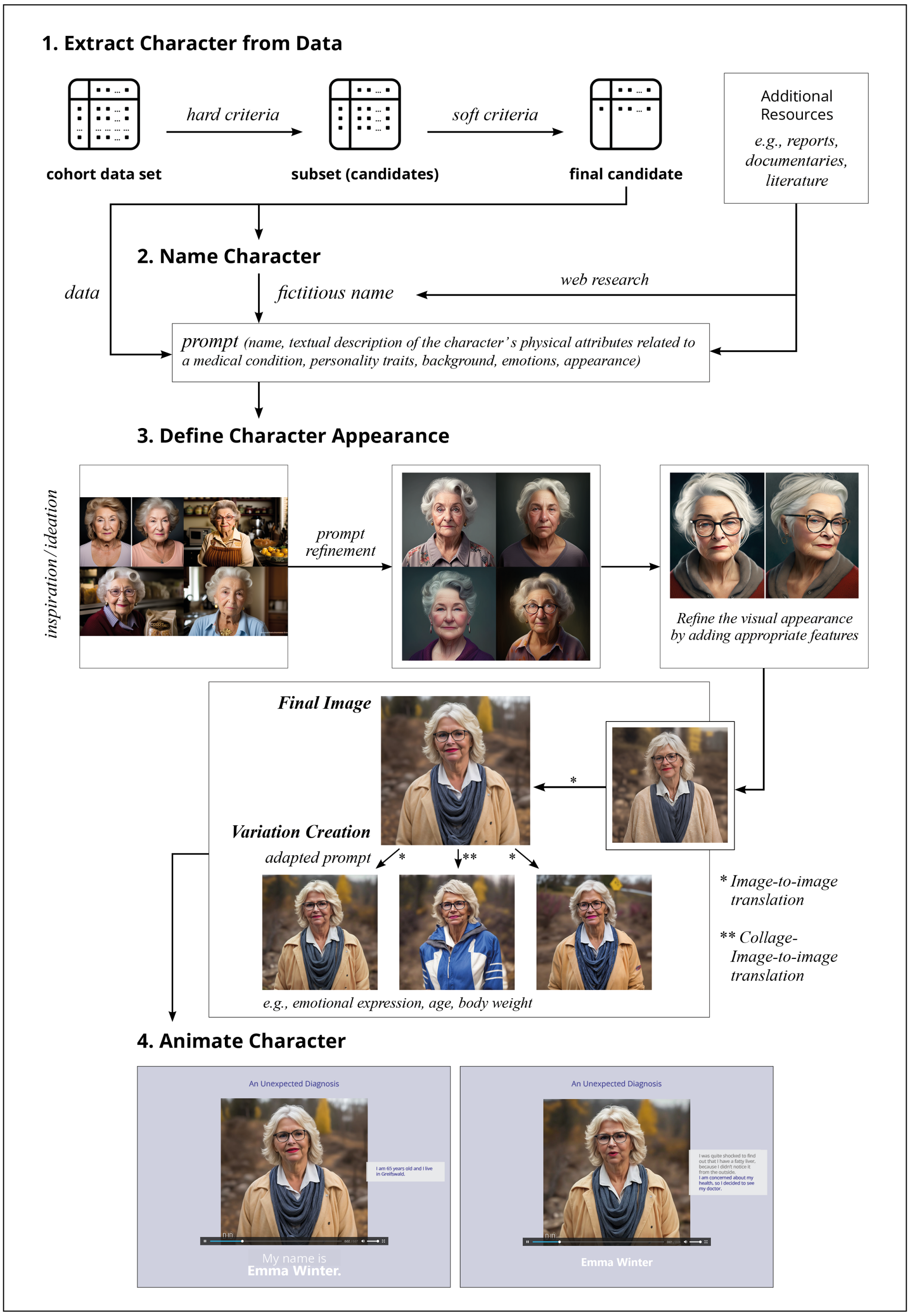

Figure 1: *Semi-Automated Character Design Pipeline.*

era. However, designers should also assess a name candidate's *popularity* in both the past and contemporary society to ensure relatability. This information, including the origin, meaning, and symbolism of names is available through various online services [Net, Rei].

Candidate names should meet linguistic and phonetic criteria, being *memorable, pronounceable, and harmonious* with the character's personality, as understood from the extracted character description in the previous step. Pronouncing first name and surname aloud together can help to assess suitability. If it feels comfortable and the sound matches the person's personality, it will also ensure that the name is easy to remember. Celebrity names should be avoided in order to create a unique identity that simulates a situation similar to meeting a new person. Finally, we want to use the name later to generate images—using a famous name will also result in the model generating similar images to the real person.

For our female character example, we selected the first name considering gender, birth year (1933), and nationality. We found that *Emma* was a popular female name in 1933–1945 Germany and found that the name is popular again today [Net], especially in Pomerania. To ensure a harmonious combination, we chose a last name that did not rhyme with the first name and was easy to read. We used a web portal [Rei] to research last names, focusing on names more popular in Northern Germany to anchor regionality. As the story was intended for both English and German audiences, we chose an accompanying last name that is known in both languages: *Emma Winter*.

3.3. Define Character Appearance

Although our pipeline is intended to integrate with any generative AI system, we use Leonardo AI, a flexible, freely-available tool designed to create game assets from characters to concept art, to define character appearance.

1. Base Prompt Input. With our approach, a prompt is required to create an AI image. The prompt is a textual description of the character that can be extracted from the data in the previous step. The first prompt may contain only data-driven features, e.g., gender, age, occupation, and somatic characteristics. In addition, an image style for the appreciated aesthetics, e.g., photorealistic, and attributes, such as 'friendly' or 'beautiful' can assign a more sympathetic and warm expression to the image. We use the following prompt scheme for generating a concise character:
`<character name> <textual description from data> <image style> <additional features, e.g., visual appearance, emotional expression>`

2. Inspiration and Orientation. The results of the first phase are characterized by a wide variety of output images where the designer finds inspiration and orientation, experimenting with attributes like hair and clothing style, and accessories that accentuate the character's personality. Following our female character study, we see in Fig. 1 that, despite the same prompt, Leonardo AI returns an array of different characters. With this as a starting point, the designer may experiment with prompt component weights and positioning—prompt components at the beginning exert more influence on the image result. Elements such as text and letters can be excluded with a negative prompt, the syntax of which differs between AI tools.

Following our female character, our final prompt was constructed as follows: *Emma Winter A beautiful, friendly, photorealistic, 65 years old, overweight, educated woman with a friendly, independent, open-minded personality, platin-blond, long pixie hairstyle, wearing glasses, she is a mother and was a kinder-garten worker –no text –no letters*.

3. Refinement. From the initial results, the prompt is fine-tuned to create a more relatable, modern, friendly, and realistic character. This phase incorporates human design sensibilities and considerations which means, exploring additional physical appearance properties that fit the extracted data description. The prompt is continuously refined until the designer achieves a character aligned with the data.

Revisiting the female character example (Fig. 1), glasses have a strong semantic association with higher education. Specifying the prompt object's position, like *wearing glasses*, was crucial to ensure accurate depiction. The designer also added a color attribute to the hairstyle for a contemporary look, prioritized the most important attributes by placing them first, and experimented with removing terms.

4. Finalize Base Appearance. The character is finalized the using *Image-to-image translation* [Hao]. Since this technique only returns similar images, this narrows the resulting design space. Key features such as the character's pose, hairstyle, and clothing style are retained, allowing the designer to choose the most appropriate character variant. See "Final Image" in Fig. 1 for the finalized female base character.

5. Generate Variants. For a vivid story, an authentic character would change its appearance slightly over time. Our pipeline incorporates a generation of additional character variants, developed from the final image from the prior step that acts as a seed image. Variations range from various emotions to different body weights and ages, which are important in medical stories that span years of a patient's life.

Fig. 1 shows the variation of the female character's expression using 'image-to-image translation' and a slightly modified prompt such as "Emma Winter worried [...]". However, large changes, e.g., very different clothing, would require the training of an own model. A shorthand technique is to create an image collage first and use image-to-image translation with additional prompt variation. Fig. 1 shows an example of a collage transformed into an image in which the character has also aged.

3.4. Animate Character

As video-based storytelling gains traction, animation adds life to characters and dynamic narrative. Animation amplifies emotional impact, infusing characters and experiences with depth.

We used D-ID [DI] to animate the character telling her story. This AI tool takes as input an image (we used our generated AI images from previous steps) and text with a selected voice style. Alternatively, an individual audio sequence can also be uploaded. By the given input the tool generates a video sequence of a speaking character that can be integrated into the narrative. We implemented individual video sequences together with other interactive elements such as 3D models and gamification elements in a web-based prototype. We attached a video of the animated character as supplemental material.

By skillfully incorporating animation, storytellers can harness its power to educate, inspire empathy, and create compelling, data-driven medical stories.

4. Discussion

In this paper, we introduce select design considerations and a semi-automated pipeline for creating characters in data-driven medical stories, acknowledging its early stage and limitations. For instance, we encountered challenges with color assignments, finding that fine-tuning color control would improve results. Additionally, character names influenced the ethnicity of generated images, and specifying clothing details sometimes focused too much on body parts, requiring prompts that prioritize the character's face. Furthermore, capturing the full impact of character design on audience perceptions and emotions is challenging. Evaluating long-term effects on knowledge, behavior change, and empathy may necessitate complex longitudinal studies. A persistent question is how to integrate the individual components of character development into a tailored system for medical stories.

5. Conclusion and Future Work

Human-AI synergy may enhance character design and storytelling, uniting creativity and design possibilities. Our research explores semi-automated character design through tailored prompts for data-driven stories in the healthcare domain. Visualizing the progression of the disease is specific to medical stories, which we have shown with the reduction of character's body weight. Our pipeline begins with data extraction, then defines a character name, followed by appearance definitions, and finally animation. Blending human design sensitivities with data analytics techniques, our pipeline enables the iterative production of characters that may contribute to telling more personalized, engaging, and understandable data-driven stories about health and wellness.

Medical and scientific character creation share similarities but differ due to sensitive data in medical contexts. Medical topics evoke emotions, necessitating appropriate, reassuring characters. Vital is a character reflection of psychological and physical disease changes for narrative alignment, as shown in our case. Validation against diverse datasets, character sets, audience perceptions, and behaviors is the next step. Future research could integrate varied medical data, AI advancements, and detailed psychological traits, histories, and emotional states for more representative characters.

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