The *KidneyTIME* educational health animation development process: lessons learned

Liise K Kayler[1,2]*, Beth A Dolph[1], Molly E Ranahan[2], Maria M Keller[3], Renee B Cadzow[4], Thomas H Feeley[5]

[1]Jacobs School of Medicine and Biomedical Sciences at the University at Buffalo, Buffalo, NY USA

[2]Transplant and Kidney Care Regional Center of Excellence, Erie County Medical Center, Buffalo, NY USA

[3]University at Buffalo, State University of New York, Department of Community Health and Health Behavior, Buffalo, NY USA

[4]D'Youville College, Department of Health Services Administration, Buffalo, NY USA

[5]University at Buffalo, State University of New York, Department of Communication, Buffalo, NY USA

Abstract

Background: The *KidneyTIME* educational animations intervention was developed through a partnership with a transplant surgeon, an expert in communication, a community transplant advocacy group, and a professional animator.

Material and Methods: *KidneyTIME* was iteratively developed relying on patient and stakeholder feedback in an effort to maximize its intended effect. The scope and execution of the project presented unexpected challenges that threatened timely completion of the intervention.

Results: Animation development encountered opportunities and challenges with receipt of federal funding for a project with the aim of producing 12 animations within 1 year. Three main challenges were identified: (1) communication between project team and animation vendor regarding contractual details and animation design, (2) methodologic process of incorporating patient and stakeholder input into video design, and (3) timely animation design changes of content, script, graphics, and movement. Short-term and long-term strategies were applied to address evolving needs within each area, including: (1) clear communication plan between researchers and animator, (2) flexible methodologies to obtain patient and stakeholder input and to make decisions, and (3) thorough animation design preparation and contingency planning.

Conclusion: This case study demonstrates how challenges can be worked through, particularly if the partnership embraces challenges as means to improvement. Recommendations have been successfully applied to ongoing initiatives undertaken by the project team and will be useful to other researchers endeavoring to develop educational animations.

Abbreviations: ECMC: Erie County Medical Center; KFWNY: Kidney Foundation of Western New York; HRSA: Health Resources and Services Administration

Introduction

Currently, the active waiting list for kidney transplantation is threefold larger than the supply of deceased-donor kidneys [1], so many recipients and their social network consider living-donor kidney transplantation [2]; however, the advantages for the recipient must be weighed against the potential risks to the donor. Making an informed choice about live kidney donation is more complex today than it used to be since more information is available regarding the medical, psychosocial, and financial risks of donating, and medical progress has led to expansion in donor eligibility and opportunities for donating (e.g., paired exchange, incompatible transplantation).

To enhance healthcare learning, a powerful format is animation. Animation is defined as "a simulated motion picture depicting movement of drawn (or simulated) objects," in contrast to video which depicts movement of real objects [3]. Over the last 5 years, animation has been increasingly applied to assist patients with decision-making in various healthcare settings but not in kidney donation. Additionally, the development process and challenges encountered by other researchers developing educational animations are incompletely reported.

We recently developed *KidneyTIME*, a comprehensive series of educational animations intended to provide patients and their support networks with decision support to consider living-donor kidney transplantation. We report our experience developing *KidneyTIME*, offering lessons learned along with recommendations for future educational animation development. Unlike previous studies, this manuscript provides an in-depth view of our animation development process, which will be valuable to others aiming to undertake similar projects.

Material and methods

Background

The Regional Center of Excellence for Transplantation and Kidney Care is a transdisciplinary clinical unit within Erie County

Medical Center (ECMC) dedicated to providing kidney and pancreas transplant services to the city of Buffalo and the Western New York region. Partnering with ECMC were an expert in organ donation interventions--including video-based formats--and a representative with the Kidney Foundation of Western New York (KFWNY), a not-for-profit community organization with grassroots integration in the West and East Sides of Buffalo. The clinical director/Co-PI of the project has had a relationship with KFWNY since taking on the leadership of the ECMC transplant unit in 2015. A partnership with the research Co-PI was initiated two years later. Through this partnership, the project received two seed grants to develop animations for patients about deceased kidney donation. Thereafter, we submitted a proposal to the Health Resources and Services Administration (HRSA) to develop and test educational animations about living kidney donation and transplantation on a larger scale. A local animation company and KFWNY were included in the HRSA grant as consultants. The application was successful, and our partnership received its first federally funded grant in September 2018. This 3-year grant project involved: (1) developing the *KidneyTIME* animations and (2) pilot testing the intervention for feasibility and acceptability among kidney transplant candidates.

Organizational Plan

Animation development: While the co-PIs worked together previously on several educational animations, a more formal structure was proposed in the grant. Given our prior experience, we thought we could predict the best way to organize animation development. Processes were initially developed for the co-PIs to serve as co-chairs of the steering committee. After gaining feedback from patients, the co-PIs/co-chairs would facilitate joint decision-making to help build consensus among the committee's constituent stakeholders (medical staff, community advocates, hospital cultural consultants, anthropologist). Specifically, the plan proposed to first obtain patient feedback after viewing the animations and then to work through the steering committee for all decision-making. The research PI would be research co-chair of the steering committee, responsible for the scientific direction of the animation development. The clinical PI would serve as clinical co-chair of the steering committee, responsible for the medical direction of the animation and direct oversight for grant deliverables.

Animation design: Animation development would be guided by cognitive factors research [4-9] and the Cognitive Theory of Multimedia Learning [3]. First, we planned to identify the educational content required to address the informational needs of transplant candidates and their supports. The content would be divided into separate short animations focusing on a relevant and practical topic, each designed to be viewed in its entirety. Scripts would be written in active voice, using simple language and conversational style. Scripts would contain 2-3 new or complex messages alongside other simple and familiar messages and cross-cut by two constructs: (1) availability of transplant providers in all phases of care and (2) inclusion of caregiver and social network support. Scenes would have low visual complexity without distractions and include only backgrounds that contributed to the message. Characters would have simple facial features that allowed them to emote but would not be humanistic. Animation would visually reinforce content simultaneous with audio. The animator would produce an early animation prototype with a scratch track voiceover narration of each script and preliminary scenes consisting of black and white line drawings (Figure 1) and minor motion. Prototypes would be iteratively refined based on viewer input and ultimately rendered into fully colored finished images (Figure 2), which would then be synchronized to the final professional voiceover.
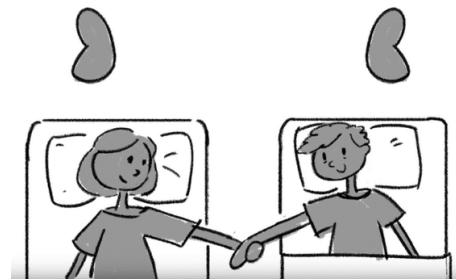

Figure 1. Early animation scene created with line drawings
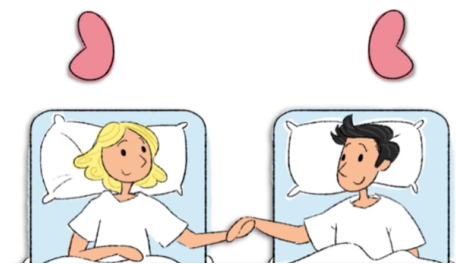

Figure 2. Final animation scene with full color

Results

Key Points

The proposed plan did not account for the real-world issues that would arise during the evolution of the animations, and the team did not have a contingency plan in place to deal with them. We encountered both opportunities and challenges with receipt of federal funding for a project with a large scope (12 educational animations within 1 year). It changed the dynamic of the animation development process and created a sense of urgency that did not previously exist. Three main areas were identified: (1) communication between project team and animation vendor regarding contractual details and animation design; (2) methodologic process of incorporating patient and stakeholder input into video design; and (3) timely animation design changes of content, script, graphics, and movement (Table 1).

Communication

Animator: The animation company that originally contracted to develop the animations and that was pivotal in decision-making around the submission increased the cost of animations after funding was awarded. The contract between ECMC and the vendor was unclear regarding the stages of animation development and the allowable number of revisions at each stage. Additional charges for revisions rendered the entire project unaffordable, and a revised agreement that would be within the approved budget could not be negotiated. We had previously obtained bids from several other animation companies; however, the cost was prohibitive due to the revisions that would be needed to fully incorporate patient input. Although there are free or inexpensive programs available to make animations, we did not have time to self-educate and create the animations ourselves. Additionally, the limited options offered by these programs might have been insufficient to make credible and professional-looking animations.

Short-term strategy: Attempts were made to procure alternative animators. The clinical PI identified a freelance animator in a neighboring city; however, the freelance artist would not agree to ultimately release ownership of the animations or supply the source files. The research PI investigated university resources and found a local

Table 1. Description of Animation Development Experience for the KidneyTIME Project

Aspect	Communication	Methodologic	Animation Design
Context	Animator charges for revisions were too expensive.	• Input from stakeholders. • Decision-making about animation design.	Animations required more revisions than anticipated.
Short-term Strategy	New animator was procured, and the partnership was productive.	• Adopt continuous approach to obtain stakeholder feedback. • Adopt flexible approach to make animation design decisions.	• Identify priority topics. • Extend the early animation phase until change and retest process is completed.
Challenges	• Tracking video script changes. • Complexity and extent of communication.	• Ensuring input from all stakeholders at optimal times during animation development. • Including both PIs in decision-making about animation design.	• Difficulty achieving effective combination of audio, image, and movement. • Time needed to refine animations.
Long-term Strategies & Recommendations	• Utilize on-line data sharing to store animations and document changes. • Establish clear communication plan between researchers and animator. • Determine contact person who has decision-making authority to be continuously available to animator for minor queries.	• Have a clearly defined yet practical structure to obtain patient and stakeholder feedback. • Embed continuous patient participation throughout the project. • Allow stakeholder input through various interaction types (email, phone, in person). • Consider what decisions will be made when, by whom, and by what process.	• Consider appropriate timelines for pre-production, active refinement, and finalization of animations. • Create a thorough pre-production preparation strategy and have a contingency plan in place. • Produce early animation prototypes as soon as possible. • Build collaborative relationship with animator to access artistic ability of animator. • Schedule frequent but brief meetings with the animator to strategize facilitators to the production process.

freelance artist and MFA student at the University at Buffalo who is an expert in this area. The artist was interested in the project, produced high-quality animations, understood the specific research revision needs, did not require co-ownership, offered a price within the scope of the budget, and agreed to supply all assets, source files, and templates.

Challenges: Extensive and detailed decisions were needed to revise the evolving animations, including: revising the script; elaborating visuals; conceptualizing ideas for updated visuals; refining image color, timing, and transition; choosing character features, gestures, and expressions; and changing narration style and pace. Although changes for each animation were succinctly documented and promptly emailed to the animator, the extent of the revisions resulted in confusion and difficulties in tracking the most recent scripts and communicating completed tasks and next steps. The animator suggested using Google Docs to manage version control; however, due to a recent institutional cyberattack, researcher access to Google Docs could not be quickly instituted. In addition to written updates, continuous minor decisions were needed to allow the animator to progress, including responding to clarifications or suggestions about script changes, requests for sample images, and pre-animation approval of images.

Long-term strategies: To organize scripts, animations, and character sheets, and to ensure researcher and animator access to most recent versions, the team utilized a university online data-sharing program (Box) that allows users to store, access, share, and edit files from the cloud. This process allowed us to quickly communicate updates to scripts (e.g., red strikethrough deletions, highlighted additions) and to scenes. Scene comments were placed below each line of the script wherein pending actions (written in blue print) and completed actions (in green print) were maintained throughout the development process. Of note, most animation companies use web-based video collaboration software to privately exchange frame-level time-coded notes (e.g. Frame.io); however, these platforms have varying capabilities. Although clients are able to add frame-specific comments, it is not always possible to visualize previous comments and changes or to make more than minor script changes by frame. In addition to the bidirectional online communication (i.e., script with accompanying scene comments), the

clinical PI was selected to serve as contact person with authority to speak on behalf of the research team to quickly respond to additional queries and allow the animator to continue the revision process.

Methodologic Process

Animation development with patient and stakeholder input: The original plan of conducting 3 cycles of patient focus groups at specific phases of animation development followed by steering committee meetings to reflect on and incorporate these data proved too slow to provide the animator with timely feedback. Additionally, our original approach of limiting the number of animations shown to patients at each focus group or interview (i.e., 6 animations per session) in order to ensure time to obtain in-depth feedback was inefficient for animations produced later in the series. Viewers of later animations would often expend valuable interview time by providing feedback regarding informational gaps that had already been addressed in the earlier animations.

Short-term strategy: Instead of conducting a limited number of large patient focus groups at pre-specified animation stages, we conducted ongoing individual cognitive interviews. This allowed for continuous evaluation and input by patients and/or their caregivers during all stages of content creation, from script revision through editing and image selection. Instead of limiting the number of animations shown at these viewing interviews, we showed all available animations. We limited the number of questions about animations that had already reached data saturation and continued to conduct in-depth probing about those animations still under refinement. This worked well to orient the viewers, allowed enough time to obtain needed feedback, and provided an added benefit of gaining input regarding the comprehensiveness of the *KidneyTIME* series.

In parallel, we contacted each steering committee member individually at a convenient time and place (in person or via email) to gather their input on each animation as it reached a specific stage (initial prototype and full color prototype).

Challenges: With the change to continuous interviewing, ensuring input from a sufficient number of representative stakeholders and

patients at optimal times during development was challenging. The original plan of including steering committee members on all decisions regarding animation refinement was not possible, and joint decision-making by the PIs was also challenging. Because of the quickly evolving materials, decisions often had to be made outside the steering committee; however, major decisions always included both of the PIs. Although steering committee member input was obtained at intervals, they did not make moment-to-moment decisions that were time-sensitive.

Long-term strategies: We established practical methods to obtain patient and stakeholder feedback and to efficiently make decisions that were as complete as possible to minimize the number of revisions and allow the animator to continue the revision process. Creating a clear communication plan with stakeholders (i.e., community, cultural, and medical advisors) to provide feedback quickly regardless of interaction type (internet vs. in person) was also necessary. Partners needed to ensure methods of obtaining feedback that respected the time of stakeholders and advisors.

Timing of Animation Design

Development of animation: The original timeline for the development of the animations was unrealistic. Our content aims were comprehensive, and unnecessary time was spent on complex messages that were not priority areas. Some aspects of the narration were incomplete, confusing, or were misinterpreted by patients. Also, the script was not always written succinctly enough or in a way that would logically advance the idea concurrent with an image. We struggled to conceptualize graphics that reflected educational messages that would be quickly and easily understood by patients. Each message was intended to be illustrated visually concurrent with the narration; however, this resulted in an overabundance of scenes and movements that confused or distracted viewers.

Short-term strategy: To ensure sufficient time to develop the intervention, the joint PIs identified priority topics and put low priority animations on hold until we were sure to meet our timelines. We spent as much time as necessary within the early animation prototype phase reworking the script to advance the ideas and enable reinforcement of messages with preliminary images. Each change in the script required a revised voiceover by the animator, retesting with viewers, and, sometimes, additional changes. Images were conceived and revised as rough sketches (Figure 1) until they were useful in elaborating the message. After checking understanding by patients, they were rendered into full color scenes (Figure 2). Efforts were made to reduce the number of images to depict the most important messages and to minimize noncontributory movements by characters. To conceptualize images, we more fully collaborated with the animator, who had a greater understanding of techniques for educational design. Our animator initially approached the project by responding to our direction with minimal comment or input. Although this was useful to allow us to learn from our mistakes, it was time consuming. With ongoing conversations discussing our challenges and seeking advice, the animator became an interested investor in overcoming the challenges within each animation.

Challenges: Developing animation for educational purposes posed a complexity that required feedback from patients and stakeholders, followed by revisions and further feedback, until sufficiently understandable messages were achieved. We were committed to working out the challenges to have a productive relationship and successful grant deliverables, and we were fortunate to have found an animator willing to collaborate with the project team.

Long-term strategies: Animation-based education development requires an appropriate timeline for pre-production, animation refinement, and finalization of animations. Since forecasting timelines was difficult, we identified priority topics and developed them first. We found it necessary to create a thorough pre-production preparation strategy with animator, patient, and stakeholder input, such as reading scripts out loud, including input from opportunistic lay persons, and describing, drawing, or providing photo references for each scene. Producing the first prototype of the animation as soon as possible enabled us to test it with the target audience to identify deficiencies and make corrections efficiently. We remained in the early prototype stage--where animations are easily revisable--until messages were clear. This phase included using a scratch track voiceover, since professional voiceover is expensive in the case of multiple revisions. We worked with line drawings until revisions were no longer needed, then followed with fully rendered images. In the final month of development, our animations were synced with professionally recorded voiceovers. Frequent communication with the animator was key to developing a productive relationship to overcome challenges and facilitated the production process.

Discussion

The current paper detailed the development process of the educational animations within the *KidneyTIME* intervention. We described the communication, methodologic, and design challenges we encountered during production of the animation series as well as the short-term and long-term strategies applied to address evolving needs. As with all projects, our process was bound by a limited budget and timeframe to complete each successive step toward realization of the project goals detailed in the original proposal. This case study demonstrates how challenges can be worked through, particularly if the partnership embraces them as a means to improvement.

We chose animation as an educational tool because of its powerful messaging potential; however, employing animation effectively in a way that promotes information processing and avoids cognitive overload requires a stakeholder- and patient-inclusive iterative approach. In *KidneyTIME*, the extensiveness of revisions required was the primary reason for our communication, methodologic, and design challenges, yet these revisions were crucial to meeting patients' learning needs. Previous literature underscores the importance of learner verification during the preproduction phase of new material development to ensure that unsuitable design and content are uncovered in time for revisions to be made [10]. This includes feedback from the target population in every stage of animation development, including designing the material, selecting the appropriate words, and creating instructional graphics. We have compiled a list of guidelines for educational animation development, which were modified from Murphy, *et al.* [11] and incorporated recommendations from the literature as well as our findings (Table 2).

During the animation development process, we made numerous changes in response to patient and stakeholder feedback. We found that the extensiveness of anticipated content within the *KidneyTIME* series was ultimately achievable due to the unique nature of animations to impart meaning. Due to the alignment of audio and visual stimuli, fewer words were needed to explain topics, resulting in improved scripts with greater linguistic simplicity. We had anticipated that each animation would be approximately 6 minutes; however, less than 3 minutes was the optimal duration for our patients.

Many issues raised by patients and stakeholders provided valuable information to enable us to adjust scripts and images in our animations

Table 2. Guidelines for instructional animation design*

Content:
· Define the purpose of the material
· Focus on behaviors or knowledge/skills instead of non-behavioral facts
· Limit the scope to essential information directly related to the purpose
· Ensure each idea is logically sequenced and consistent, so patient can predict the flow of information.
· Include a summary to review key ideas

Narrative:
· Use conversational style and active voice
· Use simple sentences; minimize sentences that contain embedded information
· Use common words (1- or 2- syllable words)
· Use examples to explain technical words, concepts, and value judgments
· Limit the number of concepts per animation
· Include patient suggestions in material development

Images:
· Use simple, adult-appropriate artwork that make the viewers feel the material was carefully designed.
· Avoid black and white line drawings/sketches and clipart.
· Avoid naturalistic drawings or photographs.
· Avoid distractions
· Use ample white space to reduce appearance of clutter
· Use color to highlight important features and draw connections.
· Place images next to the related text
· Maximize pictorial and minimize text information
· Include visuals that are functionally and culturally appropriate
· Provide explanations of charts and graphs
· Use cues such as arrows, boxes, color, and underlines to help the eye focus on relevant information
· Ensure that the cover graphic has an explicitly stated title portraying the purpose of the material
· Ensure the cover graphic looks inviting and attracts attention.
· High contrast between type and background (e.g. black type on white background)
· Text type is easy to read, uppercase and lower case (not all caps for long headers or text) sans-serif.
· Lists are grouped under descriptive subheadings or "chunks" with less than 5 items

Animation:
Limit animation to less than 3 minutes
· Include humor
· Avoid sound effects
· Use varied scene changes
· Consider the tempo of the presentation and the speed at which information is given
· Place structural features before the auditory information
· For new and complex messages, simplify the presentation and maximize audio/visual redundancy
· To elicit orienting responses, use scene changes, camera changes, and movements towards camera

These guidelines were based on recommendations by cited authors as follows: content [12]; narrative [3,10,12,13]; images [10,12,14,18]; animation [3,10,14,15].

to maintain orientation to the message. Messages designed to be heard in their entirety are subject to cognitive overload if too much information is presented too quickly or if structural element placement interferes with rather than aids in the processing of verbal information. Hence, in every video, we mixed complex topics with simple, more familiar topics and constructed images that could be understood quickly.

Lastly, we learned to incorporate much less movement than we had originally intended. The final *KidneyTIME* animations are primarily composed of scenes with a sense of movement provided by panning or zooming across still backgrounds. Brief moments of movement were interspersed throughout to reinforce messages (i.e., signaling). Previous research suggests that since movement and ongoing changes in the visual information in animations require a high level of awareness from the viewer [16], the cognitive capacity that people need to properly process the information is increased. Therefore, animations are effective when the images truly represent the content of the message and contribute to its understanding. If this is not the case, the movement of animations could potentially distract from the content [17].

Conclusion

Developing animations to deliver comprehensible health information is a complex process requiring a user-informed, iterative approach. The lessons learned from our health animation development process can be applied to other productions to strengthen their approach. Others undertaking healthcare education using animations are encouraged to develop a clear communication plan, flexible methodologies for stakeholder input and decision-making, and thorough design preparation with contingency planning before taking on a large, formalized animation project--and to be ready to adapt as unexpected challenges arise. In the end, the challenges that we faced together resulted in developing a stronger, more flexible approach that can be used in large projects to develop animations. Now that the *KidneyTIME* series has been developed, we are piloting the intervention for feasibility and acceptability among patients referred to ECMC for kidney transplantation. It is hypothesized that after exposure to *KidneyTIME*, kidney transplant candidates will report improvements in knowledge, self-efficacy, and concerns related to live kidney donation and that close relations will increasingly present to the transplant center for additional information regarding donation.

Author contributions

LK and TF participated in research design, analysis, manuscript preparation, and editing. BD, MR, and MK participated in data collection, analysis, and editing. RC participated in analysis and editing.

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Competing interest

The authors declare that they have no competing interests.

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