

# **Developing a Computer Decision Support System for Mental Health Risk Screening and Assessment**

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## **Abstract**

This ongoing research, funded by the NHS through its New and Emerging Applications of Technology, aims to improve mental-health risk assessments by developing a universally accessible computerised decision support system. The system will contain a risk-screening tool that records client data (cues) and provides risk estimates for suicide, self-harm, self-neglect, and harm to others. The tool is intended for use without specialist training and by any relevant professionals, not just those within health and social care. It will provide a new educational and clinical resource linking validated human expertise from mental-health professionals with statistical information extracted from a dedicated client database. Health and social benefits include earlier identification of people at risk, fewer inappropriate referrals, and multidisciplinary cooperation between health-care providers and other front-line workers.

## **Introduction**

According to statistics, most people will experience some kind of mental-health problem during their lives. A recent survey of private households indicated that one in six adults of working age showed symptoms of a neurotic disorder in the week before interview, with just over 0.5% experiencing a probable psychotic disorder in the previous year [1]. People living in less socially-anchored environments, such as the homeless, are known to have much higher rates of mental disorder [2]. At the same time, care in the community rather than hospitals for people with mental-health problems has increased, raising concerns about the potential risks. Reducing the risks, particularly of suicide and homicide, is high on the political and service agenda [3], leading to a number of recent NHS directives, including the Care Programme Approach (CPA).

The likelihood of experiencing mental disorder and the reaction to this are all influenced by the position of the individual in the social map. Correspondingly, treatment and access to treatment, are structured within a complex grid of reference points. They reflect severity of symptoms, informal support mechanisms, and a whole host of other factors set within a framework of geography, organisational structures, culture, race, class, and gender, all influencing the narrative of pathways (see, for example, [4]). How, then, are those most potentially at risk to access the required services?

The answer is through the pathways that the National Service Framework for Mental Health identifies, using a whole-systems approach to care provision. This presupposes that non-specialist agencies have the expertise to detect the risk a person may be presenting, and that there is a system of information in place to pass on these concerns. Consequently, when someone is at risk (by whatever description), the wider feelers of social, medical and criminal justice agencies must act to direct them to the most appropriate service at that time. The key is to empower the feelers with the necessary mental-health expertise, if potentially tragic occurrences are to be avoided. This paper describes research that intends to achieve this by providing easy access to a risk-screening tool, GRiST, which uses computer-based expertise in risk assessment.

GRiST does not require specific training and can be used by people without mental-health skills but who interface with mental-health services. Hence it disseminates expert advice to professionals who do not normally have access to it (e.g., police, paramedics, accident and emergency staff), thereby exposing many more people to early detection of their problems and the opportunity to receive appropriate assistance. GRiST will be implemented as a computer Decision Support System (DSS) that can be remotely accessed at the point of care through simple web-based browsers available to everyone (its software architecture will also facilitate its transfer to hand-held computers, increasing accessibility). It will provide expert advice that can be used to determine whether the potential risk associated with a person justifies a more detailed assessment by a specialist clinician. It is thus a risk *screening* tool, setting it apart from the alternatives, which focus

on the clinical objective of providing full risk assessments. This paper will describe the development of GRiST, its main components, and the intended benefits it will bring.

### **The rationale for GRiST**

There is plenty of evidence on how factors, taken in isolation, are associated with an increase in risk (e.g., history of previous attempts increases suicide risk), and these are included in many assessment tools. But none of them have succeeded in identifying how *combinations* or *patterns* of cues can be integrated to give a single, accurate risk prediction. Actuarial risk assessments rely on epidemiological data, which is not available for complex cue combinations. Instead, clinical judgement remains paramount and an assessment tool should combine its strengths with available probabilistic information [5]. This is exactly the intention of GRiST. The overall DSS will contain expertise based on the knowledge and reasoning processes of many experienced mental-health clinicians from different specialties. It will be accompanied by pattern recognition tools, which can generate statistical predictions from the database of client information accumulating on the DSS.

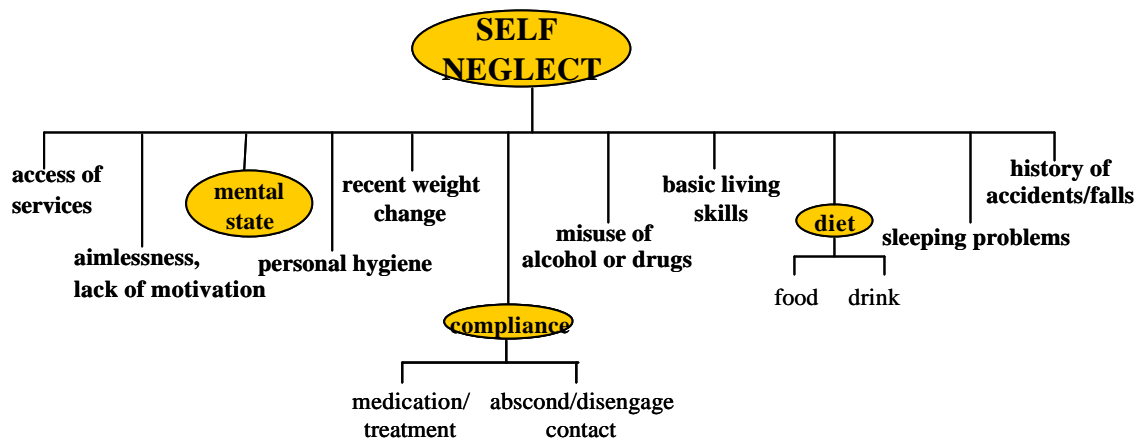
### **Representing expert clinical judgement within GRiST**

Risk assessment can be regarded as a classification activity, where a person is assigned to a relevant category such as suicide or self-harm with a degree of certainty (the quantified risk). The development task for GRiST is to represent the integrated risk-assessment knowledge of different clinicians within a single classification model. The “galatean” model [6] was the particular one chosen because it encapsulates people’s classification behaviour and facilitates elicitation of accurate measures of uncertainty. It focuses on the exceptional or hypothetically “perfect” representative of a risk class, called a “galatea” after Pygmalion’s statue of his perfect woman (giving the name GRiST, from the Galatean Risk Screening Tool). Galateas are more memorable and easy to elicit than the typical class member. For example, the galatea for suicide would have a

combination of every cue that is the maximum predictor of suicide, as opposed to alternative classification models of this type, which have a representation based on the typical person committing suicide, with less extreme predictors.

The galatean model represents uncertainty in terms of set membership. If one considers the outcome categories as sets and the objects being classified as potential members, the likelihood that an object is in any one set is given by the degree of membership. This amount is called the *membership grade* [7] which, like probabilities, may vary from 1, representing certainty that an object will be in a set, to 0, representing certainty that it will not be a member.

The galatea's generic form is a hierarchical "tree" structure. Figure 1 shows the galatea representing knowledge about self-neglect, which was obtained through interviews and other knowledge-elicitation activities with 17 mental-health clinicians. It demonstrates how the concept of self-neglect has been decomposed into its constituent elements. The bottom level of the hierarchy represents individual, measurable, descriptive attributes applicable to clients, such as whether they access services, lack motivation, have poor personal hygiene, and so on. These should not require clinical judgements to evaluate and so can be effected by people without special mental-health expertise.



**Figure 1: Hierarchical galatea structure for self neglect; mental state is itself a hierarchy that is part of several risk types and not exclusive to self neglect.**

Galateas identify data that can be provided by non-experts but, at the same time, show how experts organise the data when making risk assessments. They also contain the values that determine the degree of membership of a client in the overall risk class (i.e., the root concept representing combined risk) and within individual subconcepts of the galatea such as suicide, self-harm, and violence/aggression. Because membership grades are associated with all parts of the galatean hierarchy, risk can be decomposed into its constituent elements at any level. Providing the values enabling risk to be quantified is the next task for the GRiST project. It has been funded by the New and Emerging Applications of Technology (NEAT) research programme within the NHS and progress can be tracked via the project web site at [www.galassify.org/grist](http://www.galassify.org/grist).

At present, the project has obtained Multi-centre Research Ethics Committee clearance and established an expert panel of multidisciplinary mental-health clinicians. The panel contains about 50 members, mainly from the West Midlands and South of England, ranging from university professors to highly experienced practitioners working full-time within the health service. It covers all mental-health disciplines, including nurses, general practitioners, social workers, psychiatrists, and psychologists, with specialist knowledge covering forensic, adult, adolescent, and older

people's mental health. An advisory panel has also been established, containing high-profile representatives of the mental-health field, including charities, along with other experienced workers who were unable to commit enough time to the expert panel itself.

The expert panel is undergoing activities for eliciting galatea knowledge structures and uncertainty values using consensus methods adapted from the Delphi technique [8]. Most of the activities are being organised remotely via the project web site, with all panel members having first undergone training. Additional nominal or focus group sessions are being conducted and all experts will have had at least two individual interviews, at the beginning and towards the end of the project. There is also a separate panel of service users and carers, which reviews output from the expert panel and ensures that the emerging DSS properly incorporates service-user interests and perspectives.

### **Components of the GRiST DSS**

The eventual GRiST DSS will be a constantly-evolving, evidence-based, world-wide web site for mental-health risk assessment. It will contain resources of three types:

1. A database of client cues and associated risk judgements provided by practitioners as part of their clinical practice.
2. A suite of statistical and pattern recognition tools for analysing the database and elucidating the association of cues and risk; some of these tools (e.g. Bayesian belief networks) will generate risk predictions for clients.
3. A validated psychological model of risk assessment based on multi-disciplinary clinical expertise; it will provide a full analysis of how clinicians perceive the contribution cues make to different forms of mental-health risk.

The statistical tools and expert risk model complement each other by providing different types of information. The former uses empirical evidence and mathematical principles, but generates risk predictions that may not be explicable in terms easily understood by people without a strong numerate background. The latter uses the galatean psychological model of classification for

representing clinical expertise and is able to explain the generation of risk in terms accessible to practitioners.

### **Clinical benefits of GRiST**

It is envisaged that using the DSS will provide a number of clinical benefits, as follows:

1. *Better identification of people at risk:* The DSS will expose different types of risk and the associated levels, both of which will help identify people requiring treatment.
2. *Reduction of inappropriate referrals:* More accurate risk judgements mean clients will not be unnecessarily referred (false positives) or referred to inappropriate services.
3. *Earlier risk detection:* Widening access to risk expertise and making it usable without specialist training will help professionals from all backgrounds to detect people at risk. Indicative cues for risk will be picked up earlier and interventions initiated before more serious consequences have occurred.
4. *Knowledge about mental-health risk:* This will come partly from understanding expert risk judgements and partly from analysing associations between cue patterns and risk assessments in the client database.
5. *Education and training of mental-health practitioners:* In addition to the implicit training effect of using the DSS in practice, the DSS will have specific areas dedicated to structured educational material for practitioners. These will be based on the activities conducted by the expert panel in developing the tool, linked to statistical analyses of the DSS database of client cues.
6. *Better interdisciplinary communication of risk:* The psychological model of risk assessment will have evolved with the participation of multi-disciplinary mental-health practitioners and represents a common language for conceptualising risk, thereby facilitating communication between specialties.

7. *Increased consumer awareness of mental-health risk and appropriate interventions:* Areas of the DSS will be accessible to the general public and a link will be sought from the NHS Direct web site.
8. *Improved clinical governance* The DSS will formalise and externalise data used for risk assessments and subsequent decisions.

## **Conclusions**

It is impossible to estimate how many people with mental-health problems fail to be perceived as such when presenting themselves to one of the host of agencies constituting the official and unofficial bodies interfacing with specialist mental-health services. These missed opportunities may be disastrous, both for the individual and society as a whole (e.g., 20,927 people committed suicide in England and Wales between 1996 and 2000 [9]). GRiST is designed to fill the vacuum, by providing a universally available web-based decision support system empowering frontline services to assess risk and, thereafter, to direct the risk to appropriate services. As a web-based tool it has the capacity to overcome geographical and organisational boundaries, and to provide a language universally understood. Patient care starts wherever and whenever patients first present themselves, with GRiST able to provide the gateway. It brings health informatics into play even before the first formal “point of care”, and can subsequently inform planning through the appropriate care pathways.

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