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# Safety Planning for Suicide Prevention: Insights from the SERO App

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Abstract. Safety planning is an intervention that demonstrated to be successful in help individuals self-manage suicidal crises. The SERO suicide prevention app supports this safety planning in a digital manner. The objective of this paper is to identify the specific components of safety plans and thereby guiding the design of digital solutions in a way that it supports individuals' needs. We analysed the safety plans of all 1848 at risk users registered with the SERO app by applying BERTopic and Google's Gemma-2 Large Language Model to identify themes and topics mentioned in the safety plans. The analysis of the safety plans revealed that users frequently cited family and loved ones as motivations to live, identified certain physical signs and emotions as warning signs, and reported social contact and activities as coping strategies. Digital solutions, such as apps, as well as other traditional suicide prevention interventions with personalized support.

Keywords. Suicide prevention, Suicide, Safety planning, Topic modelling

# 1. Introduction

Suicide remains a significant public health concern worldwide, necessitating effective interventions to prevent suicidal behaviour and reduce associated mortality rates [1]. One promising approach that has gained traction in recent years is the safety planning intervention, a brief, structured method designed to help individuals self-manage suicidal crises [2–4], derived from cognitive therapy and cognitive behavioural therapy for suicide prevention. It typically involves the collaborative development of a personal safety plan, which is a prioritised list of coping strategies and resources that an individual can use in times of suicidal crisis [2]. This intervention aims to help patients recognise the warning signs of a developing crisis, use internal coping strategies, and utilise social support. Safety planning has become an integral part of standard clinical care for people at risk of suicide [3], and is increasingly being used as a stand-alone intervention, e.g. as component of digital health interventions targeting individuals at risk [5]. A meta-analysis found that safety planning type interventions were associated with a 43% reduction in the risk of suicidal behaviour compared with usual care [3]. However, the same study found no significant effect on suicidal ideation, suggesting that the

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intervention may be more effective in preventing behavioural outcomes than in reducing suicidal ideation. Research also suggests that using digital interventions that incorporate safety planning function could be beneficial for individuals with suicide ideation who are reluctant to attend healthcare services [2,9,10].

Despite the increasing use of safety planning in clinical practice, there remains a need for in-depth analysis of the content and quality of these plans. Identifying the specific components of safety plans could help to refine the intervention and improve outcomes for people at risk of suicide and benefiting society by guiding the design of digital solutions and other type of interventions in a way that it supports successful safety planning. This study aims to analyse the content of safety plans created by users of the suicide prevention app SERO. Our findings may have important implications for the refinement of digital safety planning interventions and may inform best practice for developers implementing this approach in digital health interventions.

#### 2. Method

We analyse the safety plan from users registered as individuals at risk in the suicide prevention app SERO [6]. The app is free of charge and available since December 2022 in the app stores of Google and Apple in Switzerland and Liechtenstein. The SERO app is designed to support people with suicidal behaviour and their support network. In addition to creating and sharing their safety plans with their support network, users can use the app for self-assessment based on the PRISM-S method [7], as well as for help-seeking. The safety plan structure is pre-defined by the app and offers five sections: 1) Coping strategies, 2) Distraction strategies, 3) Motivation to live, 4) Personal beliefs and 5) Early warning signs. Users can edit the contents of any of the sections at any time. The data underlying our analysis is anonymized and all registered users consented to its use for research purposes. All data collected by the app are stored as HL7 FHIR resources in a GDPR-compliant health data space. User involvement was approved by the ethics committee of Northwestern and Central Switzerland under number 2022-00870.

We present basic statistics on the number of users and length of their entries in the safety plan and the main topics of the items listed in the five sections of the safety plans using BERTopic analysis [8]. BERTopic uses a transformer-based method to process documents, embedding documents, reducing their dimensional complexity, clustering, creating bag-of-words models and using c-TF-IDF to create topic representations. The 10 most relevant topics were used for the analysis, and manually labelled by KD.

We also applied a large language model (LLM) to the entries of each section. The LLM was instructed to conduct a thematic analysis, i.e. to identify key themes in the input data. Afterwards, the list of detected key themes was again sent to the LLM to group them along main categories. An example prompt for the distraction strategies is: *"I will provide you with a text in German, where a person describes what helps him distracting in difficult situations. Since this might be only a single word, extend the input by 'hilft mir, mich abzulenken.'. Please analyse the text to identify key themes. Provide the key themes in the format \*\*Theme1, Theme2...\*\* such as \*\*Communication, Support Network, Intimacy\*\*. Do not provide explanations. Here is the text.: {text}". We used the language model Gemma-2 9B in Python using the Ollama framework (https://ollama.com) API. Ollama is a framework for building and running language models on a local machine. This was done to ensure data privacy since the safety plans can contain very personal information.* 

# 3. Results

In September 2024, 1848 users were registered as individuals at risk in the app. Table 1 shows the number of users that have added contents to each of the part of the safety plan, including entry counts and length. The section on motivation to live had the highest participation, with 505 users recording data. Personal beliefs were filled out less often and by fewer users, but the statements were longer than in other parts with 5.68 words in average. In this part, users often stored quotes or complete sentences while in the other parts single words were most prevalent. Examples include (translated from German): *Motivation to live (*"My family", "sun sets"), *Distraction strategies* ("Watching a movie", "Meeting with friends"), *Coping strategies* ("Listening to music", "Making a phone call"), *Personal beliefs* ("I am good enough" or "Something wonderful is going to happen today!"), and *Early warning signs* ("Sweaty hands", "Negative thoughts").

Part of safety plan	No. of users	No. of entries	Average number of items	Average words	Max. words
Motivation to live	505	1441	2.86	2.96	70
Early warning signs	448	1571	3.5	2.73	35
Coping strategies	443	1574	3.55	2.8	250
Distraction strategies	431	1329	3.08	2.20	22
Personal beliefs	329	701	2.12	5.68	43

Table 1. Statistics on items in the safety plans and lengths of the entries

TOPIC	Motivation to live	Personal beliefs	Warning signs	Distraction strategies	Coping strategies
Top 10 topics identified by BERTopic	Family     Life, positive     moments     Relatives     Specific persons     Usted by their names     Colleagues     Friends     Specific persons     Listed by their names     Travelling     Children     Mother	Fulfilling living     Personal successes     Carpe diem     Positive environment     Love others and be     loved by others     Friends     Religious aspects     Hapiness and     wonderful life     Good things     happening     Being patient with     oneself	Physical signs     Feelings / emotions     Sadness, bad mood     Fear, panick attacks     Negative thinking     Irritation     Circles of though     Aggressiveness     Loss of appetite     Sileep behavior	Activities (sport, nature, doing a jigsaw puzzle) Meeting friends Sport Sport Listening to music, podcasts, etc. Meet with friends Hiking in the nature or in the city Making phone calls Go outside Painting and taking photos	Listening to music     Cleaning     Watching TV /YouTube/Netflix     Cold shower, coldpack     Talking to someone     Making phone calls     Music and language learning     Painting     Positive thinking
Topics determined LLM Gemma-2	<ul> <li>Core values: Love, family, Responsibility, Connections, and aspirations: Travel and aspirations: Travel and adventure, Creativity and Passion, Purpose and Meaning</li> <li>Internat Landscape: Emotions, Self- Awareness, and Self- Care</li> <li>Challenges: Guilt, Meaninglesness and Hopelessness</li> </ul>	<ul> <li>Core values: Hope, faith, love, self-worth, restilience, acceptance, Psychological states: Purpose, meaning, fulfilment, determination, Vulnerability, Authenticity</li> <li>Social connections: Family, Belonging, Connection to Nature</li> <li>Life Experiences: Growth, change, mortality, loss</li> </ul>	Emotional states: positive/negative, intensity, fluctuation     Mental and cognitive experiences: Thoughts, feelings, behaviors Instrubances, appetite changes, risiguel/athnay; Interpersonal and social challenges: relations, chronic pain Interpersonal and social challenges: relationship issues, conflict, isolation, withdrawal, difficulty with control Risk factors: Self-harm behavior, suicidal ideation, substance abuse, crisis awareness, loss of enjoyment in activities, discarding reminders of part happiness	<ul> <li>Mental and emotional well- being (e.g. Relaxation, Stress Relief, Hindfulness, social connection, family friendships, Reading, Gaming, Physical Activity, Running)</li> <li>Leisure &amp; Reading, Gaming, Physical Activity, Running)</li> <li>Cognitive Stimulation &amp; Expression (e.g. Reading, Writing, Music, Arts, Strategy Planning, Problem-Solving)</li> <li>Social Engagement &amp; Connection (Conversations, Shared activities, Community involvement)</li> </ul>	<ul> <li>Direct coping mechanisms (e.g. Physical activities, sensory experience, distraction)</li> <li>Internal coping mechanisms (e.g. Selt-regulation, cognitive strategies, positive selt-taik &amp; reframing)</li> <li>Social support and Connection (e.g. Companionship and relationship, seeking professional help)</li> <li>Selt-care Practices (e.g. Physical health, mental and emotional well- being)</li> <li>Substance Abuse (e.g. mentioning of Ternesta)</li> <li>Religion / Spirituality</li> </ul>

Figure 1. Identified topics for safety plan sections: BERTopic vs. Gemma-2

Figure 1 presents the top 10 topics identified by BERTopic and the topics determined by the large language model GEMMA-2 for each of the five sections of the safety plan.

#### 4. Discussion

The analysis of topics registered by users of the SERO suicide prevention app in their safety plans showed numerous references to family, friends, and loved ones as significant motivations to live, as well as personal beliefs, and protective factors that aid in distraction and coping strategies. Various physical signs and emotions were identified as warning signs of an increased risk of suicide in the short term.

Evidence indicates that having a supportive social network and positive relationships are inversely associated with suicidal behaviours [11,12]. In this study, relationships with family, friends, and colleagues were the most frequently reported motivation to live in the suicide prevention app, and social interaction was also recorded as valuable distraction strategies and coping strategies. These findings confirm previous research in which social connections are pointed as significant sources of motivation to live for those at risk of suicide [11,12]. This social component could be enhanced in suicide prevention apps by adding or expanding functionalities or features that encourage users to connect and interact with their families, friends or social groups.

Coping strategies, especially the ones that include distraction activities (such as keeping busy or socializing) have shown to be helpful in decreasing suicidal ideation, at least at short term [13,14]. In our study, both the BERT and GEMMA-2 analyses show that SERO app users reported on coping strategies that involve social contact, sensory distractions (like music and media), but also mindfulness-oriented approaches, such as positive thinking, cognitive self-regulation, self-care, or spirituality. Our findings highlight the importance of including a variety of coping strategies in interventions aiming at preventing suicide that address social connection needs (e.g., connecting with friends), and other individual needs (e.g., relaxing music, positive self-talk).

Warning signs indicate an increased risk of suicide in the short term. Previous research has found that changes in mood [15], such as low mood and crying [16] along with the presence of one or more of the following factors: alcohol use, suicidal communications, preparation of personal affairs, and experiencing negative interpersonal life events [17] are critical warning signs of increased suicide risk, especially among individuals with mood disorders. In our study, we identified various warning signs, including physical signs (e.g., loss of appetite or changes in sleep behaviour) and emotional signs (e.g., negative thinking, irritation, or aggressiveness). This information is relevant for suicide prevention apps and other type of interventions, as it can inform the development of features that help users recognize and monitor these warning signs in themselves or others. By integrating tools for self-assessment and tracking these signs, the interventions can enhance users' awareness and facilitate timely action.

This study has several limitations. We do not know which safety plans belong really to individuals with suicidal behaviour, as there might be data from their family members, therapists or counsellors who tested the app. We lack information about the users, such as age, gender, possible diagnoses, or treatments. It is also unclear whether users found the app themselves or whether it was recommended. There was a marketing campaign running in one of 26 cantons in Switzerland (Lucerne). Furthermore, we do not have data on the app effectiveness or the impact of its safety planning function in preventing self-harm or suicide behaviour. Lastly, potential errors by LLM analysis may affect the accuracy of the findings.

## 5. Conclusion

This study provides insights into the motivations to live, personal beliefs, coping and distraction strategies, and warning signs documented by users of the SERO app in their safety plans. Our findings suggest that a variety of coping strategies may support individuals at risk by addressing their individual needs. Digital solutions, such as apps, as well as other traditional interventions aimed at preventing suicide behaviour could benefit from understanding the components of safety plans reported by users; and being refined and supplemented with personalized support. Further research is needed to evaluate the effectiveness of safety planning integrated in digital solutions and its potential impact at both, short and long-term suicide prevention.

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