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Psychological problems related to capillary blood glucose testing and insulin injection among diabetes patients



Review

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Abstract: **Objective:** This review is aimed at explaining the psychological problems related to capillary blood glucose (CBG) testing and insulin injection, as well as recommending essential strategies to solve the fear thereof.

Methods: Databases, including PubMed, Cumulative Index of Nursing and Allied Health Literature (CINAHL), Scopus, and Google Scholar, were searched to extract the relevant articles. Initially, the terms used to retrieve related studies were "fear of blood glucose monitoring", "anxiety capillary blood glucose testing and insulin injection", "psychological problems on blood glucose monitoring and insulin injection", "diabetes management", and "diabetes mellitus".

Results: Results showed that the psychological problems related to CBG testing and insulin injection were associated with the stress and depression experienced during diabetes self-monitoring of blood glucose. This psychological issue has its impacts such as nonadherence to medication as well as a lack of self-discipline in terms of CBG testing and insulin injection. Inadequate information, inappropriate perception, and pain/discomfort during pricking of fingers were the main reasons for the psychological issues in CBG testing and self-injection of insulin.

Conclusions: The expected benefits of this review include the explanation of the issues related to the psychological problems in CBG testing and insulin injection among type 2 diabetes mellitus (T2DM) patients. This review article also provides the recommendations on providing counseling and empowering the patients on CBG monitoring and insulin injection. Moreover, family members should provide psychological support to reduce fear, anxiety, and distress arising from CBG testing and insulin injection.

Keywords: diabetes mellitus • psychological problems • capillary blood glucose testing • insulin injection

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1. Introduction

Capillary blood glucose (CBG) testing and insulin injection are essential strategies to monitor the blood glucose level and to support a successful diabetes self-management behavior among patients with diabetes mellitus (DM). Globally, the percentage of blood glucose tests undertaken for controlling and managing blood

glucose concentration is lower among DM patients. A recent study conducted in Nigeria showed that only 47.8% of patients conducted CBG testing.¹ The study also found that in Spain, only 52% patients conducted CBG testing for managing blood glucose levels.²

CBG testing and insulin injection have been widely recommended for patients and health-care providers

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as an integrated part of DM self-management (DMSM) practice.³ The frequency of self-testing among type 1 DM (T1DM) patients is approximately three times a day, while type 2 DM (T2DM) patients are required to perform CBG testing and insulin injection two times daily.⁴ This has been recommended for both patients and their family members because it is easy, very cheap, and less invasive to perform at home so as to maintain a constant level of blood glucose by applying precise regimens.⁵ CBG testing¹⁶ and insulin injection can also improve the practice of self-monitoring of blood glucose (SMBG) and medication-taking among DM patients,⁸ as well as helping to detect hypoglycemia and to adjust their insulin dosage appropriately during DMSM practice in T2DM patients.^{6,7}

The CBG testing and insulin injection processes tend to have positive effects on management of the blood glucose level; however, their impact as a psychological effect on the patient's uptake and adherence to CBG testing, as well as insulin injection, remains significant and essential for DM patients to cope with.⁸

Intense fear of self-injection is the most plausible reason for the precipitation of psychological distress.⁹ Moreover, CBG monitoring or pricking the finger may trigger distress and severely hamper self-management.¹⁰ This fear of CBG testing and insulin injection is often associated with nonadherence in DM patients, which leads to inadequate glycemic control⁸ and may increase the risk of severe diabetes complications.¹¹

Recently, it has been recognized that there is still a gap in the analysis of psychological problems related to CBG testing and insulin injection. There have been only a few literature reviews concerning the psychological issues of CBG testing and insulin injection. This present review focuses on exploring the current information on fear and other psychological aspects of CBG testing and insulin injection to obtain valuable information¹⁵ developing strategies to solve the problem of fear and to improve the quality of life among T2DM patients.

2. Objectives

This study is aimed at exploring and narratively describing studies related to the psychological problems faced during CBG testing and insulin injection among DM patients.

3. Methods

3.1. Data sources and search strategy

The databases, including PubMed, Cumulative Index of Nursing and Allied Health Literature (CINAHL), Scopus, and Google scholar, were searched to extract relevant articles. Initially, the terms used to extract related studies were "fear of blood glucose monitoring", "anxiety

capillary blood glucose testing and insulin injection", "psychological problems on blood glucose monitoring and insulin injection", "diabetes management", and "diabetes mellitus". The keywords of "psychological problems on blood glucose testing and insulin injection" were the primary search terms and entered as the medical subject heading (MeSH) in the abstract and title fields. The details are summarized in Table 1.

3.2. Eligibility criteria of the study

The articles were selected based on the inclusion criteria, which included English language articles published between 2005 and 2017. The researchers also included several types of study designs, including a survey, a descriptive study, a qualitative study, a quasi-experimental study, a randomized controlled trial, and a mixed-method design, in the screening process.

3.3. Exclusion criteria of the study

Lack of description of appropriate outcome measures (e.g., studies in which psychological aspects were not included as the primary outcomes) were excluded from this review. Unpublished articles and articles reporting on inappropriate populations, such as people with gestational diabetes or other metabolic diseases, also were excluded.

4. Theoretical framework

The conceptual framework of this study was based on a stress-adaptation model that explained the process of adaptation specific to adults with T2DM, proposed by Pollock.¹² The manner in which patients adapt to the stress of diabetes is affected, or mediated, by how

Sources of data	Keywords
PubMed	* Fear AND Capillary blood glucose OR Insulin injection AND Diabetes * Psychological problem on capillary blood glucose OR Insulin injection AND Diabetes
Scopus	* Fear AND Capillary blood glucose OR Insulin injection AND Diabetes * Psychological problem on capillary blood glucose OR Insulin injection AND Diabetes
CINAHL	* Fear AND Capillary blood glucose OR Insulin injection AND Diabetes * Psychological problem on capillary blood glucose OR Insulin injection AND Diabetes
Google Scholar	* Fear AND Capillary blood glucose OR Insulin injection AND Diabetes * Psychological problem on capillary blood glucose OR Insulin injection AND Diabetes

Table 1. Database search and keywords.

they cope with the fear and anxiety of diabetes. Thus, improvements in blood glucose control are proposed in relation to coping, self-efficacy, family functioning, and self-management as mediating factors (Figure 1).

5. Synthesis of the results

The findings of this study are described narratively according to the thematic framework composed of the following:

- (1) Definition of CBG testing and insulin injection;
- (2) Psychological barriers related to CBG testing and insulin injection;
- (3) Factors related to fear and psychological issues in the context of CBG testing and insulin injection;
- (4) Impacts of psychological problems in CBG testing and insulin injection;
- (5) Strategies to manage the psychological problems related to CBG testing and insulin injection; and
- (6) Recommendation to manage psychological problems in CBG testing and insulin injection.

6. Results

The results of this study are expressed based on the thematic framework as follows.

6.1. Definition of CBG monitoring and insulin injection

6.1.1. CBG monitoring

CBG testing can be defined as a method of checking the blood glucose concentration in patients with

hyperglycemic or hypoglycemic conditions.¹³ Blood glucose testing is typically done by piercing the skin at the fingertip and then applying the blood to a chemically active disposable strip. SMBG is a strategy for health-care providers and patients to assess the effectiveness and safety of a self-management plan in terms of glycemic control. In addition to intervention, the benefits of intensive glycemic control on the prevention and reduction of complications due to diabetes can be demonstrated.¹⁴

Using the CBG monitoring technique, patients can evaluate their response to a therapy and can assess whether the blood glucose level meets the target or not.¹³ Incorporation of CBG testing with DMSM practice can be an essential instrument to guide medical nutrition therapy, adopt proper kind of physical activity, prevent hypoglycemic complications, and adjust medications for patients who take prandial insulin doses.^{13,15}

Optimal CBG monitoring requires patients and health-care providers to properly review and interpret the results. Therefore, patients should understand how to use blood glucose data to adjust their food intake, get adequate physical exercise, or adopt medication therapy to achieve the desired blood glucose control. The frequency of blood glucose monitoring should be reevaluated to avoid overuse.^{16,17}

6.1.2. Insulin injection

Insulin injection is used among T2DM patients when they have the problem of insulin being broken down by their digestive enzyme and hence insulin cannot be substituted in the oral pill form. Insulin injection is delivered by three techniques, as follows. (1) Syringe and needle are used to push the insulin into a layer of fat below the skin, called as the "subcutaneous tissue".

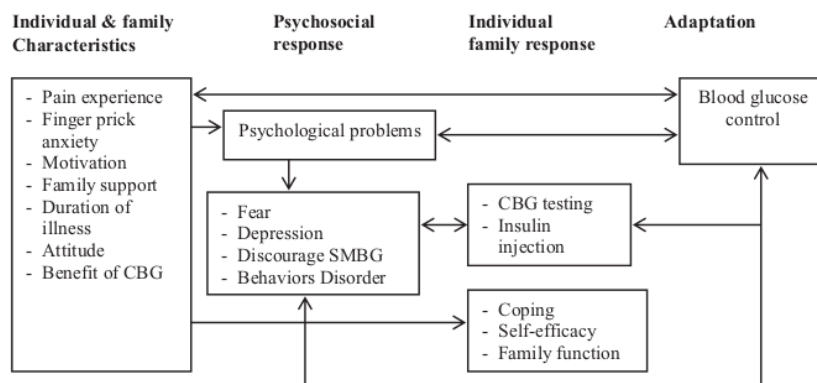


Figure 1. Conceptual model of psychological adaptation for diabetes mellitus.

Usually, the layers of fat may be selected from among the following sites for the easy absorption of insulin into the blood stream: abdomen, hips, thighs, buttocks, and the back of the arms. The injection site can be changed every 2–3 days to reduce pain and lesions. (2) Insulin pens containing insulin instead of ink are used to deliver insulin at a set dose with a disposable needle. Pen needles can be applied with a variety of lengths and thicknesses of the injection areas. The pen method is considered to be more convenient and accurate to use when compared with the syringe method. (3) Electronic insulin pumps to continuously deliver insulin into the fat layer. This method is appropriate for those T2DM patients who need multiple injections per day of insulin.¹⁸

6.2. Psychological barriers related to CBG testing and insulin injection

Psychological barriers are proved to have adverse effects on DMSM practice (Table 2). Similarly, psychological barriers are mainly affected by inappropriate perception and negative attitude on CBG testing and insulin injection. Psychological problems, such as fear of needles, stress, emotions, and bad experience, are associated with nonadherence and lack of self-discipline in CBG monitoring and insulin injection.¹⁹

Dealing with the results of blood glucose tests is also a critical issue in CBG testing. Frustration related to high blood glucose reading and negative appraisal could decrease the CBG frequency.^{19,20} Many patients are often discouraged in their efforts toward self-regulation when faced with adverse health outcomes.²¹ Moreover, depressed and anxious diabetic patients who often face repeated failures in maintaining their blood glucose

level in accordance with normal levels are prone to emotional exhaustion and apathy, even uncontrollable stress.²¹ Moreover, the failure of physicians in discussing the CBG results in a positive manner becomes a significant reason for patients avoiding CBG testing or insulin injection.²²

The apparent fear and other psychological issues related to CBG testing and insulin injection require further interest from health-care professionals. Diabetes professionals should be sensible persons who pay attention to the patients' psychological needs regarding CBG testing and its results and, in addition, be able to offer patients problem-solving assistance and promote relaxation techniques to enhance coping skills and self-efficacy in dealing with DM. Offering a "team" approach to address barriers and involving the patients in the analysis of their response to SMBG practice is essential for resolving conflicts within families.²³

Psychological problems related to insulin injection induce delay of treatment as a result of clinical inertia and insulin resistance. The clinical problems include misconception on the effectiveness of insulin injection, the belief that starting insulin is a sign of treatment failure, fear of and pain during injection by needles, and fear of their suffering from hypoglycemic/hyperglycemic symptoms.²⁴

A meta-analysis in one study summarized the psychological problems related to insulin therapy among T2DM patients and indicated that the risk of depression was more among patients with long-term treatment using insulin injection.²⁵

From its initiation, further counseling and education using concepts related to patient-orientated standard of care should be emphasized; precise knowledge of the psychological aspects of treatment and counseling

Authors	Study designs	Psychological issues related to CBG testing and insulin injection
Ong et al. 2014 ¹⁹	Qualitative design	<ul style="list-style-type: none"> – Fear of needles and the fingertip pricking being painful – Frustration related to high blood glucose reading – Lack of motivation of SMBG
Taylor et al. 2017 ²⁶	Mixed qualitative and quantitative design	<ul style="list-style-type: none"> – Stress and emotions described as shame, laziness, and forgetfulness among patients, family members, and community members
Van Dooren et al. 2016 ²⁷	Cohort study	<ul style="list-style-type: none"> – High levels of depressive and anxiety symptoms related to diabetes management – Personality traits including negative affectivity, the tendency to experience negative emotions across situations and during social interaction – The tendency to inhibit the expression of feelings in social interactions to avoid disapproval
Gucciardi et al. 2013 ²⁸	Qualitative design	<ul style="list-style-type: none"> – Negative emotional responses to unexpected blood glucose readings, burden of SMBG, and lack of self-discipline
Shlomowitz et al. 2014 ⁸	Cross-sectional study	<ul style="list-style-type: none"> – 58% of patients presented finger prick anxiety and 30% of patients had general anxiety
Yoshioka 2018 ²⁴	Editorial	<ul style="list-style-type: none"> – Misconception on effectiveness of insulin injection – Fear of and pain during injection by needles – Fear of their suffering from hypoglycemic/hyperglycemic symptoms – Wrong belief on insulin injection as treatment failure
Bai et al. 2018 ²⁵	Meta-analysis	<ul style="list-style-type: none"> – Depression on long-term insulin therapy

Table 2. Psychological issues related to CBG testing and insulin injection.

techniques are important to maintain the adherence to DMSM practice, CBG testing, and insulin injection among T2DM patients.

6.3. Factors related to psychological problems in the context of CBG testing and insulin injection

Table 3 summarizes the factors related to psychological problems and its impacts on CBG testing and insulin injection. The psychological aspects related to CBG testing and insulin injection have become a significant issue in DMSM practice. These psychological issues are mainly concerned with insufficient knowledge and inappropriate perception of CBG testing, including its benefits, indication, and side effects.

Experience of pain or discomfort while pricking the finger was the most common reason that discouraged DMSM practice, especially CBG testing or insulin injection. Pain associated with finger pricking is the main reason, apart from the costs, holding back patients from SMBG. This condition might also induce a negative perception of DMSM in general. Thus, convincing the patients, especially young ones, to measure blood glucose several times a day appears to be a trouble for health care providers, patients, and families.

A study conducted by Shlomowitz et al.⁸ found that 30% of patients faced finger prick anxiety and 33% of patients had general anxiety. Positive correlations were found between finger prick anxiety and avoidance of CBG testing. This reluctance was more common in females who had an experience of pricking pain, in addition to forgetfulness, fear of results, boredom, and embarrassment related to public testing.

Another study showed some shreds of evidence on the level of anxiety in CBG testing. In a Dutch study,²⁸ the psychological problem related to CBG monitoring was identified as emotional distress and avoidance lifestyle behaviors among diabetes patients with insulin dependence. Less than 10% of patients had high scores on the fear of insulin injection and CBG testing.

One-fourth of the patients refused to complete an additional self-testing of blood.²⁸

The World Health Organization (WHO) has recommended practical guidelines on CBG monitoring in the context of the site of capillary testing in adult or pediatric patients. A lancet should be shorter than the estimated depth to avoid pressure compresses on the skin.²⁹

6.4. Impacts of psychological problems related to CBG testing and insulin injection

The reasons for nonoptimal diabetes management with insulin injection or CBG testing are fear of injection, fear of discomfort from the needle, pain on pricking the finger, anxiety, and the stress due to complicated treatment and side effects of the dose. This psychological problem eventually has a negative impact, causing misconception toward glucose monitoring and nonadherence to medication, diabetes-related fear, stigma, and discouragement of patients from monitoring blood glucose or using insulin for treatment.

The Diabetes Attitudes, Wishes and Needs (DAWN) study³¹ reported that about 57% of diabetic patients feel discouraged from using insulin therapy because they are worried about the possibility of starting the treatment in future. The results were also quite similar in another study,² which revealed that only 52% of T2DM patients monitor blood glucose for controlling the disease, while 48% feel reluctant to initiate CBG testing and insulin injection. Fear of insulin or fear of the needle may be associated with ineffective glycemic control and may reduce patients' health status and their quality of life.^{3,32}

6.5. Strategies to manage the psychological problems related to CBG testing and insulin injection

Self-testing and self-injection have become an essential part of management for diabetes patients who are

Authors	Factors related to psychological problems	Impacts of psychological problems on CBG testing and insulin injection
Ong et al. 2014 ¹⁹	– Patient's emotion – Low support and insufficient knowledge	– Misconception toward glucose monitoring and nonadherence to medication taking
Taylor et al. 2017 ²⁶	– Insufficient knowledge related to SMBG – Unclear communication between health-care providers and patients	– Misconception related to SMBG, influence of the diabetes-related stigma, and physiological and psychological issues
Nazmi et al. 2013 ³⁰	– Experience of pain or discomfort while pricking the finger	– Patients discouraged from monitoring blood glucose
Shlomowitz and Feher 2014 ⁸	– Experience of finger prick anxiety – Injection pain	– Avoiding self-monitoring by CBG

Table 3. Factors related to fear and psychological issues of CBG testing.

taking insulin doses based on different levels of blood glucose.³³ Effective diabetes management has demonstrated that intensive monitoring of CBG and other diabetes risk factors can delay the progression of complications due to diabetes. However, many patients are reluctant to adjust management intensively due to psychological problems related to CBG testing and hypoglycemic symptoms.

Specific strategies to approach the management of the psychological problems associated with CBG testing and insulin injection are limited. Snoek et al.²¹ have introduced the five-step psychosocial model of SMBG to reduce the psychological problems related to blood glucose monitoring. This model presents strategies to decide whether patients can perform CBG monitoring or not and then evaluate the outcomes to determine the perceived barriers and benefits of CBG monitoring for maintaining the blood glucose level. Understanding the fundamental psychological principles in blood glucose monitoring is a prerequisite to designing an effective program for patients who experience problems with CBG monitoring. Applying a new technological innovation is more likely to influence the precision of measurement and enable patient convenience. However, it is a fundamental challenge to manage negative feedback as a part of self-regulating behaviors.

Another study recommends a different approach, known as "cognitive behavioral therapy (CBT)", for managing the psychological problems related to CBG monitoring. This strategy applies an educational approach as the cornerstone of behavior change, followed by exploring the negative beliefs that generate a contrary conclusion, anxiety, depression, and guilt.³⁴ The strategy also involves challenging negative thoughts and has been

used to alter behaviors and to treat mood disorders among T2DM patients.

Blood glucose awareness training (BGAT) is a psychoeducational intervention to consistently demonstrate the ability of CBG testing in detecting and alleviating both hypoglycemic and hyperglycemic conditions while reducing the sequel of extreme blood glucose levels. This strategy applies didactic education, followed by empowerment of patients with information about BGAT and skills related to it. The last step of BGAT is to detect, anticipate, avoid, and treat extremes of blood glucose, a sequel of extreme blood glucose, and adverse psychological functioning. The fear and the depressive syndrome also need to be addressed in a systematic controlled manner to improve patients' health outcomes.³⁵ The details are summarized in Table 4.

7. Discussion

CBG testing and insulin injection comprises an essential strategy in insulin-treated T1DM and T2DM. This approach provides a more accurate pattern of daily blood glucose fluctuations, helps determine the effect of DMSM practice, and helps to avoid unrecognized hypoglycemia.³⁷

Previous studies, including meta-analyses and systematic reviews, have reported a positive association between SMBG with behavioral change on the one hand and reduction in glycated hemoglobin (HbA1c) levels on the other.^{38,39} A recent study has also shown that a structured blood glucose-testing schedule has positive impacts on HbA1c improvement after following the DMSM program.⁴⁰

Authors	Strategies	Description of the strategy
Snoek et al. 2008 ²¹	A 5-step psychosocial model of SMBG	<ul style="list-style-type: none"> - Deciding whether or not to perform a test. This choice may be based on routine - Deciding whether or not to perform an analysis; this choice is based on the method - Behavioral psychology to predict the negative experience with SMBG - Diabetes education and sufficient cognitive ability - Immediate action of SMBG - Appraisal of SMBG outcomes
Welschen et al. 2013 ³⁴	Cognitive behavioral therapy (CBT)	<ul style="list-style-type: none"> - The CBT explores the negative beliefs that generate a contrary conclusion, anxiety, depression, and guilt. This strategy involves challenging negative thoughts and has been used to alter behaviors and to treat mood disorders
Funnell et al. 2004 ³⁶	Confrontation, persistence, and reality (CPR) strategy	<ul style="list-style-type: none"> - The CPR focuses on confrontation and assessment of patient's obstacles, including psychological issues - Persistence is talking about the interaction and collaboration between patients and health-care provider in diabetes care - The reality aspect covers the ongoing monitoring process
Cox et al. 2006 ³⁵	Blood glucose awareness training (BGAT)	<ul style="list-style-type: none"> - This is a psychoeducational intervention that consists of education on blood glucose and how diabetes management affects blood glucose level - Empowering patients with such information and skills is through BGAT - Detection of extreme blood glucose, a sequel to excessive blood glucose, and psychological issues such as fear and depressive symptoms

Table 4. Strategies to manage the psychological problems related to CBG monitoring and insulin injection.

Several psychological barriers are linked with CBG monitoring and insulin injection, including fear of needles, the fingertip pricking being painful, stress and frustration arising from blood glucose results, lack of motivation, negative emotional response, and high levels of depressive and anxiety symptoms. These barriers have a significant influence on medication adherence and blood glucose monitoring.

Some evidences show that depressive and emotional disorders, such as anxiety, stress, and distress, lead to cognitive decline.⁴¹ These are also linked to disability, lack of health-care use, and premature mortality.⁴² Although the psychological issues among DM patients are extensive, person-centered treatment of this chronic illness and psychological support are quite low. Only 48.8% receive a treatment focused on psychological support.⁴³

Some authors propose different strategies and approaches, including the five-step psychosocial model of SMBG, CBT, CPR strategy, and BGAT. These strategies are effective in managing the psychological issues related to CBG testing and insulin injection.

The American Association of Diabetes Educators¹⁸ recommends that the idea of CBG testing and insulin injection therapy should be introduced as early as possible in DM patients to decrease the psychological problems related to those treatments. Patients should have clarity and should be able to understand the importance of CBG testing and insulin injection, as well as the side effects of both the procedures.

8. Conclusions

This review confirms and describes the psychological aspects related to CBG testing and insulin injection among DM patients. The information obtained helps provide recommendations to reduce the psychological problems related to CBG testing and insulin injection.

9. Recommendations to manage the psychological problems related to CBG testing and insulin injection

Specific recommendations to manage the psychological problems arising from CBG testing and insulin injection can be summarized as follows.

9.1. Recommendations for action

- (1) Provide individual counseling and share experiences on how to deal with psychological problems among T2DM patients so as to reduce fear,

anxiety, and depressive symptoms related to CBG testing, insulin injection, and prognosis of diabetes.

- (2) Empower T2DM patients on continuing DMSM management, especially with CBG monitoring and insulin injection.
- (3) Strengthen family members' inclination to support and care for diabetes patients during daily life activities and to provide psychological support in motivating the patients to adhere to treatment.
- (4) Enhance the knowledge and skills of T2DM patients in connection with CBG testing and insulin injection by participatory learning with coaching, to reduce wrong beliefs and misconceptions related to insulin therapy.

9.2. Recommendations for further study

Clinical inertia or failure of health-care providers to initiate or intensify insulin treatment for T2DM patients needs to be explored in a systematic manner by using concept analysis or systematic review and meta-analysis.

9.3. Strengths and limitations

Since this review provides valuable information regarding the psychological problems commonly faced by DM patients, the findings can be used as inputs for health-care providers before designing an appropriate program for DM patients who perform SMBG and self-injection of insulin. However, some limitations are still found in this study because we have analyzed the results in a narrative form rather than as a systematic review or meta-analysis. This is due to the difficulty in accessing primary data and the variability in study designs, which did not allow us to pool data as a meta-analysis study.

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Ethical approval

Ethical issues are not involved in this paper.

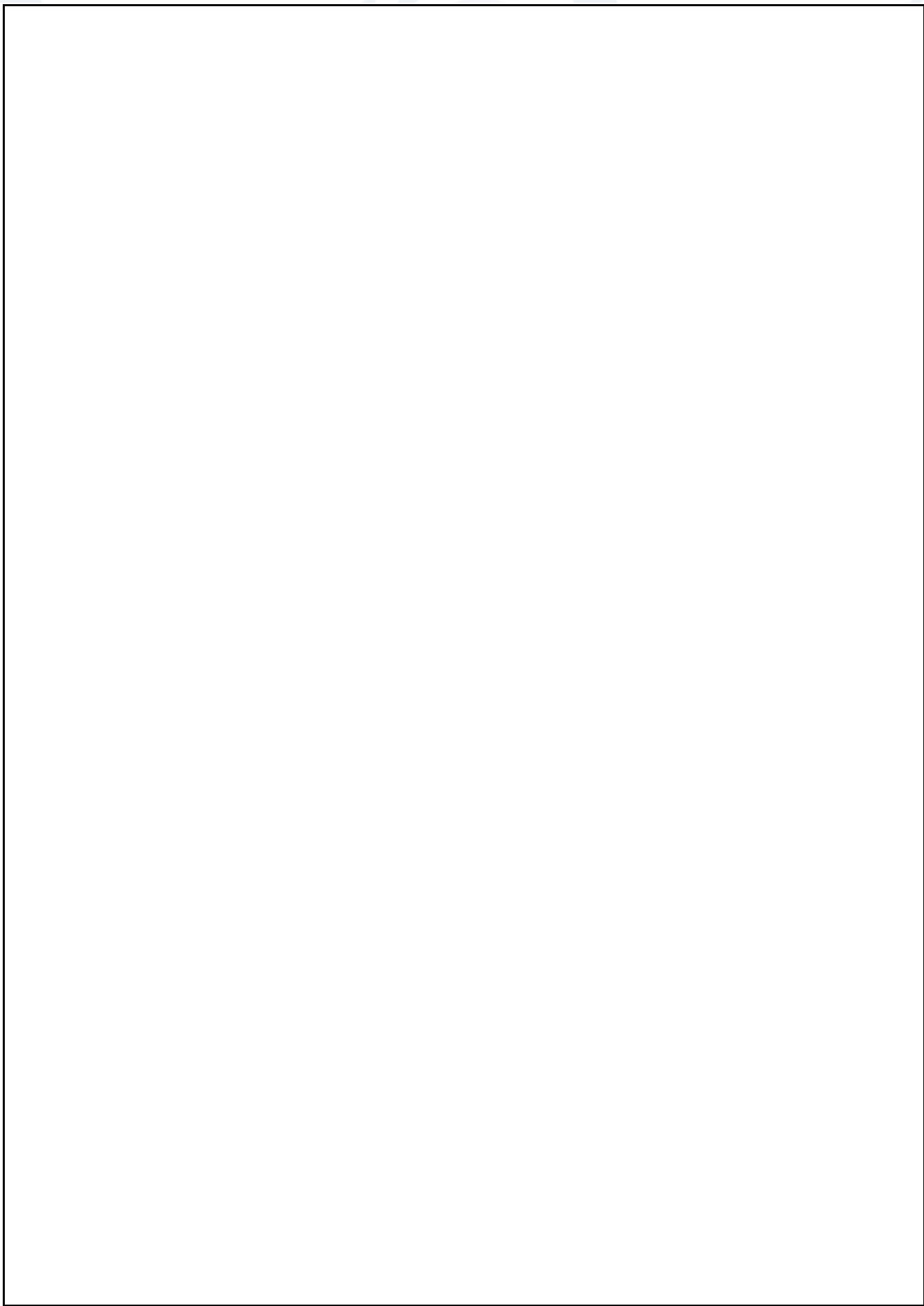
Conflicts of interest

All contributing authors declare no conflicts of interest.

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