# Athens Journal of Health and Medical Sciences

Quarterly Academic Periodical,
Volume 9, Issue 4, December 2022
URL: https://www.athensjournals.gr/ajhms
Email: journals@atiner.gr
e-ISSN: 2241-8229 DOI: 10.30958/ajhms


## Front Pages

# Athens Journal of Health and Medical Sciences

*Published by the Athens Institute for Education and Research (ATINER)*

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The Athens Journal of Health and Medical Sciences
ISSN NUMBER: 2241-8229 - DOI: 10.30958/ajhms
Volume 9, Issue 4, December 2022
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The current issue is the fourth of the ninth volume of the *Athens Journal of Health and Medical Sciences* (AJHMS), published by the **Health & Medical Sciences Division of ATINER.**

Gregory T. Papanikos
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The Health Economics & Management Unit of ATINER will hold its **22nd Annual International Conference on Health Economics, Management & Policy, 19-23 June 2023, Athens, Greece s**ponsored by the Athens Journal of Health and Medical Sciences. The aim of the conference is to bring together academics, researchers and professionals in health economics, management and policy. You may participate as stream leader, presenter of one paper, chair of a session or observer. Please submit a proposal using the form available (https://www.atiner.gr/2023/FORM-HEA.doc).

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**1-4 May 2023, Athens, Greece**

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- Abstract Submission: **3 October 2022**
- Acceptance of Abstract: 4 Weeks after Submission
- Submission of Paper: **3 April 2023**

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*Athens Journal of Health & Medical Sciences - Volume 9, Issue 4, December 2022 – Pages 199-214*

# SAFER: An Occupational Health and Safety Teaching Framework for Nursing Students

*By Rose Boucaut[*] & Sophie Lefmann[±]*

*Occupational health and safety (OHS) education is integral to healthcare practice. Nurses/nursing students are particularly vulnerable during their work in this high-risk industry. Current clinical teaching appears to focus on individual risks rather than provide a broader overview of the complex issues involved. A novel educational resource, the Safety Assessment Framework for Evaluation and Assessment (SAFER), is presented, addressing a gap in current education resources for nursing students to broaden understanding about OHS. The study re-examined pilot focus group data from first- and third- year student OHS focus groups in an Australian university School of Nursing. The SAFER framework was informed by student nurses impressions/ experiences of OHS (published in 2015 and 2016), supported by a literature review. Central to the SAFER framework is OHS 'risk management'. It incorporates stakeholders and Australian legislation, all in relation to 'responsibility' and 'trust'. Examples use focus group participant voice, linked with researcher interpretation and supporting documentation. Clinical educators now have a broad resource to facilitate student group discussions about OHS from multiple perspectives. SAFER's value beyond face validity should be tested, to confirm its applicability as a teaching resource in various university and training environments.*

**Keywords:** *occupational health, education, nursing, curriculum, students*

## Introduction

International reports about the healthcare industry workforce indicate that occupational health and safety (OHS) is a matter of global concern (ICN 2017, NIOSH 2014, Wåhlin et al. 2018). The Australian Work Health and Safety Strategy 2012-2022 is a policy framework which aspires to reduce future workplace injury and illness. Accordingly, healthcare and community services are targeted priority industries (Safe Work Australia 2012). As a 'healthy' workforce is required to provide ongoing care for all members of the community it is logical that attention is paid to teaching healthcare students about OHS from early pre-registration training. However, the best way to educate students about OHS is not fully described in the literature.

Further to legislative obligations (e.g., for professional registration or accreditation), learning about OHS is necessary for students. Healthcare is a high-risk industry for work injury (e.g., from manual handling) and illness (e.g., disease transmission) (Driscoll 2008, NIOSH 2014, Wåhlin et al. 2018). As nurses comprise a large percentage of the health workforce, their OHS deserves considerable attention (ICN 2017). Appropriately, it forms an essential part of nursing student education, due to the breadth of procedural tasks and patient

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conditions that can compromise a student's safety. However, developing an organised way of dealing with this component of student education is a challenge for clinical teachers, particularly due to the difficulties with managing self-care and patient safety simultaneously in complex and dynamic settings (O'Keefe et al. 2020). This article presents a research-informed teaching resource for nursing students to facilitate their learning about OHS and illustrates it with examples from nursing students explored by Boucaut and Cusack (2015, 2016).

## Background

Globally, nursing students face numerous clinical and non-clinical stressors while undertaking their training (Boucaut and Knobben 2020, Olvera Alvarez et al. 2019). The clinical hazards they face include, but are not limited to: disease transmission (Rahiman et al. 2018); musculoskeletal injuries (Menzel et al. 2016); sharps injury (Hambridghe et al. 2016,Thomas 2020); stress (Gibbons 2010, Olvera Alvarez et al. 2019); incivility (Cooper and Curzio 2012); and workplace violence (de Villiers et al. 2014). Clinical stressors student nurses reported in pilot focus groups comprised three key themes: trust (e.g., in colleagues); knowledge and awareness of OHS practices and; responsibility (e.g., towards patients, recognising scope of practice) (Boucaut and Cusack 2016). Non-clinical stressors which nursing students may experience include: difficulties with managing a work-life balance (Rella et al. 2009); financial stress (Loftin et al. 2012); and campus safety (de Villiers et al. 2014).

How best to facilitate knowledge and preparedness for student nurses to apply safe work principles beyond basic procedures in the face of such hazards appears to have not been clearly articulated in an overall framework within the wider literature. Existing literature mostly relates student safety to particular hazards, as reported above, rather than considering students' broader capacity to assess, evaluate and apply principles of OHS knowledge in fluid settings and scenarios. While key examples of protocols and areas of caution are essential and appropriate to clinical teaching (Feo et al. 2016) students arguably require an additional 'holistic' framework to reflect on multiple intrinsic and extrinsic hazards encountered during working life.

Makin and Winder (2008) provide a framework to enhance OHS by considering three hazard perspectives: safe person (personnel); safe place (workplace); and safe system (management). Using similar perspectives in relation to healthcare and trust, Beitat et al. (2013) consider the importance of trust in persons, organisations and processes; and trust in the overall healthcare system. This is a useful multi-dimensional approach because it trains learning across organisational and personal domains. Using these perspectives may help nursing students scaffold their considerations of safety and trust in the multifaceted environments they work in during their training. Hewett et al. (2013, p. 36.) describe nursing students' placement environments, especially hospitals: as, '… complex and dynamic organisational environments.' The complexity of these environments, they state, '… derives not only from technical factors, but also from the multi-professional,

hierarchical social system that operates them, and the lack of formal, codified rules that govern them.' A well-structured framework could assist nursing student learning about OHS and help students to manage their own safety within such complex surroundings while absorbing nursing knowledge and skills.

Australian universities and teaching environments, such as clinical placements, have legislative responsibilities to provide safe work systems. In South Australia, an example is the Work Health and Safety Act (2012). These range from simple systems, like sign-on attendance, to complex processes such as evacuation or lockdown procedures. In the South Australian jurisdiction, the term 'workers' includes students and therefore both students and employers have responsibilities under the Act. As employers, universities also have OHS responsibilities to staff and students, including providing a safe work environment and safe systems of work. Because university supervisors have a duty of care to their students (Work Health and Safety Act 2012), students require education about OHS and self-care to ensure these principles are firstly, understood and secondly, upheld. These responsibilities play out in an environment where trust is paramount. The importance of 'responsibility' and 'trust' is described in the Code of Professional Conduct for Nurses in Australia as: '[an expectation that] nurses will conduct themselves personally and professionally in a way that maintains public trust and confidence in the profession. Nurses have a responsibility to the people to whom they provide care, society and each other to provide safe, quality and competent nursing care' (NMBA 2010, p. 2). This Code of Professional Conduct also applies to registered nursing students conferring a responsibility to conduct themselves in a manner which reflects these sentiments.

Legislative and professional responsibilities for students around patient care need to be explicit within the pre-registration nursing curriculum. Of specific note, the Code of Professional Conduct for Nurses in Australia requirement - described above - is that these responsibilities extend beyond patients to other stakeholders including peers, co-workers and society (NMBA 2010). Although the code does not clearly define what is meant by 'society', it is reasonable to include the University, students' clinical placement organisations, as well as their family and friends. Nursing students have demonstrated their ability to reflect on the shared responsibilities they have with these broader society stakeholders (Boucaut and Cusack 2016), and reinforcing these responsibilities within their curriculum is appropriate.

In their writings about trust, Candlin and Crichton (2013) identify the links between issues of trust, responsibility, and risk. Consideration of each of these issues is important to reveal some of the complexities that nursing students should consider in regard to their own safety (O'Keeffe et al. 2020). Trust 'can be a risky venture' (Carter 2009, p. 394) because placing trust in another person or organisation does not ensure that such trust is appropriate (i.e., used in the way the trustee might intend). Indeed, trust can be misplaced. Dinç and Gastmans (2012) also describe a number of articles about the importance of trust in nursing practice, highlighting the significance of trust between nurses, nurses and patients, nurses and other healthcare professionals, and trust in the work setting, or institutional trustworthiness. Enhancing students understanding about trust (Materne et al.

2017), responsibility (Clouder and Adefila 2017, Perry et al. 2018) and risk in relation to their own safety and the safety of those they work with and care for will broaden their reasoning about OHS (Clouder and Adefila 2017, O'Keeffe et al. 2020).

Ultimately nursing students may face numerous hazards during both their pre-registration training and following graduation (Driscoll 2008, NIOSH 2014). Educators need resources to enhance student learning about their legislative responsibilities and other matters in relation to hazards associated with their role both as students, and future health professionals. Where appropriate these resources should reflect on issues of trust, knowledge and responsibility to take a more holistic approach to OHS (Boucaut and Cusack 2016). The conceptual framework described in this paper is a teaching resource that incorporates both the legislation and stakeholder viewpoints to consider these issues broadly. It is a research-informed teaching resource developed for nursing students to facilitate their learning about OHS, and it is illustrated in this paper with examples from nursing students explored by Boucaut and Cusack (2015, 2016).

## Theoretical and Methodological Foundation

With ethics approval (H-2015-222) faculty members at an Australian university explored nursing students' general perceptions and experiences about OHS via two pilot focus groups in 2014. The approach comprised semi-structured questioning within the group setting. A variety of reflections on student OHS was encouraged, including impressions about hazards, injuries and illnesses, work practices, safety culture, and self-care. Nine students participated in the groups facilitated by a nursing and an OHS practitioner. The first-year student group comprised six students (three male and three female), and the final year student group comprised three female students. The specific conduct of the focus groups has been previously reported in two separate articles, one on clinical findings (e.g., practical and procedural components of nursing practice) (Boucaut and Cusack 2016) and the other on non-clinical findings (e.g., university and campus life) (Boucaut and Cusack 2015).

The lead investigator of this research (RB) was employed as the nursing school health and safety officer at the time. Focus groups were an appropriate research method, congruent with the consultative style of the OHS legislation (Safe Work Australia 2011). The three key focus groups themes in relation to the clinical findings included: trust, knowledge and awareness of OHS, and responsibility. Connections between these themes, and the thought processes of students about how these three components influenced their descriptions of OHS situations were the catalyst for the conceptual framework presented in this paper, produced after secondary data analysis of the original focus group transcripts.

Additionally, the lead author (RB) endeavoured to be explicit about other OHS practices which helped shape her world view (Nayar and Stanley 2014). The authors are health educators with an implicit interest in understanding students'

views and experiences of OHS, fundamental to informing their teaching of students about OHS and self-care.

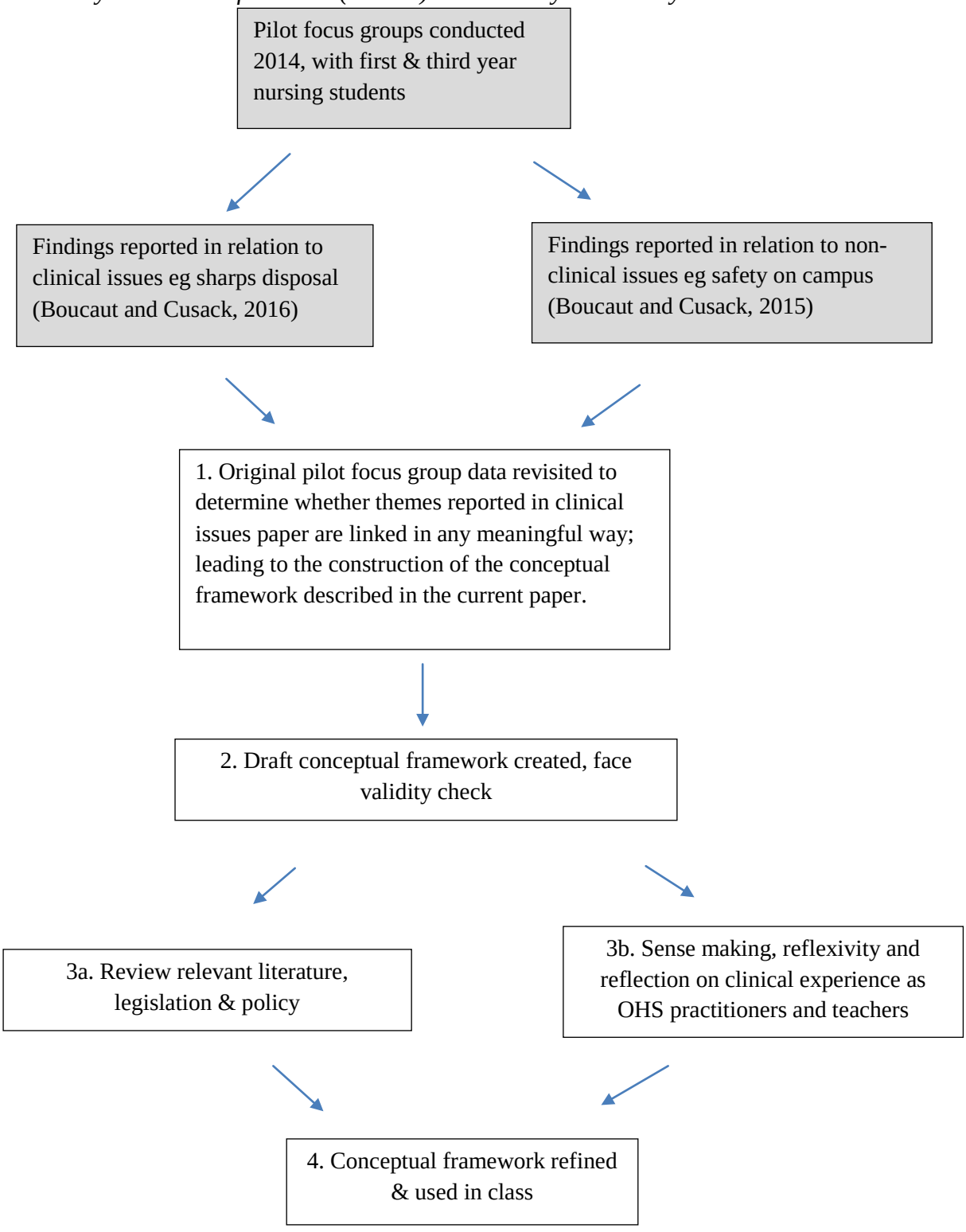
Following the development of themes from the focus group data, questions remained about links between the three core themes and other information within the data. In re-examining the data (Figure 1), it was possible to diagrammatically connect the themes and domains (clusters) of information within the data; this diagram formed the basis of the conceptual framework presented here (Figure 2). A conceptual framework was appropriate because such a structure 'identifies a set of variables and relationships that should be examined in order to understand the phenomenon' (Kitson et al. 2013). It is not a rigid application of points or processes, but instead a guide to thoughts and actions in an organised yet fluid way. Hence the conceptual framework can be used to form the basis of a discussion with students to facilitate learning about OHS.

Research analysis comprised four sequential steps (Figure 1). These steps included (i) reviewing focus group transcripts to determine if themes were linked in any way, and if so how; then (ii) drafting a conceptual framework to reflect links found within the data and sharing this with colleagues for feedback to check face validity. Step three comprised two distinct components: (iii.i) reviewing literature in relation to the themes and relevant legislation and (iii.ii) sense-making including reflection on practice and whether the framework fostered consideration of practical OHS issues. Finally, step four involved using the framework in class with nursing and allied health students to facilitate discussion about OHS.

Verifying research trustworthiness was appropriate through processes of peer debriefing, creating an auditable trail of evidence to enhance research credibility, and having coding independently verified (Miles and Hubermann 1994, Seale and Silverman 1997). Further, the framework's 'transferability' examines its application to other settings; it occurs through piloting the framework with other medical and allied health student groups which has since commenced (Miles and Hubermann 1994).

The intent of the current project was to develop a transferable framework of OHS reflection for students that acknowledged the fluidity of the healthcare and university systems, each of which is an 'open, complex and pluralist system' (Anaf et al. 2007).

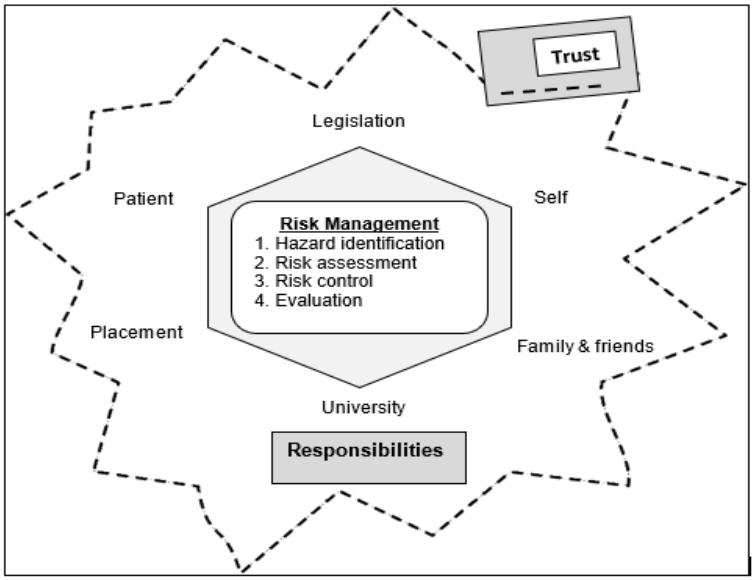
**Figure 1.** *Developing the SAFER OHS Conceptual Framework*: *Relationship of Previously Published Information (Shaded) to Secondary Data Analysis*



*Interpretation: Development of the Conceptual Framework*

Three themes from the student focus groups, ***knowledge, responsibility and trust***, form the inner, middle and outer layers of the framework respectively (Figure 2); derived from the previous data set.

**Figure 2.** *The SAFER Conceptual Framework*




The inner part of the framework [***knowledge***] is titled 'risk management' as understanding this process is important foundation knowledge for OHS. Boucaut and Cusack's (2015, 2016) semi-structured line of questioning in the focus groups revealed OHS influenced nursing students' lives and practices in six discrete domains:

i. Legislation
ii. University
iii. Placement
iv. Self-care
v. The patient
vi. Family and friends

In the middle layer of the framework these six domains are represented as points of the hexagon of ***responsibility***. The outer layer of ***trust*** encompasses all of the components within the framework.

To verify the process of data being developed into research themes, Table 1 illustrates the six domains with focus group data, 'participant voice'. The authors have comments on the data and educational opportunities, 'researcher interpretation' while 'supporting documentation' refers to legislation, policies, and other relevant information about each domain.

**Table 1.** *Domains Illustrated by Student Nurse Participant Voice from Previous Focus Groups**#.

| Domain | Participant voice (focus group quotes) | Researcher interpretation | Supporting documentation |
|---|---|---|---|
| **Legislation** | *I've seen over the last 10 years a lot of attention to workplace health and safety and a lot of legislation has come in … the School [of nursing] has a Duty of Care and the hospital would [have too] and the placement [as well] (1st year male student)*<br><br>*… people tend to be quite afraid of getting in trouble, litigation … (3rd year female student)* | Student discussion on safely legislation was limited (n=1). The student who spoke of the Duty of Care and legislation had prior work experience within an organisation which, the student reflected, had been required to respond to new safety requirements.<br><br>Fear of litigation was raised by students in relation to student responsibilities for an unsteady patient who might fall. Students reported they would try to catch the patient rather than let them fall, although this may injure the student. Their concern for the patient rather than themselves, highlights the need to clarify student responsibilities in relation to the legislation, and university and placement expectations.<br><br>These findings suggest that students require specific education about relevant legislation that applies to them, and the associated responsibilities. | The Work Health and Safety Act (2012), places responsibilities on employers and workers.<br><br>Information about the safe handling of people is contained in the Model Code of Practice: Hazardous Manual Tasks (Safe Work Australia 2011) .<br><br>The Australian Nursing and Midwifery Federation (2016) has numerous OHS policies, including but not limited to: Smoke free work environment (2015); Safe patient handling (2015); Bullying in the workplace (2015), Fatigue prevention (2016); Workplace stress prevention (2016).<br><br>The Health Practitioner National Law Act (2009) requires all nursing students to be registered with their national board (the Nursing and Midwifery Board of Australia). The universities facilitate this process. |
| **University** | *Universities have a bad reputation for being targeted by people who target other people to mug them or assault them or other things (1st year male student)**<br><br>*... if you're doing an injection [the tutors remind] you to check that you've got a sharps container close by … just prompting where they can see you might be lacking because you're trying to learn and do things at the same time (3rd year female student)#*<br><br>*The tutors are really good (3rd year female student)* | Students were aware of issues related to safety on campus. Generally, they felt protected within their own cohort.<br><br>The university has its own corporate brand to promote in order to attract and retain students. Having a safe system of work and meeting OHS legislative requirements is an important part of this.<br><br>The students valued the support of their clinical tutors in regard to student safety. | Some Australian Universities have a Student Charter which provides '…students with an overview of what they can expect of the University, and of their responsibilities as students', and commits to provide a safe and supportive environment.<br><br>The Australian Nursing and Midwifery Accreditation Council (2016) determines whether university programs meet education standards. |
| **Placement** | *I won't drink, not when I'm on placement (1st year female student)#*<br><br>*I know that when you're tired you do make mistakes and I do worry about that (3rd year female student)#**<br><br>*… In the Emergency Department there's a strong security presence (3rd year female student)* | Students' reflections on safety included considerations of their own safety, patient safety and also that placements had responsibilities to provide a safe work environment for staff and students more generally.<br><br>Placements need to provide safe learning environments for students. Students have a role to provide feedback about placement activities and suitability of the site as a | As employers, placements have a Duty of Care for staff and student OHS, for example to induct students and provide adequate supervision. As healthcare providers they have responsibilities to their patients, staff and students, such as providing a safe environment and appropriate facilities. Workers (including students) have obligations to conduct themselves in a safe manner (Work Health and Safety Act 2012). |

| | | | |
|---|---|---|---|
| | *I know a person who works at Aged Care and he says that ENs and RNs literally get told to stop using so many gloves cos they are just wasting money so they will be washing patients…without gloves on their hands (1st year, male student)*<br><br>*I think, in a hospital, the unit will provide [manual handling] training (1st year female student)* | placement. Educators need to encourage students to provide this feedback and ensure there are mechanisms to provide honest feedback safely.<br><br>Placement staff may or may not be as caring about the students as university staff. Supervisory placement staff may not fully understand students' scope of practice. University educators should raise student awareness of these potential issues to enhance student safety. | Students require clearance prior to undertaking clinical placement, for example for immunisation, police checks and Tuberculosis screening (An Australian University, n.d. a) |
| **Self-care** | *You should have a healthy lifestyle … set a good example for the patients, so protect yourself so you can protect others (1st year male student)**<br><br>*You have to use your back a lot to move patients and equipment … Especially in aged care; apparently it's very physical (1st year female student)*<br><br>*We have practised putting on gowns and gloves (1st year female student)*<br><br>*The thing is getting to and from placements with shift hours (3rd year female student)*<br><br>*… coming into uni … having to use computers, a lot of reading and … studying … I was getting a lot of headaches (3rd year female student)**<br><br>*… a lot of time we talk to each other [to debrief] (3rd year female student)#* | Self-care was identified by both first and third years to be an important part of being a nursing student. Their identification of self-care was often so that the students could care well for their patients rather than care for themselves *per se*.<br><br>In a controlled environment, using scenarios, educators can challenge students to reflect on the level of risk to their own health and safety, as well as the risk to other workers so that the students develop the ability to consider this in various circumstances.<br><br>Students may not be aware that attending clinic when unwell may have adverse effects on colleagues as well as patients. When injured e.g. with a sore shoulder they may not be an effective team members in a two person lift. When unwell e.g. with gastro or the flu, they may transfer their sickness to patients or other staff. The students have a responsibility to ensure they do not adversely affect others. | Nursing students need to be physically fit to undertake the clinical component of their training (University of Adelaide 2016).<br><br>Universities offer a range of services to promote student mental and physical health and manage existing issues (University of South Australia 2016).<br><br>Canadian nursing students reported fatigue and that they do not allocate sufficient time to exercise due to competing demands on their time (Chow and Kalischuk 2008). Chronic fatigue and stress can lead to burnout in nursing students and new graduates (Rees et al. 2016).<br><br>The Work Health and Safety Act (2012) states that while at work, workers have duties to 'take reasonable care of their own health and safety' (Section 28) and to take reasonable care that they 'do not adversely affect the health and safety of others.' |
| **Patient** | *… you know they'd rather save the patient, like do whatever they can to help their patient (3rd year female student)*<br><br>*[the tutor said of a patient with inappropriate behaviour]… if you really don't feel comfortable looking after him then you don't have to (3rd year female student)*<br><br>*... it was kind of … sad …then we had a debrief … on our last day one of the residents died, we talked about that for a bit (3rd year female student)* | The focus of safe behaviour reported by students was primarily for the patients benefit. Students need education throughout the duration of their training, about the balance between safe-patient and safe-self. Further students need support to reason through factors that influence this balance in clinical situations of escalating complexity. | The Australian Health Practitioner Regulation Agency (AHPRA) and the Nursing and Midwifery Board of Australia work in partnership to protect the public (patient welfare).<br><br>Under the National Law, education providers are required to advise AHPRA of student health impairments that may place the public at substantial risk of harm |

| | | | |
|---|---|---|---|
| **Family and friends** | *…I am worried about contagious diseases we could contract … and pass on to our families(1st year female student)*<br><br>*…I need to make sure … I don't want put the health of people I know and love at risk (3rd year female student)#*<br><br>*…..…my biggest issue is fatigue … based around family [responsibilities] (3rd year female student)#*<br><br>*I was lucky I had male friends that would walk me to placement (3rd year female student)*<br><br>*… a family member of mine had passed away [on that ward] only a few months ago... I found that really quite confronting (3rd year female student)#* | Students shared their concerns for their responsibilities to family and friends. Students generally focussed on the health of others, rather than themselves.<br><br>Students may have caring responsibilities for family in addition to studies. External work places demand on students.<br><br>Students recognise and appreciate support from family and friends, e.g., to provide transport and to debrief about their work. This need for debriefing is backed up by University counselling services. | University safety systems incorporate counselling services to support students for both course related matters and personal matters (University of South Australia 2016).<br><br>The Communicable Disease Control Branch of the South Australian Government aims to limit healthcare associated infections, in healthcare facilities and their spread to the community (SA Health 2016). |

*Source:* Boucaut and Cusack (2015, 2016).

## Discussion

### *Risk Management – The SAFER Central Framework Component*

In reference to Figure 2, the central part of the SAFER conceptual framework for teaching nursing students about OHS is the risk management methodology which underpins the OHS legislative approach in Australasia (SAI Global 2009) and in Britain (Health and Safety Executive 2014). Understanding OHS risk management is a route of entry to developing knowledge and awareness about OHS and to acquiring an appreciation of OHS legislation relevant to nurses. Risk management involves four sequential steps: 1) hazard identification; 2) risk assessment; 3) risk control and; 4) evaluation. A starting point for student nurses to understand risk management is knowledge of the main hazards involved in nursing practice (described previously in 'Background') and how to identify hazards. Enabling students to determine the level of risk involved in their activities (O'Keeffe et al. 2020), the ability to decide on appropriate control strategies and subsequently evaluate them is a worthy benchmark to aim for in pre-registration education. Teaching students about risk helps them consider problems of an OHS nature logically to assist their clinical reasoning and increase their self-efficacy. Students can be prompted to realise different ways they probably use this process unconsciously in everyday life. For example, when crossing the road or, in health practice, assisting a patient from sitting to standing. Equipping students with this knowledge provides them with a foundation upon which to make safe decisions throughout their nursing careers.

### *Responsibility and Trust, Legislation and Stakeholders – The SAFER Middle and Outer Framework Components*

The middle and outer components of the SAFER conceptual framework are considered together because while they are separate concepts, they are closely aligned (Figure 2). The middle part enables students to recognise and consider the *'responsibility'* that comes from being a nurse. Its hexagonal shape illustrates the six discrete domains representing both the legislation and five stakeholders who are: self (the student); the patient; the university; the placement; and family and friends. There are responsibilities associated with the legislation and each of the five stakeholders that students need to appreciate, outlined in Table 1.

The outermost component of the conceptual framework is a circle of trust which is fundamental to patient care (Kitson et al. 2013). The circle of trust has perforations (representing permeability and changeability), identifying that levels of trust may vary and trust can be positive but can also be misplaced in certain situations. Students should become aware of issues of trust to enhance self-care, co-worker and patient safety and their own responsibilities to be trustworthy, for example to work safely in teams. The focus group theme showed that students reported *'trust in their colleagues'* as an important concept (shown in Table 1, self-care in relation to debriefing).

*Levels of Systems Thinking for Safety*

Students can be encouraged to consider OHS in terms of levels of prevention and intervention. The World Health Organisation (2002) encourages people to organise their thoughts on health systems within complex networks into three levels: micro (individual or patient level), meso (healthcare organization and community level) and macro (policy level). Conceiving the healthcare system in this way encourages thinking about the dynamics of the healthcare system and also provides the students with the opportunity to realise that health and safety issues often traverse multiple levels (Makin and Winder 2008). The value in exploring relevant OHS scenarios with students is that they can see the need for solutions to be introduced at more than one level. The conceptual framework (Figure 2) can be used to encourage multifaceted consideration of scenarios in this system levels way of thinking.

Within the focus groups students frequently talked about hazards at the micro-level, like the need for hand-washing, and the meso-level, such as the need for security presence in the emergency department (Boucaut and Cusack 2016). There was much less talk within the focus groups about macro level issues (e.g., legislation). That the majority focused on the micro- and meso-level problems and interventions highlights that students tend to think more narrowly about OHS than at a broader policy level. Given that students have limited experience and technical skills this could be expected. The intention is to direct discussion towards any one, or all, of the three components of the conceptual framework to more comprehensively scaffold their learning. Students can be encouraged to contemplate some OHS challenges and interventions initially in straightforward scenarios with novice students (Benner 1982) progressing to more complex scenarios in concert with the stages of their developing OHS knowledge and their increasing clinical experience.

*Self-care*

Educators and staff have responsibilities for the OHS of students they supervise. In their paper on accountability and responsibility Scrivener et al. (2011) describe challenges Registered Nurses face, concerning their duty of care, when delegating tasks to students. These staff must ensure their task delegation is appropriate to the student's level of competency and safety. During the focus groups first-year nursing students reported placing substantial trust in their clinical tutors (Boucaut and Cusack 2016). While appropriate in some circumstances, at other times students may need to consider the wisdom of putting all their trust in their superiors, in relation to self-care. Educators have an inherent responsibility to prepare students to have heightened awareness of situations that may adversely affect the students' own OHS. It is valuable for students to also recognise that responsibility for their own self-care may not be others' priority and reliably implemented, especially given the complexity of patient care. Even when students become aware of situations where their safety may be compromised they may face difficulty voicing concerns about their own safety. Reasons for this include: not knowing the boundaries to their scope of practice, the authority gradient within the

work environment, and the duality of managing self-care and patient-care in a complex and dynamic setting. Having conversations with students about the challenges student nurses may face to their own safety at work is a vital role for educators.

*Flexibility of the SAFER Conceptual Framework*

The SAFER conceptual framework is a resource for student reflection on practice. It may also assist educators who are less acquainted with OHS to begin to develop curricula.

The 'responsibility' aspect of the framework could be adapted to suit the end-user, depending on the student activity. The hexagon of stakeholders and legislation can be tailored to reflect the stakeholders associated with different student groups. For example, the 'placement' element could be deleted for those students who do not undertake clinical placements. There is also the capacity to include additional elements or stakeholders if needed.

## Limitations

Although the SAFER conceptual framework is modelled on themes arising from a pilot study with two focus groups of Australian nursing students (Boucaut and Cusack 2015, 2016), it is arguably a helpful educational resource to facilitate structured discussions with students about OHS. The framework has initial face validity and has provided a helpful basis for discussion between the authors and students in nursing and physiotherapy, each being health care groups where both students and professionals are at high risk of OHS issues (Kneafsey et al. 2012). In the future, the SAFER framework should be evaluated more broadly by those with OHS clinical education expertise to confirm its face and content validity and to determine its usefulness for wider acceptance.

## Conclusion

An OHS teaching resource has been developed - the SAFER conceptual framework-that incorporates the concepts of knowledge of OHS risk management, responsibility and trust. The concepts relate to themes identified within previous nursing student focus groups. The SAFER conceptual framework provides a useful starting point for students to learn about OHS. The framework reinforces that a risk management approach is fundamental to every student learning about OHS; and by considering other components around the students' professional responsibilities and the inherent trust issues therein, we can broaden students thinking about OHS from early stages in their training.

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*Athens Journal of Health & Medical Sciences - Volume 9, Issue 4, December 2022 – Pages 215-228*

# Effects of Public Reporting Programs: Organizing and Synthesizing the Literature

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*Public Reporting (PR) of quality data is a common instrument to support transparency, accountability, and quality improvement in modern health care systems. Although, programs exist for 30 years, signals for its efficacy are inconclusive and new measurement schemes enjoy great popularity. The aim of this study was a realist view of the current literature dealing with effects of PR and finding answers on the broad and often unquestioned use by health authorities. This review considered literature from relevant databases and included all type of studies. In a kind of map, authors organized the research based on different paradigms and theories. Results indicate, first, patients rarely use the reported data. Second, providers show limited usage as well, but it is the more promising way which could lead to quality improvement. This review suggests that PR is a popular topic in different academic fields and health care policy. Despite of its high use, PR often does not show its full potential. Pure rational approaches to describe the effect of PR fall short. Further research should strive to do better by paying more attention to the breadth, theories, and context of the field as well as collective solution-finding among academia, policy, and practice.*

**Keywords:** *quality improvement, delivery of health care, health policy, information dissemination, quality indicators, health care*

## Introduction

In nearly all developed health care systems, increasing costs, lack of effectiveness, and poor efficiency of health care provision is in constant public discussion. These improvement potentials are estimated by the OECD (2017) with a cost reduction of about 20%. So, it has become common that elements of the market economy are implemented to control rising costs. Although the evidence on the relationship between quality and cost is inconsistent (Jamalabadi et al. 2020), transparency initiatives of performance and quality are strongly promoted by health authorities. Public reporting (PR) is a commonly established quality strategy (OECD and WHO 2019), whereby the behavior of different stakeholders in the system should be stimulated.

> Public reporting is data, publicly available or available to a broad audience free of charge […], about a health care structure, process, or outcome at any provider level

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> […]. […] public reporting is generally understood to involve comparative data across providers, […]. (Totten et al. 2012)

Berwick et al. (2003) described two main target groups of PR. On the one hand, patients could use reports to choose their health professionals or hospital before a therapy. On the other hand, providers could compare with others to start quality improvement.

While primal PR appeared at the end of the 1980s in the United States (Hannan et al. 1994), it is a relatively new topic within most European countries. But today, almost every country in Europe has a PR program, although evidence of its effectiveness lags behind the frequency of its use. Internationally, various reviews showed inconsistent findings to support or not support behavior change on the basis of PR, be it of patients or providers (Campanella et al. 2016, Ketelaar et al. 2011, Metcalfe et al. 2018, Vukovic et al. 2017). These reviews summarized the included studies methodologically in a classical systematic manner. Although the topic has been much researched in classical ways and the results are not clear, PR is almost unquestioned and even increasingly used for years.

To induce awareness of this problematic development, it would be necessary to take stock of the broad knowledge that has been acquired during the last 30 years. Not only scholars in medicine but also others, for example, in sociology, showed interest in researching PR. Therefore, it is a multidisciplinary topic where theories and paradigms from different fields have been applied. Because PR in health care is embedded in a complex web of social interventions and its context, the way it should be looked at is not only a linear one (Pawson et al. 2005). In this situation, utilizing systematic review methods which were particularly developed for summarizing medical treatments are not adequate to give an overview to the current state of the literature in these different fields. Multitheoretic approaches within different research paradigms and non-standardized keywords in other disciplines than nursing, medicine, and economics are reasons which must be considered. Therefore, to the body of knowledge should be looked at in a different manner.

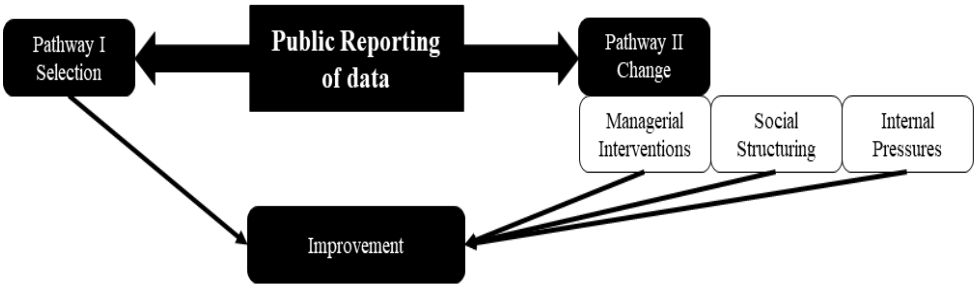
So, the aim of this study is to present a review format based on the proceeding which is normally done for reviews in management and organizational sciences (Rousseau et al. 2008). There usually, an organizing framework to categorize the current state of the literature is presented or developed. In a kind of map, the authors organized research based on different theories and paradigms; completeness is not an explicit goal. Answering the question what effects PR has and synthetization of its literature is conducted by a realist view (Pawson et al. 2005). This study is not about the average effectiveness of interventions, but about asking the right questions and asking the questions right. Moreover, this review is heavily focused on the practice evaluation of PR and its explanations as policy, although the theoretical underpinnings remain an important foundation.

So, the authors firstly present an organizing framework which is followed by methodology. Results show the main evidence for the research question. In the following section, the results are discussed and synthesized. Conclusions follow as last part.

## Organizing Framework

As indicated, PR has been studied in different fields within or without various paradigms and theories. The concept development begun 15 years after the first programs with Berwick et al.'s (2003) article "Connections Between Quality Measurement and Improvement". Deeper theoretical foundations and clarifications were carried out by Contandriopoulos et al. (2014). For this review, the authors summarized the basics and extensions of the theoretical modes of action (see Figure 1).

**Figure 1.** *Structuring Framework*




*Source:* Berwick et al. 2003, Contandriopoulos et al. 2014.

Berwick et al. (2003) described two ways to improve performance: "Pathway I: Improvement Through Selection" and "Pathway II: Improvement Through Changes in Care". In Pathway I, it is supposed that publication of performance data principally influences patient's decision for a particular health care provider which shows better performance (Berwick et al. 2003). Contandriopoulos et al. (2014) expanded the model with the underlying behavioral theories and proposed that Pathway I is the simplest functional form. Thereby, the revealed measurements are an economic understanding and patients behave rationally. Theoretically, this leads to a Darwinian selection of health care providers.

In Berwick et al.'s (2003) view, Pathway II addresses organizations in health care. It informs the managers to analyze their processes and to initialize performance improvements directly. Further research showed a potential loss of reputation that stimulates quality initiatives (Hibbard et al. 2005). Contandriopoulos et al. (2014) suggested splitting Pathway II in three sub-pathways.

Pathway 2a, "Change Through Managerial Interventions" goes back to a rational image of the human being (Contandriopoulos et al. 2014). The management in health care organizations behaves unemotionally; they monitor activities and invest the resources in the goals and outcomes of the company. The released measurements help to achieve them.

Pathway 2b, "Change Through Social Structuring" picks up the complex functioning of the human being and organization's embedding in society (Contandriopoulos et al. 2014). It describes a neo-institutional understanding. The Neo-Institutionalism views society as a network of values and norms which significantly influence organization's behavior (DiMaggio and Powell 1983).

Consciously or unconsciously, organizations incorporate these conceptions to gain legitimacy and resources which are fundamental to survival (Meyer and Rowan 1977).

Pathway 2c, "Change Through Internal Pressures" mainly stimulates internal groups (Contandriopoulos et al. 2014). Especially health professionals could be concerned about loss of reputation (Hafner et al. 2011).

## Methodology

As already stated, PR is looked at from different angles that can be seen by using a broad field of theories, paradigms, and concepts. Preliminary clarifications showed that MESH-terms are not applicable, which was already mentioned by Totten et al. (2012). Due to lack of unity of terms, the search was derived based on the mentioned keywords in previous reviews and the main terms of the concepts (see Table 1).

**Table 1.** *Search Terms*

| | **Terms** |
|---|---|
| Health care organization | Health care (organization/ industry)/ Health services OR In/Outpatient OR Provider/ Hospital/ Clinic |
| Performance measurement | Performance measure*/ data/ indicator/ outcome/ assessment/ evaluation/ information OR Quality measure*/ data/ indicator/ outcome/ assessment/ evaluation/ information OR Outcome measure*/ data/ indicator/ assessment/ evaluation/ information OR Clinical measure*/ data/ indicator/ outcome/ assessment/ evaluation/ information OR Quality assurance OR Patient satisfaction |
| Public reporting | Public Reporting OR Public Disclosure OR Information Dissemination OR Release of performance data OR Benchmarking OR Mandatory Reporting OR Report/ Score card OR League table OR National quality reporting system OR Performance reporting OR Quality reports OR Comparative performance data OR Quality comparison OR Quality of (health) care reporting OR quality account |
| Consumer behavior | Consumer/ Patient/ Choice/ Purchaser/ Regulatory behavior/ participation OR Consumer/ Patient/ Stakeholder/ Hospital selection OR Decision making OR Market share OR Case number |
| Quality improvement | Quality/ Process improvement/ management/ initiatives OR Organizational/ Executives/ Administrators/ Health professional behavior/ reaction/ response |
| Transparency and Accountability | account* OR transparency OR awareness |

An extended literature search was performed during summer 2020 mainly at the University of St. Gall/Switzerland. Considered databases were: Business Source Ultimate, Emerald, Scopus, Wiso, Econlit, Web of Science, Socindex, and Social Sciences Citation Index. At the Private University for Health Sciences, Medical Informatics and Technology (UMIT), Hall in Tirol/Austria, an expanded

search was conducted on the databases of Medline, Embase, CINAHL, and Cochrane-Library. A supplementary manual search and screening reference lists of important reviews completed the procedure.

Articles published between January 1990 and December 2019 were included. All study types and outcome measures were considered. Only publications in English and German were selected. There were no further search restrictions. A flowchart of the study selection was not presented because completeness was not an explicit goal of this review. Due to heterogeneity of the field and studies, a standardized quality assessment was not applied and not applicable, as e.g., in organization and management no methods assessing studies` quality exist. The organizing framework (see Figure 1) served as base for the subsequent assignment and presentation of the body of knowledge.

## Results

The included studies revealed major differences concerning settings and interventions. Heterogeneity between them was substantial. Regarding Berwick et al.'s (2003) pathways, the vast majority of studies corresponded to Pathway I. There were fewer studies matching Pathway II and its subgroups.

### *Pathway I: Improvement through Selection*

Studies were performed in different settings and particularly in the Anglo-American area. In the last decade, work to this topic appeared also in Continental Europe. Considering different outcomes, there are studies showing inconsistent effects on market share and case numbers (Dunt et al. 2018, Grabowski and Town 2011, Vukovic et al. 2017, Wang et al. 2011). For the assumption that better rated hospitals show an increasing number of cases and bad ones a decreasing, were also found not more than small indications (Pope 2009, Romano et al. 2011, Wübker et al. 2008). Furthermore, there is a range of qualitative studies on the question of awareness of PR and the effects on selection of providers by patients and their relatives. Most of the work showed that only few patients (8-45%) know about an existing publication and a group of patients (28%) is not interested in these (Aryankhesal and Sheldon 2010, Khang et al. 2008, Mazor and Dodd 2009, Patel et al. 2018, Pope 2009, Prang et al. 2018). Younger and better skilled people have more knowledge of it (Khang et al. 2008). But by present, PR does not influence patients` choice of providers essentially (Mazor and Dodd 2009, Merle et al. 2009). The distance to providers (Pope 2009), the influence of family members, relatives, and treating medical doctors (Merle et al. 2009, Schwartz et al. 2005), or own experiences with providers (De Cruppé and Geraedts 2017, de Groot et al. 2011) are factors which have more influence on the decision where the patients finally go for treatment. Another problem is that released information is not always understood (Kang et al. 2009), for example, sections about risk adjustment and confidence intervals seem to be difficult for laymen (Mazor and Dodd 2009).

*Pathway II and its Subgroups: Improvement through Changes in Care*

Studies assigned to *Pathway 2a (Change Through Managerial Interventions)* were numerous (Contandriopoulos et al. 2014). Some quantitative studies investigated the effects of PR of hospitals' (Hibbard et al. 2003, Jang et al. 2011) and long-term care institutions' quality data (Mukamel et al. 2010, Zinn et al. 2010) on their treatment processes. They reported an increase of quality initiatives. Hibbard et al. (2005) and Kraska et al. (2016) found a significant performance improvement of hospitals which took part in a PR compared to none or private reporting. Other studies showed little or no effect of PR on quality activities or performance improvement on provider level (Dahlke et al. 2014, Jang et al. 2011, Ryskina et al. 2018, Yamana et al. 2018). Systematic reviews demonstrated mostly consistent evidence. PR stimulates quality improvement on provider level but not on individual level of a single health professional (Campanella et al. 2016, Fung et al. 2008, Ketelaar et al. 2011). Qualitative research studied the perception, attitude, acceptance, and activities of quality management towards existing or planed PR of executives and administrative staff. Some studies showed that a considerable proportion of those were not aware of an existing program (Greenhalgh et al. 2014, Waelli et al. 2016). Further, hospital leaders expressed negative attitudes and resistances against some parts of the reports (Lindenauer et al. 2014, Mannion et al. 2005, Reeves and Seccombe 2008). On the other side, there are studies which demonstrated that certain aspects of the reports are meaningful, interorganizational dissemination occurs, launch of quality initiatives takes place, or improvements were reported (Barr et al. 2006, Castle 2005, Chassin 2002, Hafner et al. 2011, Laschober et al. 2007, Mukamel et al. 2007, Vallance et al. 2018). In this regard leadership skills were emphasized (Guerrero et al. 2016).

Few studies used a *neo-institutional understanding of PR (Pathway 2b)* (Contandriopoulos et al. 2014). Chang (2006) showed that external factors are key requirements for change processes. Thereby, receipt of legitimacy and resources from politics and society are central. This was confirmed by Nielsen and Riiskjær (2013), who said that the released data have a diagnostic aspect and on the other hand external forces are necessary to stimulate change. Monteduro (2017) concluded that the size of an organization has an influence on visibility in the public and raises the pressure to deal with the data to increase legitimacy from stakeholders. But, the presence of external rankings and equally the missing of meaningful reporting for providers could subvert management's responsibility to improve (Rasche and Gilbert 2015).

*Pathway 2c (Change Through Internal Pressures)* was also rarely focused (Contandriopoulos et al. 2014). One study found that different experts showed significant variability in the interpretation of PR metrics, especially risk adjustment seems to be difficult (Govindan et al. 2017). Further, immaturity of PR was criticized by medical directors and therefore clinicians should be involved in development of measurements to make them more meaningful for the stakeholders (Canaway et al. 2018). Moreover, cardiologists had more trust in a not publicized vs. published program (Morrison et al. 2019). Last but not least, PR

triggered reputational concerns and focus check in the definition of hospitals' objectives (Hibbard et al. 2005, Hafner et al. 2011).

## Discussion

This study categorizes research in the field of PR considering a review format from management, organizational behavior, or sociology. A comprehensive literature search in relevant databases along common keywords found lots of different studies. They showed the heterogeneity in the current literature to the topic of PR.

Studies assigned to *Pathway I (Improvement Through Selection)* are in the forefront, but quality improvements are rare (Berwick et al. 2003). Patients often do not know about an existing PR and orientate much more on own experiences, recommendations of relatives, and referring physicians (Merle et al. 2009, Schwartz et al. 2005). For the underlaying theory that patients behave rationally, only small indications can be found. Possible interpretations for that are the regulated health market, the information asymmetry in the system, and the complexity of the reports and system itself (Berwick et al. 2003, Govindan et al. 2017). Like Contandriopoulos et al. (2014), authors emphasize that Pathway I does not seem to be the most promising way to explore, explain, and hope for positive effects of PR.

Hence, there is more hope in Berwick et al.'s (2003) *Pathway II (Improvement Through Changes in Care)*. Looking at the framework, the simplest functioning form is the rational behavior of the management in "Change Through Managerial Interventions" (Contandriopoulos et al. 2014). Qualitative studies showed that a considerable proportion of managers in health care organizations are not aware of an existing PR program (Waelli et al. 2016). Furthermore, systematic reviews followed that PR promoted only somewhat patient outcomes (Ketelaar et al. 2011, Metcalfe et al. 2018). In this view, PR is minimized to a mechanistic and pure rational tool that could inform provider's management to better assure that scarce resources would be allocated in all conscience. Rindova et al. (2018) call this perspective "information mediation". But indeed, it seems that managers – like patients – do not behave rationally.

Discussion to the other subgroups of PR is hard to carry out. There is a large gap between literature with and without theoretical basis. The early studies – these are the majority – performed within medical disciplines and are mostly atheoretical. In past studies, the linear, rationalistic, and atheoretical thinking, together with narrow inspection, do not adequately show the broadness of the phenomena. Theoretically, a more realistic understanding and social anchoring of PR would be promising. Nowadays, there are few studies which consider sociological theories and would correspond to "Change Through Social Structuring" (Contandriopoulos et al. 2014). The neo-institutional view emerged out of the pure economic and rational ones. Socially constructed values and norms influence the behavior of organizations (DiMaggio and Powell 1983). To gain legitimacy and resources, it is necessary that health care organizations do what the

public is expecting (Meyer & Rowan 1977). So, PR exercises a stimulus effect on the behavior of organizations. Something similar could be assumed for "Change Through Internal Pressures" on health professionals' level (Contandriopoulos et al. 2014). Potential loss of reputation is thereby relevant (Hafner et al. 2011, Hibbard et al. 2005). But even looking at PR from a different perspective, many questions remain. It seems that organizations and professionals do have design spaces and are not completely dependent from their environment. This would correspond to the strategic choice theory (Child 1972). Under this aspect, evidence on reactions to PR could be seen more as continuum and multifaceted. For example, PR demonstrated more benefit when markets are competitive and measured baseline performance is low (OECD and WHO 2019). But, as a tool toward quality improvement and fulfilling demanding expectations, PR should be able to do more. Most countries in the industrialized world have several initiatives, measure various indicators at different levels, and address varying target audiences (OECD and WHO 2019). Investments in PR seem to outweigh its benefit (Blanchfield et al. 2018, Carpenter-Hubin and Crisan-Vandeborne 2016). For this discrepancy, Brunsson (2006) names "Mechanisms of Hope" to establish rational organizations to be key drivers for such initiatives. Hope that continued efforts with the same approach will bring the intended benefit (Watzlawick 1993). But, decision-making and cognitive processing research revealed that rationality in health care is difficult to perform (Djulbegovic and Elqayam 2017). However, this does not imply a negative conclusion for PR. Authors see the findings out of this review not as final and much more as part of a learning process to better understand that complex interventions in complex environments, such as PR in health care, need to be looked at in a different manner. So, following implications for health policy and recommendations for further research could be made.

*Implications for Health Policy*

The authors conclude that PR initiatives were developed to the best knowledge and belief. Nevertheless, it is recommended to see engagement in PR in the longer term and reviewing it constantly for fine-tuning (OECD and WHO 2019). Ongoing efforts are necessary to improve benefit for specific target groups, for example, patients or providers. Adaption of reporting programs to specific expectations and needs would be advisable (Canaway et al. 2018, Shuker et al. 2018). Therefore, patients and providers should be involved when developing reporting schemes. PR that functions like a panacea is not realistic.

*Recommendations for Further Research*

This study showed that phenomena in health care are studied within different disciplines. As a result, the range of methods is huge and studies' validity could be criticized upon researcher's perspective (Kuhn 2012). Recognition of complexity and acceptance of diversity in the field of health care should be drivers for a broader view and strategy to overcome these problems. Therefore, research in PR should take increased notice of underlying human behavior and organizational theories. Regarding the stimulus potential, further research in PR should consider embedding in society. Then, "the relationship between evidence and policy is complex and not a rational, linear one" (Hunter 2016). Furthermore, the context of PR initiatives and the mechanisms behind it should increasingly be focused when studying effects of PR (Pawson et al. 2005, Totten et al. 2012).

*Strength and Limitations*

The new and contribution to the body of knowledge is the conducted review format applied to the topic of PR. It tried to organize and summarize the literature with a realist view (Pawson et al. 2005). It represents a move away from one-size-fits-all methods opening the eyes to a realer world view and addressing improvements for PR as policy strategy.

However, this review has several limitations to notice. Standardized keywords and definitions in the field of PR do not exist. The multifaceted approach within several disciplines made it impossible to conduct a classical systematic review how it is used, for example, in medical or nursing sciences. By contrast, for scholars in management or sociological sciences the used review format conforms to the usual approach. An existing conceptual framework served as basis for studies' allocation. Unfortunately, theoretical anchoring was not reported equally in all included work. Finally, the conducted review method lets room for interpretation and is not as clear as systematic ones (Pawson et al. 2005).

## Conclusions

This review suggests that PR is a popular topic in different academic fields and in health care policy. Despite of its high use, PR often does not show its full potential. Pure rational approaches to describe the effect of PR fall short. Further research should strive to do better by paying more attention to the breadth, theories, and context of the field as well as collaborative solution-finding between academia, policy, and practice.

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*Athens Journal of Health & Medical Sciences - Volume 9, Issue 4,*
*December 2022 – Pages 229-244*

# Identifying the Well-suited Chinese Herbal Products for Hepatocellular Carcinoma (HCC) Patients in Terms of Hazard Ratio and Child-Pugh Score Improvement: A Frequentist Statistical Analysis Applying 'Netmeta'

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*Hepatocellular carcinoma (HCC) causes high mortality and global burden. In addition to the conventional western treatments, HCC patients are actively seeking adjuvant therapies, such as traditional Chinese medicine (TCM), hoping to improve treatment outcomes and prolong survival. Until 2021, only two network meta-analyses (NMAs) compare different HCC treatments, which, however, did not compare all forms of TCM formulations, and there is no evidence informing which TCM works best for an outcome. This frequentist NMA, conducted with R (version 4.0.2) under the random-effect model, ranks all TCM integrative treatments by P-scores with its 'netmeta' package for two outcomes, survival (hazard ratio) and Child-Pugh score improvement (odds ratio). There are 289 RCTs retrieved from literature screening for NMA. For survival, the combination of Buxu Huadu decoction and Jinshuibao capsule ranks first overall (P-score 0.9745, HR 0.1962). Fugan injection is the best TCM injection (P-score 0.9809, HR 0.3051). Shugan Huazhuo decoction (P-score 0.9448, HR 0.3728) and Peiyuan Guben capsule (P-score 0.9677, HR 0.2946) are the best decoction and product for oral administration respectively. Aidi injection ranks first in Child-Pugh score improvement (P-score 0.7539, OR 4.3429). This NMA guides clinical decision making in all kinds of settings. Multi-centered RCTs are warranted for further verification.*

**Keywords:** *traditional Chinese medicine (TCM), hepatocellular carcinoma (HCC), network meta-analysis (NMA), adjuvant treatments, frequentist statistical analysis*

## Introduction

Ranking top ten of prevalent type of cancers in the world, liver cancer has imposed enormous burden globally with a high mortality rate. Hepatocellular carcinoma (HCC), accounting for 90 % of the liver cancers, contributes to the high mortality rate and global burden. According to the Barcelona-Clínic Liver Cancer (BCLC) staging system, HCC can be stratified into 5 stages of severity according to the size of tumor and liver function (Child - Pugh classification). Most HCC patients are diagnosed late so they miss the optimal opportunity for hepatic resection. They have been actively seeking alternative treatments (e.g., traditional Chinese medicine) to enhance the efficacy of conventional therapies in the hope of prolonging survival and improving treatment outcomes. Network meta-analysis (NMA), with the main feature of combining direct and indirect evidence from multiple RCTs that compares multiple TCM-integrative treatments/interventions, can better direct decision-making than the pairwise meta-analysis (Salanti 2012, White 2015). Until 2021, there are two studies of this kind comparing TCM injections and different

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HCC treatments. Chen et al. (2019) compared 5 different treatments in treating advanced HCC patients including sorafenib, transarterial chemoembolization (TACE), sorafenib + TACE, TACE + TCM, and sorafenib + hepatic arterial infusion chemotherapy (HAIC). They reported that TACE + TCM exhibits the best treatment response in advanced HCC patients. On the other hand, Dou et al. (2020) compared the effectiveness of Aidi injection, compound Kushen injection, and Kanglaite injection as adjuvant treatments to systemic chemotherapy for HCC patients and reported that Kanglaite injection outweighs the other two products in tumor response. However, there is still no evidence assessing all forms of TCM formulations and informing which one works best for each defined outcome. To fill the knowledge gaps, the objective of this study is to rank all forms of TCM formulations/products for two outcomes, long-term efficacy (survival) and the improvement in hepatic function (Child-Pugh score), aiming to produce comprehensive evidence to inform clinical decision making for TCM practitioners in HCC adjuvant treatments.

The introduction defines the research question of this paper. The second section of the paper includes a literature review on TCM as HCC adjuvant treatments. The third section details the methodology applied in this study. The fourth section provides reporting and interpretation of results. The fifth section discusses the research findings and explores the strengths and limitations of this NMA. The final section of this paper conveys a conclusion of this study.

## Literature Review

Conventional treatments (CT), as defined by the National Cancer Institute in USA, are the standard treatments widely adopted by healthcare professionals (National Cancer Institute n.d.). Though popular as they are, applications of western conventional treatments come with underlying limitations and restrictions that they are not perfectly suited for all kinds of HCC patients. Therefore, the EASL clinical guideline strongly encourages clinical trials of adjuvant therapies for HCC treatments (European Association for the Study of the Liver 2018). Traditional Chinese medicine (TCM) is the most common type of complementary and alternative medicine (CAM) being applied as adjuvant therapy for cancer (Chen et al. 2008, Xiang et al. 2019). By the theory of TCM, illness is caused by the imbalance of Yin and Yang so TCM aims to correct the "internal disequilibrium" that would lead to the development and progression of tumor (Xi and Minuk 2018, Xiang et al. 2019). Xi and Minuk (2018) and Liao et al. (2020) reviewed the ten most frequently prescribed herbs in the treatment of HCC, namely, Fuling, Baizhu, Huangqi, Baihuasheshecao, Gancao, Chaihu, Dangshen, Baishao, Danggui and Biejia. TCM herbs attenuate the adverse reactions of chemotherapeutics and improve quality of life in HCC patients (Xi and Minuk 2018). TCM practice relies heavily on recommendations and personal experience of TCM practitioners rather than on randomized-controlled clinical trials (Fung and Linn 2015, Liao et al. 2020, Xi and Minuk 2018). TCM modernization is a process involves transforming long-accumulated personal experiences in clinical practice into well-

documented evidence-based medicine (Guo et al. 2012). To boost TCM modernization, researchers strive to back up TCM theory with solid scientific evidence in academia (Fang et al. 2020, Liu et al. 2019a, Zhong et al. 2018). Scientific evidence synthesized through collaborative efforts supports TCM modernization with contemporary interpretations to traditional theories and knowledge.

Research in TCM efficacy should be prioritized in the process of modernization in order to declare its clinical value (Guo et al. 2012). While clinical trials aim to evaluate the efficacies of TCM-integrative treatments with the CT-only control group (Huang et al. 2013, Zhang et al. 2019, Zhong et al. 2014), meta-analyses pool together different clinical studies to determine the advantages of TCM-integrative treatment groups over the CT-only control groups. The head-to-head comparisons in Chinese, e.g., Cao et al. (2017), Li et al. (2018), Wang et al. (2016), and English languages, e.g., Jia et al. (2020), Liu et al. (2019b), Ma et al. (2017), Meng et al. (2008), Meng et al. (2011), Shen et al. (2017), Shi et al. (2017), Shu et al. (2005), Wu et al. (2009), Xu et al. (2020), Yang et al. (2017), Yao et al. (2019), show that the combination of TCM and CT leads to positive treatment outcomes. The two recent NMAs set off the research question for this study. TCM formulations have been developed into various dosage forms, including oral, intravenous, and external administration (Lin et al. 2011). Capsules and decoction, which are frequently adopted in the treatment of liver diseases (Zhao et al. 2014), have not been investigated by the previous network meta-analyses. Therefore, by filling the research gaps, the present study produces the latest evidence to inform clinical decision making for TCM prescription in HCC therapy.

## Methodology

### *Study Selection and Effect Estimates*

The study is designed and carried out in accordance with the principle of frequentist NMA approach and the PRISMA-NMA statement (Hutton et al. 2015, Seide et al. 2020). Electronic search is conducted since inception in six bibliographic databases, namely, CNKI (China National Knowledge Infrastructure), Wanfang, ScienceDirect, PubMed, Medline and Web of Science using a pre-specified search strategy. The last search was conducted in November 2020. The selection process is conducted in compliance with the PRISMA 2009 Flow Diagram (Moher et al. 2009). The NMA will be feasible when there are at least 10 included studies retrieved by articles screening. Otherwise, the studies will be summarized by a systematic review. Randomized controlled clinical trials (RCTs) with HCC patients as the participants, TCM with western treatments (TCM + WT) in the intervention groups and WT only in the control groups, as well as outcome parameters measuring overall survival and improvement of hepatic function (Child-Pugh score) are included in this network meta-analysis.

Hazard is an instantaneous event rate at an exact time for a group of patients; hazard ratio measures the proportion of hazards between two groups (Zwiener et al. 2011). The event is defined as death in the survival analysis in the present study. Survival analysis investigates time-to-event data from the starting point of study to the time of event occurrence (Kartsonaki 2016). Survival data, including numbers, rates, as well as the datasets in the Kaplan-Meier curves are reconstructed into values to be measured by hazard ratio by applying the formulas proposed by Tierney et al. (2007) and using the WebPlotDigitizer software.

The Child-Pugh score, which is closely related to survival, is applied to evaluate liver functions. It has been incorporated into BCLC staging system to guide the selection of treatments (Hung et al. 2014). The Child-Pugh scoring system stratifies the liver function into 3 levels according to the points measured by the clinical and laboratory criteria. Improvement of Child-Pugh score includes progression from grade B to grade A, from grade C to grade B, and it also includes direct promotion from grade C to grade A. Data regarding improvement in hepatic function can be extracted directly from RCT reports by recording the numbers of patients in both arms experiencing improvement in Child-Pugh score, which is measured in odds ratio.

*Network Meta-Analysis with R*

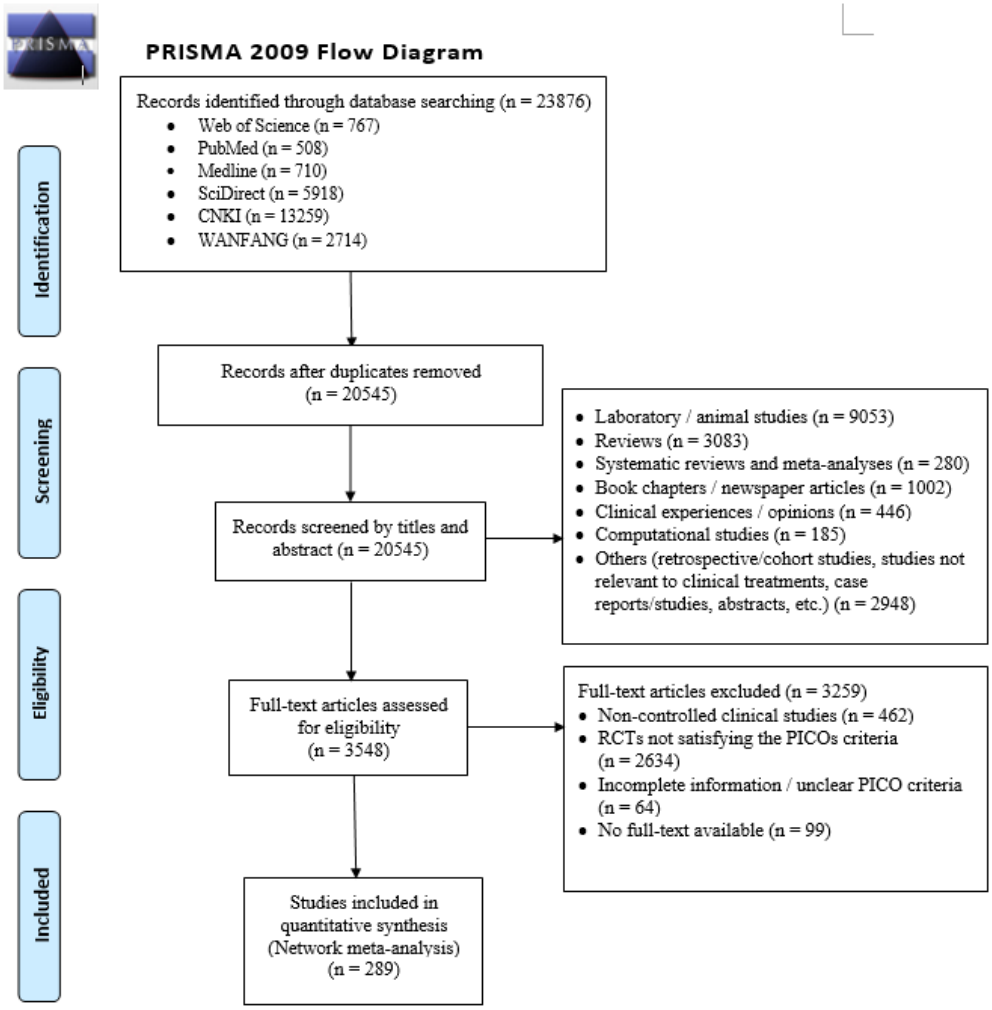
The NMA and relevant statistical analyses are conducted with R (version 4.0.2) by referring to the Cochrane Handbook for Systematic Reviews of Interventions (second edition) (Harrer et al. 2019, Higgins et al. 2020). This NMA is conducted in a frequentist approach by the 'netmeta' function from the 'netmeta' package in R. P-scores, which are generated by the 'netrank' function, can rank the TCM-integrative treatments according to their treatment performance. Larger P-score indicates higher rank among all treatments, i.e., P-score at 100% represents the best treatment without uncertainty (Veroniki et al. 2018). To indicate whether small effect sizes indicate a 'good' or 'bad' effect by specifying the 'small. values' parameter, the output provides the answer to the question regarding the best intervention. In order to look at the ranking of TCM-integrative treatments according to different forms of formulations, the treatments are subdivided into 4 subgroups, namely, decoctions, injections, products for oral administration and mixed formulations/external applications. NMA is conducted for each of the subgroups. Statistical tests, such as Kruskal-Wallis test, is conducted by applying the 'kruskal.test' function to the effect sizes by subgroups to identify any statistical difference in effect sizes among the subgroups. When there are subgroups differences ($p < 0.05$), a post-hoc test, such as Dunn's test, is applied to pinpoint the significantly different pairs. Sensitivity analysis is conducted by leaving out studies of certain characteristics from the model. Egger's regression test is performed with the 'regtest' function from the 'metafor' package to assess the publication bias of the included studies. It provides statistical evidence for potential publication bias (Viechtbauer 2010). The funnel plot asymmetry resulting from publication bias is corrected by the trim-and-fill method (Duval and Tweedie 2000).

## Results

### *Articles Screening*

As illustrated by the PRISMA 2009 Flow Diagram (Figure 1), 289 RCTs were retrieved from a total of 23876 records for NMA, wherein 283 RCTs reporting survival outcome and 10 studies reporting improvement in Child - Pugh score.

**Figure 1.** *The PRISMA 2009 Flow Diagram for Articles Screening*




### *Data Analyses*

<u>Survival Analysis by Subgroups</u>

The RCTs for survival analysis are subdivided into 4 subgroups, i.e., decoctions (n=127), injections (n=90), products for oral administration (n=51), mixed formulations/external applications (n=15). Table 1 shows the top 5 ranks of interventions for each of the subgroups. Shugan Huazhuo decoction with western treatment (SGHZd + WT) ranks first among all TCM decoctions (P-score 0.9448,

HR 0.3728). Fugan injection with western treatment (FGi + WT) ranks top among all TCM injections (P-score 0.9809, HR 0.3051). Peiyuan Guben capsule with western treatment (PYGBc + WT) attains the highest P-score among all TCM products for oral administration (P-score 0.9677, HR 0.2946). Lastly, the integrative therapy of Buxu Huadu decoction, Jinshuibao capsule and western treatment (BXHDd + JSBc + WT) ranks first among the mixed formulations or external applications (P-score 0.9884, HR 0.1962). Kruskal-Wallis rank sum test in Table 2 shows that no significant difference in effect sizes is observed between the subgroups ($p>0.05$).

**Table 1.** *Survival Analysis by Subgroups and the Top 5 Ranks of Products / Formulations*

| Subgroups | Rank | TCM-integrative interventions | P-score (random) | HR | 95%-CI |
|---|---|---|---|---|---|
| Decoctions (n=127) | 1 | SGHZd + WT | 0.9448 | 0.3728 | [0.2556; 0.5438] |
| | 2 | SGJPHWd + WT | 0.9362 | 0.3573 | [0.2104; 0.6066] |
| | 3 | PWXLd + WT | 0.8866 | 0.4465 | [0.3491; 0.5710] |
| | 4 | YQHYJDd + WT | 0.8814 | 0.4227 | [0.2690; 0.6644] |
| | 5 | XCHd + WT | 0.8739 | 0.4365 | [0.2926; 0.6513] |
| Injections (n=90) | 1 | FGi + WT | 0.9809 | 0.3051 | [0.1950; 0.4775] |
| | 2 | SQFZi + WT | 0.8763 | 0.4518 | [0.3505; 0.5823] |
| | 3 | AC-IIIi + WT | 0.8287 | 0.4561 | [0.2741; 0.7590] |
| | 4 | EYDZYi + WT | 0.8161 | 0.479 | [0.3171; 0.7235] |
| | 5 | HCSi + SMi + WT | 0.7821 | 0.5008 | [0.3289; 0.7625] |
| Products for oral administration (n=51) | 1 | PYGBc + WT | 0.9677 | 0.2946 | [0.1692; 0.5129] |
| | 2 | SQc + WT | 0.9068 | 0.3829 | [0.2404; 0.6099] |
| | 3 | YGKAp + WT | 0.8881 | 0.4003 | [0.2509; 0.6388] |
| | 4 | LZBZp + WT | 0.8523 | 0.4145 | [0.2316; 0.7416] |
| | 5 | AT3c + WT | 0.7673 | 0.4955 | [0.3191; 0.7695] |
| Mixed formulations / external applications (n=15) | 1 | BXHDd + JSBc + WT | 0.9884 | 0.1962 | [0.0748; 0.5148] |
| | 2 | FYHXd + HJp + WT | 0.9047 | 0.4569 | [0.3967; 0.5261] |
| | 3 | BJJp + ADi + WT | 0.8559 | 0.482 | [0.3860; 0.6018] |
| | 4 | YQo + WT | 0.7438 | 0.545 | [0.4517; 0.6576] |
| | 5 | HGXZd + SJXTo + WT | 0.6955 | 0.5689 | [0.4812; 0.6727] |

Abbreviations: SGHZd, Shugan Huazhuo decoction; SGJPHWd, Shugan Jianpi Hewei decoction; PWXLd, Pingwei Xiaoliu decoction; YQHYJDd, Yiqi Huayu Jiedu decoction; XCHd, Xiaochaihu decoction; FGi, Fugan injection; SQFZi, Shenqi Fuzheng injection; AC-IIIi, AC-III injection; EYDZYi, emulsified Yadanziyou injection; HCSi, Huachansu injection; SMi, Shengmai injection; PYGBc, Peiyuan Guben capsule; SQc, Sanqi capsule; YGKAp, Yanggan Kangai pill; LZBZp, Lingzhi Baozi powder; AT3c, AT3 capsule; BXHDd, Buxu Huadu decoction; JSBc, Jinshuibao capsule; FYHXd, Fuyuan Huoxue decoction; HJp, Huaji pill; BJJp, Biejiajian pill; ADi, Aidi injection; YQo, Yangqi ointment; HGXZd, Hugan Xiaozheng decoction; SJXTo, Sanjie Xiaotong ointment; WT, western treatments.

**Table 2.** *Kruskal-Wallis Rank Sum Test for the Statistical Difference Between Subgroups*

| Kruskal-Wallis rank sum test | | |
|---|---|---|
| **Kruskal - Wallis chi-squared** | **df** | **p-value** |
| 0.61235 | 3 | 0.8936 |

Sensitivity Analysis of Survival Outcome

Sensitiviy analysis is conducted by removing studies of certain characteristics. (Table 3). The integrative therapy of Buxu Huadu decoction, Jinshuibao capsule and western treatment (BXHDd + JSBc + WT) ranks first overall (P-score 0.9745, HR 0.1962), and when formulations without names, decoctions, injections and products for oral administration are respectively removed. Fugan injection with western treatment (FGi + WT) ranks first when studies involving more than 1 TCM as well as studies involving mixed formulations/external applications are removed respectively. The results of sensitivity analysis show that the model of this network meta-analysis is robust.

**Table 3.** *Sensitivity Analysis and the Effects on Top 5 Ranks of TCM-integrative Interventions in Survival Outcome*

| **Selection criteria** | **Rank** | **TCM-integrative interventions** | **P-score (random)** | **HR** | **95%-CI** |
|---|---|---|---|---|---|
| All studies | 1 | BXHDd + JSBc + WT | 0.9745 | 0.1962 | [0.0705; 0.5464] |
| | 2 | FGi + WT | 0.9673 | 0.3051 | [0.1923; 0.4842] |
| | 3 | PYGBc + WT | 0.9665 | 0.2946 | [0.1722; 0.5039] |
| | 4 | SGHZd + WT | 0.9333 | 0.3728 | [0.2601; 0.5344] |
| | 5 | SGJPHWd + WT | 0.9259 | 0.3573 | [0.2130; 0.5992] |
| Removing formulations without names (n=14) | 1 | BXHDd + JSBc + WT | 0.9739 | 0.1962 | [0.0705; 0.5464] |
| | 2 | FGi + WT | 0.9663 | 0.3051 | [0.1923; 0.4842] |
| | 3 | PYGBc + WT | 0.9655 | 0.2946 | [0.1722; 0.5039] |
| | 4 | SGHZd + WT | 0.9316 | 0.3728 | [0.2601; 0.5344] |
| | 5 | SGJPHWd + WT | 0.9239 | 0.3573 | [0.2130; 0.5992] |
| Removing studies involving more than 1 TCM (n=27) | 1 | FGi + WT | 0.9689 | 0.3051 | [0.1904; 0.4889] |
| | 2 | PYGBc + WT | 0.9682 | 0.2946 | [0.1708; 0.5082] |
| | 3 | SGHZd + WT | 0.9332 | 0.3728 | [0.2569; 0.5410] |
| | 4 | SGJPHWd + WT | 0.9261 | 0.3573 | [0.2112; 0.6044] |
| | 5 | SQc + WT | 0.9130 | 0.3829 | [0.2431; 0.6031] |
| Removing studies involving decoctions only (n=127) | 1 | BXHDd + JSBc + WT | 0.9726 | 0.1962 | [0.0707; 0.5447] |
| | 2 | FGi + WT | 0.9601 | 0.3051 | [0.1936; 0.4809] |
| | 3 | PYGBc + WT | 0.9601 | 0.2946 | [0.1732; 0.5010] |
| | 4 | SQc + WT | 0.9046 | 0.3829 | [0.2473; 0.5929] |
| | 5 | YGKAp + WT | 0.8869 | 0.4003 | [0.2580; 0.6211] |
| Removing studies involving injections only (n=90) | 1 | BXHDd + JSBc + WT | 0.9740 | 0.1962 | [0.0700; 0.5503] |
| | 2 | PYGBc + WT | 0.9654 | 0.2946 | [0.1699; 0.5108] |
| | 3 | SGHZd + WT | 0.9308 | 0.3728 | [0.2549; 0.5451] |
| | 4 | SGJPHWd + WT | 0.9234 | 0.3573 | [0.2100; 0.6077] |
| | 5 | SQc + WT | 0.9104 | 0.3829 | [0.2415; 0.6069] |
| Removing studies involving products for oral | 1 | BXHDd + JSBc + WT | 0.9761 | 0.1962 | [0.0706; 0.5456] |
| | 2 | FGi + WT | 0.9708 | 0.3051 | [0.1929; 0.4826] |
| | 3 | SGHZd + WT | 0.9385 | 0.3728 | [0.2612; 0.5321] |
| | 4 | SGJPHWd + WT | 0.9303 | 0.3573 | [0.2136; 0.5974] |

| | | | | | |
|---|---|---|---|---|---|
| administration only (n=51) | 5 | PWXLd + WT | 0.8781 | 0.4479 | [0.3542; 0.5663] |
| Removing studies involving mixed formulations / external applications (n=15) | 1 | FGi + WT | 0.9710 | 0.3051 | [0.1923; 0.4842] |
| | 2 | PYGBc + WT | 0.9702 | 0.2946 | [0.1722; 0.5039] |
| | 3 | SGHZd + WT | 0.9370 | 0.3728 | [0.2601; 0.5344] |
| | 4 | SGJPHWd + WT | 0.9295 | 0.3573 | [0.2130; 0.5992] |
| | 5 | SQc + WT | 0.9171 | 0.3829 | [0.2455; 0.5971] |

Abbreviations: BXHDd, Buxu Huadu decoction; JSBc, Jinshuibao capsule; FGi, Fugan injection; PYGBc, Peiyuan Guben capsule; SGHZd, Shugan Huazhuo decoction; SGJPHWd, Shugan Jianpi Hewei decoction; SQc, Sanqi capsule; YGKAp, Yanggan Kangai pill; PWXLd, Pingwei Xiaoliu decoction; WT, western treatments.

Hepatic Function in Child - Pugh Score

Table 4 shows the P-scores of TCM-integrative interventions along with odds ratio and 95% confidence intervals. Aidi injection + western treatment (ADi + WT) has the highest P-score (0.7539) among all other treatments, with the odds ratio of 4.3429 [1.0240; 18.4185]. It can be inferred that patients on this integrative therapy are more than 4 times more likely to improve in Child - Pugh scores.

**Table 4.** *P-scores of TCM-integrative Interventions in Child-Pugh Score Improvement*

| **TCM-integrative interventions** | **P-score (random)** | **OR** | **95%-CI** |
|---|---|---|---|
| ADi + WT | 0.7539 | 4.3429 | [1.0240; 18.4185] |
| SYc + WT | 0.7383 | 4.1912 | [0.9217; 19.0580] |
| JLc + WT | 0.7114 | 3.6233 | [1.2522; 10.4838] |
| STRGd + WT | 0.5100 | 2.2500 | [0.3075; 16.4615] |
| JDFZY + WT | 0.4042 | 1.6800 | [0.3355; 8.4138] |
| QGJDSJd + WT | 0.3919 | 1.6276 | [0.3338; 7.9352] |
| CKSi + WT | 0.3455 | 1.4919 | [0.5894; 3.7764] |
| WT | 0.1447 | / | / |

Abbreviations: ADi, Aidi injection; SYc, Shenyi capsule; JLc, Jinlong capsule; STRGd, Shentao Ruangan decoction; JDFZY, Jiedu Fuzhengyin; QGJDSJd, Qinggan Jiedusanjie decoction; CKSi, Compound Kushen injection; WT, western treatments.

Publication Bias

The publication bias of the included studies is assessed through Egger's regression test. Table 5 reports the results of Egger's regression test for the studies of survival outcome along with numbers of studies, z-values and p-values. No publication bias is observed among the included studies ($p>0.05$).

**Table 5.** *Egger's Regression Test for Pairwise Interventions of Survival Outcome*

| Interventions | Number of studies | Egger's regression test | | |
|---|---|---|---|---|
| | | z | p | Predictor |
| ADi + WT | 19 | -1.1772 | 0.2391 | Sampling variance |
| CBMc + WT | 4 | -0.8695 | 0.3846 | Sampling variance |
| CKSi + WT | 17 | -0.5184 | 0.6042 | Sampling variance |
| ELEi + WT | 4 | -0.6379 | 0.5235 | Sampling variance |
| EYDZY + WT | 3 | 0.0528 | 0.9579 | Sampling variance |
| FZJDd + WT | 3 | -1.0602 | 0.2891 | Sampling variance |
| GFLt + WT | 3 | -0.0908 | 0.9277 | Sampling variance |
| HCSi + WT | 12 | 1.6221 | 0.1048 | Sampling variance |
| Hg + WT | 3 | -0.3061 | 0.7596 | Sampling variance |
| JDXZY + FZYLd + WT | 3 | -0.6665 | 0.5051 | Sampling variance |
| JLc + WT | 3 | 0.2131 | 0.8312 | Sampling variance |
| JPHYd + WT | 5 | -0.5397 | 0.5894 | Sampling variance |
| JPLQd + WT | 4 | -0.5521 | 0.5809 | Sampling variance |
| KLTi + WT | 7 | -0.8407 | 0.4005 | Sampling variance |
| PWXLd + WT | 3 | -1.0682 | 0.2854 | Sampling variance |
| SGJPd + WT | 3 | -0.5557 | 0.5784 | Sampling variance |
| SGJPXJd + WT | 7 | -0.0668 | 0.9467 | Sampling variance |
| SJZd + WT | 5 | 0.1045 | 0.9168 | Sampling variance |
| SYc + WT | 4 | -1.7176 | 0.0859 | Sampling variance |
| TACE(WT + BJp) | 5 | -0.3749 | 0.7077 | Sampling variance |
| ZGHZd + WT | 3 | 0.0242 | 0.9807 | Sampling variance |

Abbreviations: ADi, Aidi injection; CBMc, Compound Banmao capsules; CKSi, Compound Kushen injection; ELEi, Elemene injection; EYDZY, emulsified Yadanziyou; FZJDd, Fuzheng Jiedu decoction; GFLt, Ganfule tablet; HCSi, Huachansu injection; Hg, Huaier granule; JDXZY, Jiedu Xiaozhengyin; FZYLd, Fuzheng Yiliu decoction; JLc, Jinlong capsule; JPHYd, Jianpi Huayu decoction; JPLQd, Jianpi Liqi decoction; KLTi, Kanglaite injection; PWXLd, Pingwei Xiaoliu decoction; SGJPd, Shugan Jianpi decoction; SGJPXJd, Shugan Jianpi Xiaoji decoction; SJZd, Sijunzi decoction; SYc, Shenyi capsule; TACE, transarterial chemoembolization; BJp, Baiji power; ZGHZd, Zhenggan Huazheng decoction; WT, western treatments.

For the outcome of Child - Pugh score improvement, Egger's regression test is conducted for the only one intervention, Compound Kushen injection with western treatment (CKSi + WT) (Table 6). No publication bias is observed among the studies ($p>0.05$).

**Table 6.** *Egger's Regression Test for Pairwise Intervention of Improved Child-Pugh Score*

| Interventions | Number of studies | Egger's regression test | | |
|---|---|---|---|---|
| | | z | p | Predictor |
| CKSi + WT | 3 | -0.3482 | 0.7277 | Sampling variance |

Abbreviations: CKSi, Compound Kushen injection; WT, western treatments.

## Discussion

*Research Findings of Survival in Terms of Hazard Ratio*

In survival analysis, the mixed formulation of Buxu Huadu decoction, Jinshuibao capsule and western treatment (BXHDd+JSBc+WT) ranks first among all treatments, even when formulations without names, decoctions, injections and products for oral administration are removed from the network meta-analysis model. Fugan injection is the best injection overall and its combination with western treatment (FGi + WT) is the best therapy even when multi-TCM treatments and mixed formulations are removed. Kruskal-Wallis rank sum test indicated that no statistical difference in effect sizes is found between the subgroups (decoctions, injections, oral products, and mixed formulations), implying that their effect sizes are similar and no single subgroup dominating the others in terms of hazard ratio. As shown by the sensitivity analysis, the network meta-analysis model is robust; removing some studies from the model does not result in major adjustment in P-scores, and hence the ranking.

*Research Findings of Child - Pugh Score Improvement in Terms of Odds Ratio*

The result in Child - Pugh score improvement of this NMA conincides with the finding reported by Chen et al. (2018) that the combination of Aidi injection with TACE can significantly improve the liver function of HCC patients in comparison with TACE alone. As there are only 10 included RCTs for this outcome, sensitivity and subgroup analyses were not conducted. Publication bias is not observed among the included studies as shown by the Egger's regression test.

*Contradiction with Previous Studies*

On the other hand, the NMA conducted by Dou et al. (2020), which included only 20 RCTs retrieved from 7 databases, was run by a Bayesian fixed-effect model with treatments being ranked by SUCRA scores. They reported that Kanglaite injection has better performance than Aidi injection and compound Kushen injection in tumor response when combining with systemic chemotherapy. However, Kanglaite injection in this study, with no publication bias, is not among the top ranks in survival outcome. This is somehow contradictory to their results since tumor response is closely related to survival.

*Research Significance*

Comprising of thorough literature screening and statistical NMA, this study, for the first time, compares all formulations of TCM applied as adjuvant HCC therapies. In addition, it attempts to explore the comparative efficacies of TCM treatments through data reconstruction from a variety of raw data. In the absence of publication bias among the included studies, the ranking of TCM-integrative interventions guides the rational use of TCM in different clinical settings.

*Research Limitations*

In spite of the research significance, this study does come with a number of limitations. Net effects, which estimate the effects that each intervention being able to produce a certain level of outcome by itself, are not measured exactly in this study (Ragin n.d.). Each of the TCM interventions exerts different weights in each study, which are undetermined in RCT reports. By the nature of NMA (Li et al. 2011), this study analyzes both direct and indirect comparisons of TCM-integrative interventions with western treatment as a common comparator, deducing the best TCM intervention without taking into consideration the variations on weights between studies. According to the BCLC staging system, the clinical decision regarding the selection of western treatments goes with the patients' tumor stages. In this study on TCM-adjuvant treatments, patients in both intervention and control groups were recruited across all tumor stages rather than at one single stage, which makes the subgroup analysis of NMA by tumor stages impossible. It is one reason that limits the external validity of the results. On the other hand, the retrieved RCTs were all based on one single country, China. Thus, the results of this study are not globally representative and might not be generally applicable. It is another reason that limits the external validity of the results. Subject-expectancy effect, a form of unconscious affection to the outcomes of study due to initial expectation of results by the research subjects, can bias the results of RCTs and the effect of which can be eliminated by double-blinded experiments (Microsoft Academic n.d.). Blinding and its implications on outcomes should be evaluated in one of the domains in risk of bias assessment. Since quality assessments are not conducted at this stage, the proportion of RCTs with blinding compliance is unavailable. Lack of blinding is reported to exaggerate the odds ratio greatly (Hrobjartsson et al. 2012). Therefore, the results of this study should be interpreted with caution.

## Conclusion

The combination of Buxu Huadu decoction and Jinshuibao capsule, Shugan Huazhuo decoction, Fugan injection and Peiyuan Guben capsule work best for survival outcome. Aidi injection works best for the improvement of Child - Pugh score. Accommodating to the demands of different forms of TCM formulations in various patient groups, the results of this study cater to the needs of clinical decision making in all kinds of settings. HCC patients need different forms of TCM formulations depending on their tumor stages, quality of lives and liver functions. The present NMA maximizes the therapeutic potential of TCM by unveiling the top TCM interventions for different outcomes and in respective subgroups. The statistical evidence in this study directs further clinical research in TCM as adjuvant treatments in HCC therapy. Multi-centered randomized controlled clinical trials are warranted to verify the results of this NMA.

## Acknowledgments

Gratitude goes to Dr. Ying Bian, Dr. Yuanjia Hu, Dr. Defang Ouyang, Dr. Ging Chan and Dr. Hao Hu from the Institute of Chinese Medical Sciences at the University of Macau for their constructive advice on this manuscript. Special thanks are credited to Dr. Siu-wai Leung for his feedbacks and comments to the research design of this study. Thanks to the University of Macau library for providing resourceful information for this study.

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*Athens Journal of Health & Medical Sciences - Volume 9, Issue 4,*
*December 2022 – Pages 245-264*

# The Role of Positive Psychological Capital in the Prediction of Teachers' Well-being Mediated Through Motivation: A Review of Literature

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*Based on the self-determination and positive psychology theory, teachers' motivation links the relationship between psychological capital and teacher well-being and discusses their theoretical and practical benefits. It is argued that the scientific literature from wide-ranging and diverse studies on teachers' well-being in elementary and secondary school focused on the pathological lens and healing specific disorders under a variety of life course threatening conditions across cultural contexts. Seligman (2011) criticised that mental health professionals and psychologists gave much prominence to mental disorders and pathologies, overlooking two crucial missions in the field of psychology: (a) helping healthy people to be happier and more productive and (b) actualising human potential. Depending on the current recommendation of positive psychology, and based on the literature gap and relevance of the issues, this study used a theoretical model of self-determination theory of motivation (Ryan and Deci 2017), psychological capital (Luthans et al. 2007a); hedonism well-being (Diener 2009a); and teacher well-being (Collie et al. 2015). Thus, in this review, the operational definition, components and measurements of positive psychological capital, teacher well-being and motivation of teachers and their link strongly supported with scientific literature and a future testing model was proposed. In this study, the links between each construct were addressed, and their educational implications to teachers, students, educational settings and policymakers are presented.*

**Keywords:** *subjective well-being, teacher well-being, positive psychological capital, motivation*

## Introduction

Nowadays, there is a growing interest in the self-determination theory of motivation and positive psychology due to its potential benefits to education, health and organisational settings. What defines and brings teacher well-being has been a debatable topic for a century, and one that has engaged many of the world's great scholars (e.g., Ryan and Deci 2001; Ryff and Singer 2008; Ryan and Deci 2011; Collie et al. 2015). The scientific study of well-being and the positive aspects of mental health has dramatically expanded in recent years (Kashdan et al. 2008, Cooke et al. 2016). However, well-being is not a finite entity or an end in itself, but an open-ended potential that unlocks other benefits and is promoted like a good investment (Ereaut and Whiting 2008). Therefore, research findings that develop an understanding of well-being among teachers are essential for teachers and students, schools, and the nation (Collie et al. 2015). This debate dates back to Aristotle, the

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famous founder of well-being, and the scientific debate continues today regarding how to operationalise and measure well-being.

To clarify the various well-being models, a link with motivation and psychological capital and a comprehensive model based on scientific literature will be essential to advancing future inquiry on education, health, and organisational settings.

Traditionally, teacher well-being has primarily been examined by focusing on the pathological aspect (Spilt et al. 2011). In addition, earlier researchers used psychological capital intervention strategies primarily focused on ameliorating stress and burnout (Çavuş and Gökçen 2015). Nowadays, the positive psychology movement inspired contemporary researchers to emphasise what is right with people and contributes to human flourishing and growth potential (Seligman and Csikszentmihalyi 2000, Carver and Scheier 2002, Snyder and Lopez 2009, Csikszentmihalyi 2014). However, the previously established models did not address or precisely measure employees' well-being (Collie et al. 2015). For instance, Diener (2009a) calls researchers to define and limit their research concept with work-related well-being using positive psychological capital (Gibson and Hicks 2018, Mangundjaya 2012, Youssef-Morgan and Luthans 2015).

The newly emerging concept in various fields of psychology is known as positive psychological capital (PsyCap). Nowadays, researchers and experts increasingly recognise the role and function of psychological capital and believe it to have the potential to attain optimal flourishing in workplaces. The practical utility of the model in the workplace continues to grow (Görgens-Ekermans and Herbert 2013).

Therefore, the current review has undertaken this opportunity to fill the gap of the previous literature concerning the three variables (teacher well-being, motivation and psychological capital). To delimit the scope of the review next, we describe the meanings, components, measurement and their implications to the students, teachers, policymakers, and organisations. Before discussing the main pillars of the review, the following guiding questions were raised to frame the focus on the collection of articles:

1. How have positive psychological capital, teacher well-being, and motivation been assessed in the research literature?
2. What role does psychological capital play, together with motivation, in predicting the well-being of teachers?
3. Does motivation mediate the relationship between psychological capital and teacher well-being?
4. What are the implications for studying teacher well-being for schools, teachers themselves, the policymakers, the students, and the possible roles for educational psychology?

## Significance of the Review

This review's proposed comprehensive well-being model has many potential benefits to clinical, educational settings, and other organisations. Earlier research,

once considered vital for well-being, has proven insufficient for attaining sustainable sources of competitive advantage and maintaining the welfare of humans across their lifespan. However, the birth of positive psychology currently focuses on individual and work-related well-being. Recently, scholars believed that teaching by its complex nature is affected by many potential factors. Therefore, the central investigation theme is their status of well-being (Diener 2009a, 2009b, 2009c, Ho et al. 2010) based on positive intervention (Luthans et al., 2015). Therefore, well-being expresses that positive psychology proposed the significant determinants and countless advantages gained through investing, controlling, developing, and managing psychological capital (Luthans et al. 2015). Thus, this new psychological capital approach to gaining a decisive advantage and result of harmony between major environmental factors on the one hand, and psychological capitals (resources) of teachers on the other. Recently, scholars in positive psychology, mental health, and behavioural sciences focused on teachers' well-being as an entire area of investigation (Collie 2014, Zewude and Hercz, 2021).

Nowadays, teacher well-being as an area of inquiry has several reasons. Firstly, it adds to the understanding of teachers' well-being to help to understand the factors that are of great concern to teachers and helps to create conducive school contexts to enhance their well-being (Hamre and Pianta 2010). Secondly, examining the most satisfying and rewarding teachers can better help to understand their attitudes toward school reforms and affirmative psychological intervention programs (Van Horn et al. 2004, Youssef-Morgan and Luthans 2015). Thirdly, academics square measure vital adults in children's scholastic lives. There is some proof that teacher well-being, even indirectly, has potential effects on children's socio-emotional adjustment and tutorial performance (Malmberg and Hagger 2009, Hamre and Pianta 2010). Fourth, in a current global world, the well-being of teachers plays a significant role in enhancing the current problem of teacher attrition, an ongoing issue in education contexts (Acton and Glasgow 2015). Last but not least, understanding teacher well-being is critical for teachers and students; there are still several gaps in the literature (Collie 2014). As a result, the present review contributes to the further development of a solid theory on comprehensive teachers' well-being for future empirical research, which has been lacking and has a significant contribution to the area of education and health settings.

These reviews provided helpful information to select applicable well-being models that address the individual and teacher work well-being. In addition, several pieces of literature have been conducted in the two dominant well-being approaches: eudemonic and hedonic. However, they did not address precisely the true work life of teachers and therefore there is a gap in the study. The present review attempted to address these limitations by evaluating a full range of published articles designed to operationalise well-being from a positive psychology and self-determination theory of motivation perspective.

## Methodology

The terms psychological capital and teacher wellbeing; psychological capital and motivation; motivation and teacher well-being were searched in four databases, including Scopus, Google Scholar, Springer, and Eric. The search resulting from these databases include journals, books, articles, and theses publications. The review was conducted strictly following the association and relationships among these three constructs. The first results were well-being in which 765 documents were accessed. Second, PsyCap and motivation, 46 materials were accessed; thirdly, regarding psychological capital and motivation, 245 documents were found. These articles were then checked to determine if they explain the relationship between psychological capital, well-being, and motivation. Based on these, they met the inclusionary and exclusionary criteria. Nevertheless, 91 articles were used; however, in this review, seven (7) articles were the most widely used as a deliberate focus to achieve the intended objectives. Based on the articles' findings, this review focused on meanings, core components and measurements of teacher well-being, psychological capital and motivation and their implication discussed below.

## Review of Thematic Areas

### *Well-being Approaches, Dimensions, and Measurements*

There has been a continual struggle within the diverse areas to accept and integrate scientifically-viable evidence on well-being into policy and practice (Huppert and Ruggeri 2017). This is due to the lack of a comprehensive well-being theoretical model developed by researchers. Over the last five decades, well-being has been conceptualised in various ways (e.g., Huppert and Ruggeri, 2017, Deci and Ryan 2008, Ryan and Deci 2011). For example, what is it that makes a good life desirable? What determines a high quality of well-being? Diener (2009c) answers these questions by explaining that a person feels and thinks their life is beneficial regardless of how others see it, which is called subjective well-being (Diener 2009c). Another question is that well-being has been defined and explored according to two broad psychological and historical traditions but distinct perspectives.

First, the eudaimonic well-being approach is known as psychological well-being, a six-dimensional model consisting of environmental mastery, autonomy, purpose in life, self-acceptance, personal growth and positive relations with others (Ryff and Keyes 1995). Psychological well-being is defined as psychological health achieved by functioning at an optimal level, fulfilling one's potential, or realising one's true nature (Ryff and Singer 2008). Regarding assessment, the eudemonic view of well-being assesses how well people live connected to their true selves (Ryff and Singer 2008).

Second, the hedonic well-being approach is subjective well-being, a tri-partite model consisting of positive affect, the absence of negative affect and satisfaction with life, and a focus on pleasure and happiness (Ryan and Deci 2001). In contrast to the eudemonic view, the hedonic view (subjective well-being) equates well-

being with happiness and is often operationalised as the balance between positive and negative affect (Ryan and Deci 2001) and longer and healthier life (Ryan and Deci 2011, Diener et al. 2015). The theorists of this perspective tend to conceptualise well-being in terms of all three of these core constructs. Subjective well-being is outlined as a broad class of phenomena that features people's emotional responses, domain satisfactions, and global judgments of life satisfaction (Diener 2009a). Diener's work was focused on trying to describe who is happy, broadly? A different review of his work depicted the happy person as a "young, healthy, well-educated, well-paid, extroverted, optimistic, worry-free, religious, married person with high self-esteem, high job morale, modest aspirations, and of either sex" (Diener 2009b, 2009c). However, experts also noticed that "happiness" is not a single entity but can be broken down into elements (Diener 2009c). Diener et al. (1985) developed the most prominent hedonic well-being assessment, still now the most useful .

Third, the PERMA profiler well-being model developed by Seligman (2011) operationalises well-being into five components: positive emotions, engagement, relationships, meaning and accomplishment.

The fourth category of conceptualisations of well-being is school- and teacher-based well-being. Regarding the schools' context, Saaranen et al. (2007) has created the teachers' well-being includes four dimensions: the pupil/student, health care services, cooperation between school and homes, and school staff's occupational well-being. However, due to a lack of proper assessment, Collie et al. (2015) proposed a tri-partite dimensional model to operationalise teacher well-being. These are:

Workload Well-being

Currently, known experts have increasingly called to examine well-being in different domain-specific contexts such as work-related domains (Diener 2009c, Collie et al. 2015).

For instance, Stanley (2018) found that of 3,750 teachers, one in every 83 teachers were "signed off" work on long-term sick leave due to anxiety and mental illness caused by work. Although, 76% of education professionals have experienced behavioural, psychological or physical symptoms due to their work (Stanley 2018). Three main potential risk factors have been mentioned in the UK multiple times (Stanley 2018). These are high workload (professionals dislike working in education); high levels of stress (more than two-thirds [67%] of education professionals describe themselves as stressed); the need for a better work/life balance (more than half of [58%] the education professionals typically work more than their contracted hours and experience difficulty achieving good work). The fact is that plenty of studies across different nations indicated that in Australia, 41%, in the UK, 67%, and the United States, 46% of 7,200 teachers report high levels of occupational stress (Cross 2018).

Therefore, its reduction is the main issue that would most improve or enhance employee well-being betterment of the teaching profession. Furthermore, significant evidence from the substantial body of scientific literature shows that one of the most remarkable features in psychology and in educational psychology in particular

is work-related well-being, which is the most powerful indicator for determining overall life quality. This is essential for understanding individuals' outcomes at work, and is positively correlated with life experiences (Rath and Harter 2010, Collie et al. 2015).

Organisational Well-being

Organisational well-being is defined as issues relating to teachers and instruction, relations and communication among staff and administrators, recognition gained from administrators and participation in decision-making (Collie et al. 2015). In the study by Collie (2014), teachers generally felt that the organisational-level aspects of their work positively influenced their well-being. Furthermore, she found that administrators could improve the well-being of teachers by creating a positive atmosphere in the school, ensuring teachers have input in decision-making and ensuring appropriate and constructive rules (Collie 2014).

Student Interaction Well-being

Spilt et al. (2011) noted that stress is typically experienced when threatened goals greatly concern individuals. On the other hand, events that facilitate a highly-valued goal elicit pleasant emotions and contribute to positive well-being. Besides, relationships with students can only be harmful or beneficial to the well-being of teachers when teachers have a need/desire for personal relationships with students (Day and Leitch 2001, Spilt et al. 2011). The *adult attachment model* of reciprocal caregiving and care-seeking is a more appropriate lens to view the teacher-student relationship. However, the standard attachment model that applies to education is a teacher as a caregiver and a student as a care-seeker (Riley 2009). Concerning this, the authors added that teacher-student relationships that are characterised by conflict and mistrust have harmful effects on children's learning. What is more, there is little recognition of the internal needs that teachers themselves may have for positive, personal relationships with individual students (Hamre and Pianta 2010).

According to Collie et al. (2015), the three factors regularly examined at work are: work-related stress (relating to workload), organisational-level stress (relating to school-level issues), and student-related stress (relating to student behaviour) (Collie et al. 2015), and three well-validated subjective well-being constructs (life satisfaction, positive affect, and negative affect) (Diener 2009c). Aelterman et al.'s (2007) empirical studies support that work stress, organisational-level stress, and student-related stress factors are also relevant for teacher well-being. However, Collie et al.'s (2015) model did not reflect the overall teacher's satisfaction in their life rather than focusing on work-related stress. As a result, we adopt the approach taken in the well-established six-component model (Diener 2009c, Collie et al. 2015). This binding model can be built upon previous theoretical and empirical work to determine the complex nature of teachers' work-related stress and the overall satisfaction of their life.

Regarding the assessment of teacher well-being, (Collie et al. 2015) developed a teachers' evaluation of their experiences at work and the effects on their well-being using positive psychology. This involves asking teachers to rate the extent to

which different aspects of their teaching work affect their well-being, and provides an advanced method for gaining insight into the core aspects of teaching work that affect teacher well-being (Collie 2014). An essential feature of this type of measure is that it highlights tangible factors that administrators and schools can address to better support teacher well-being (Collie 2014). More research findings suggest that there may be yield in examining teacher well-being through a multi-dimensional lens. Although the authors prove the inner structure of the size, our analyses even have practical implications. Collie et al. (2015) recommended that future research examine whether efforts designed to improve teacher well-being may give rise to changes in other teacher and student motivation and therefore outcomes.

Based on the arguments and various well-being models, it is very challenging to assess organisations and individuals. Therefore, in this review, we tend to depend upon the theory of positive psychology (Seligman 2011), self-determination theory of motivation (Ryan and Deci 2017), and the emerging theory of teacher well-being (Collie et al. 2015). Therefore, the present review study draws on research that proposes a combination of subjective well-being and teacher work well-being to give a more accurate and complete picture of teachers' well-being for future practical inquiry.

Regarding the assessment of hedonic well-being (subjective well-being) assessed through the satisfaction with life scale (SWLS) by Diener et al. (1985), the positive affect and negative affect (PANAS) scale was coined by Diener and Chan (2011). These instruments provide researchers with an overall score of participants' well-being that can be used to understand how an individual is generally faring (Collie 2014). However, they do not provide information about what specific aspects of the individual's life influenced his or her score of well-being, nor an understanding of well-being specifically related to work.

Several pieces of literature support the relationship and potential role of PsyCap to teacher well-being. For example, subjective well-being components like life satisfaction and positive affect are positively associated with psychological capital (Culbertson et al. 2010) and motivation (Ryan and Deci 2017). For example, (Mbatha 2016) indicated a positive relationship between psychological capital and subjective well-being, and high levels of psychological capital are associated with high levels of subjective well-being. On the other hand, Mbatha (2016) also found a significant positive correlation between hope and subjective well-being, hope and resilience, and subjective well-being and resilience.

### *Psychological Capital or the HERO Model*

What will fundamentally change by having a highway advantage in the "teaching profession" and "teachers' well-being"? How can teaching organisations and individual teachers achieve enhanced complex problems in their profession and personal lives? This literature pointed out a newly emerging positive flourishing theory to gain a decisive advantage for teachers and the teaching profession which is called positive psychological capital or psychological capital (PsyCap).

Various authors and sources synonymously use the terms 'psychological capital' and 'positive psychological capital'. Luthans et al. (2015) broadly defined

psychological capital as an individual's positive psychological state of development explained by four dimensions: (1) redirecting paths to success and, if necessary, preserving them toward goals (hope); (2) the self-confidence to take responsibility for challenging tasks (efficacy); (3) when beset by adversity and troubles, bouncing back to attain success (resilience); and (4) by making positive attributions about succeeding now and in the future (optimism). Luthans (2002) also defined psychological capital as the study of applying positively-oriented psychological capacities and human resources that can be measured, developed, and effectively managed for performance improvement in today's workplace. Psychological capital is also a positive psychological resource with four distinct constructs. These four PsyCap fundamental elements are: hope, efficacy, resiliency, and optimism, and together, serve as prominent resources that positively affect well-being (Youssef-Morgan and Luthans 2015). They travel together and interact work synergistically, producing differentiated manifestation over time and across context (Çavuş and Gökçen, 2015, Luthans et al. 2015, Burhanuddin et al. 2019).

Psychological capital is also seen as a resource that goes beyond *social capital* (relationships, networks) (Adler and Kwon 2002) and *human capital* (experience, knowledge, skills, and abilities (Van Marrewijk and Timmers 2002). However, it deals with "who you are here and now" and "who you can become" (Luthans et al. 2004, Youssef-Morgan and Luthans 2015). Since psychological capital is concerned about who the person is and who they can be through positive development in general (Luthans and Youssef 2004, Burhanuddin et al. 2019).

Popular literature distinguished the positive psychological capital from other positive constructs that already existed in organisational, industrial and personal development; popular literature focused on theoretical ground, empirical evidence, and valid and reliable measurement (Luthans et al. 2010).

The positive psychological capital construct of Luthans et al. (2007a) is an accurate and measurably reliable higher-order, latent multi-dimensional construct. Also, the theory of positive psychology has consistently demonstrated the link between PsyCap (hope, efficacy, resilience, and optimism: HERO) and employees' well-being (Mangundjaya 2012, Siu et al. 2015, Youssef-Morgan and Luthans 2015, Gibson and Hicks 2018), subjective well-being (Afzal et al. 2016), vocational well-being (Zhao and You 2019), academic motivation (Jafri 2017), employee productivity (Ganotice et al. 2016), and intrinsic motivation (Choi and Chang 2014). Rabenu et al. (2017) also added that PsyCap was found to have a healthy, positive, and direct correlation with well-being and performance.

Nowadays, researchers and experts increasingly recognise the role and function of psychological capital and are believed to have the potential to attain optimal flourishing in workplaces (Luthans et al. 2007b). Further, psychological capital as a whole should also contribute to well-being (Li 2018). Additionally, employees' self-efficacy also appears as an essential precursor of positive work-related well-being, such as health and job satisfaction (Van Seggelen and Van Dam 2016).

Following the different inclusion criteria and a key role for positive psychology, Luthans and his colleagues founded the four psychological capacities or resources: hope, self-efficacy, resilience, and optimism (HERO), which are considered dimensions of psychological capital and are illustrated in Figure 1.

**Figure 1.** *The PsyCap Components (HERO Model; Selvaraj 2015)*


In terms of measuring psychological capital, Luthans et al. (2015) developed an empirically-validated and reliable psychological capital questionnaire in the workplace. The items used therein were originally drawn from validated published scales commonly used in positive psychology. These individual scales were used in previous studies in the workplace. Six items in their study questionnaire represent each of the four components that make up PsyCap. They adopted these items for the workplace from the following standard scales: (1) Hope (Snyder et al. 1996); (2) Efficacy (Parker 1998); (3) Resilience (Wagnild and Young 1993); and (4) Optimism (Scheier and Carver 1985). Therefore, PsyCap meets the criteria for valid measurement and openness to development, and a growing number of studies have demonstrated that it impacts the desired outcomes in the workplace (Luthans et al. 2007a, Youssef-Morgan and Luthans 2015). Luthans et al. (2015) reported the reliability of measures of psychological capital of the reliability using the Cronbach alphas for each of the four six-item adapted measures and the overall PsyCap measure for the four samples were (Luthans et al. 2015): hope (.72, .75, .80, .76); self efficacy (.75, .84, .85, .75); resilience (.71, .71, .66, .72); optimism (.74, .69, .76, .79); and therefore the overall PsyCap (.88, .89, .89, .89).

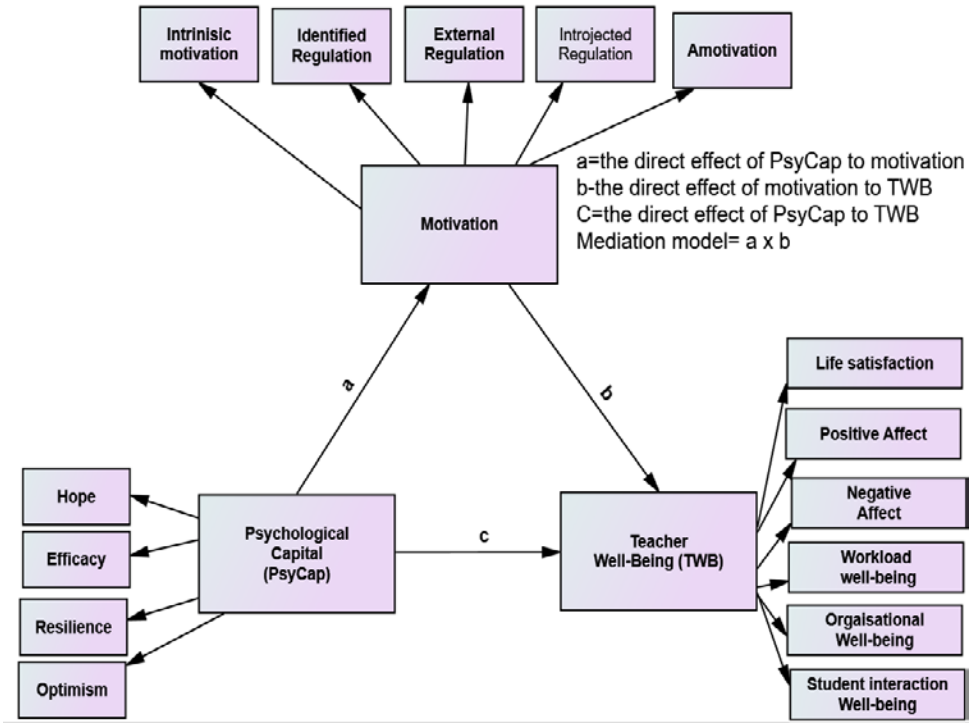
*Motivation*

Researchers vastly studied the concept of motivation and its associated constructs. Also, many empirical studies have examined the relationship between PsyCap and workplace outcomes. However, there has been no comparative research on the factors that may mediate the relationship between PsyCap and teacher well-being through motivation. In addition, there is evidence of the relationship between PsyCap and well-being. One dominant influential theory investigated broadly by scholars is the self-determination theory (SDT). However, some self-determination theory research has focused on the extreme ends of the continuum, focusing on extrinsic versus intrinsic motivation (Deci and Ryan 2000, Deci and Gagne 2005).

Ryan and Deci (2000), the founder of SDT, differentiates several types of motivation based on various goals or reasons that give rise to an act. Fernet et al. (2008), also based on SDT, define three broadly known motivations from low to high: amotivation, extrinsic motivation, and intrinsic motivation and psychometrically

assess. Self-determined kinds of motivation have positive and negative consequences or outcomes. For example, intrinsic motivation and identified regulation result in positive effects, whereas external regulation, introjected regulation, and amotivation lead to negative results (Fernet et al. 2008). Additionally, intrinsic motivation enables individuals to develop internal psychological growth, integrate the personality, allow integration of psychological stability, and foster positive life processes (Ryan and Deci 2000), and the most positive determinants of a personal and higher level of well-being (Ryan et al. 2008). As a result, self-determined types of motivation in the workplace are associated with higher job satisfaction (Fernet et al. 2008) and better psychological capital (Ferraro et al. 2018). Chian and Wang (2008) also found how different motivations independently shape individuals' perceptions of well-being. Thus, teachers with high psychological capital tend to have high motivation, are more intrinsically motivated, have highly integrated regulation and have low introjected, external and amotivation.

**Figure 2.** *A Theoretical Model of the Relationship Between PsyCap (Luthans et al. 2015), Motivation (Ryan and Deci 2017), and Teachers' Well-being (Collie et al. 2015)*




In conclusion, SDT is the most noticeable and applicable theoretical model that links teachers' well-being and work task motivation. Moreover, SDT has innumerable benefits in acting toward fruitful results, such as parents, health care providers, religious leaders, managers, coaches, and teachers (Ryan and Deci 2000). Also, from the positive psychology perspective, PsyCap can predict work motivation and well-being (Ferraro et al. 2018, Fermiano Fidelis et al. 2021,

Skhirtladze et al. 2019) and teacher well-being (Ryan and Deci 2000, Collie et al. 2015, Zewude and Hercz 2021). Consequently, this review was examined the proposed constructed theoretical frameworks displayed in Figure 2.

## Conclusion

In the last decades, psychologists and health professionals have devoted themselves to the weak sides and focused on healing specific disorders of human beings but generally ignored or failed to contribute to human strengths, flourishing, and optimum functioning. Findings from diverse literature on teachers' well-being in elementary and secondary school converged with striking regularity with a pathological lens and focused on healing specific disorders. However, exploring what makes teachers happy and flourish from a positive psychology and self-determination motivation perspective remains unresearched. Seligman criticised psychology's problem-oriented approaches and perspective rather than helping healthy people be happy, productive and actualising full potential.

The rather debatable, general models and assessments of teacher well-being and its association with other variables will be supplemented with a piece of empirical and theoretical evidence appropriate for future inquiry. Nowadays, studies are limited, and more research needs to be done to link psychological capital and motivation interventions to teacher well-being. The positive psychological capital model focuses on different companies and organisations rather than educational institutions; however, research is needed on educational settings based on a positive psychology perspective. Regarding the assessment of PsyCap, motivation and teacher well-being assessments area also played a crucial role in that the instruments are cross-culturally validated. This review has addressed a clear and evidence-based causal mediation relationship to a rather vague model. To sum up, this review gives a clear picture of the teacher well-being model with other positive constructs that will hopefully become a guiding model for researchers in this new and applicable area.

### *Educational Implications*

Based on the above review, we propose educational impacts on teachers' well-being for students, schools, and government policymakers. Unfortunately, there are few empirical and theoretical pieces of evidence on the role of positive psychological capital on teachers' well-being (Ross et al. 2012, Eurofound 2013, Kern et al. 2014, Mccallum et al. 2017, Kaur and Singh 2019, Malureanu and Enachi-Vasluianu 2019). Literature often describes teacher well-being in negative terms, like how low mental health of teachers increases teacher stress, frustrations, and problems related to retention at the workplace, anxiety, mental health, and burnout (Kaur and Singh 2019).

Based on the above studies and of the present review, we propose the following implications and intervention strategies that help to enhance teachers' well-being using a positive psychological capital.

*Implications for Teachers*

Positive functioning is not merely extant stress; it conjointly entails thriving physically, mentally, socially, and professionally (Kern et al. 2014). Scholars conduct a few critical studies to promote teacher well-being. School factors and their well-being are deeply connected to the quality of their work and individual lives (Collie et al. 2015, Mccallum et al. 2017). Teacher wellbeing, therefore, is of critical importance to the future of education. To promote teacher well-being, teacher educators often have high-quality efficacy skills, a good sense of hope, and handle their problems systematically and strategically.

Strategies of Teachers Initiative and Professional Learning Activities

Kaur and Singh (2019) suggested the following strategies to enhance teacher well-being:

Teachers' initiatives

Recreation sessions, reading a book, having time with family and friends, critical thinking approaches, management of emotions, mindfulness techniques, participation in sports activity, meditation and spending some time alone help to reduce stress levels and to support teachers in maintaining their well-being (Kaur and Singh 2019).

Professional learning activities

Career development and professional learning activities enable professional growth and life satisfaction through professional collaboration. Develop a focus to include teachers' specific needs and professional learning programs, provide more focus on teacher's holistic development, pleasure, happiness, and well-being, then we will be able to produce competent teachers (Kaur and Singh 2019).

Individual Teacher Well-being Strategies

The Meta-analysis study evidenced that teachers' personal qualities and abilities have contributed to promoting teacher wellbeing like aptitudes, beliefs, decision making, self-understanding, resilience, and flexibility (McCallum et al. 2017). According to Mccallum et al. (2017), the most flourishing teacher well-being interventions are:

- Reflection strategies for approaching expert practice.
- Mindfulness training to handle stress.
- Training psychology to build learning communities.
- Increasing mindset approach to resolve problems.
- Self-care practices to restore when needed, celebrate achievements and success to feel valued.

Positive Psychology Approaches or Strategies

Seligman's work on positive psychology has been well documented and promoted across the schooling and education sector (Mccallum et al. 2017).

Concerning this, Kern et al. (2014) identified the associations between multiple aspects of employee wellbeing and three primary outcomes, including physical health, life satisfaction, and professional thriving using the PERMA model. In addition, Kern et al. (2014) found that "when lecturers do well across multiple successfulness domains, they are conjointly a lot of committed to the varsity, and a lot of happy with their health, life, and jobs."

Resilience Strategies

Enhancement initiatives to advance teacher resilience have addressed the complex nature of teachers' work and interactions and equips teachers with adaptability to successfully respond to complex experiences (Mccallum et al., 2017).

*Implications for Schools/Universities*

There are a limited number of theoretical and empirical pieces of evidence in which teachers' well-being impacts the school or organisations (Ross et al. 2012, Kern et al. 2014, Kaur and Singh 2019, Malureanu and Enachi-Vasluianu 2019). However, in the above studies, teacher well-being, especially the positive aspect, has been overlooked. Therefore, on the basis of the studies mentioned above and of the present review, we propose the following intervention strategies for those schools that want to enhance teachers' well-being.

School-wide Positive Behaviour Interventions Supports

- Interactive school activities as a means of instruction to harmonise students' involvement with the group work promote and improve teachers' well-being (Malureanu and Enachi-Vasluianu 2019).
- A safe learning environment is supported by promoting tolerance and cooperation in school.
- Teachers should provide care and support to ensure healthy relationships among students and create a learning environment where everyone feels comfortable and safe leads to well-being (Malureanu and Enachi-Vasluianu 2019).
- The provision of simple, efficient, and valuable skills, staff in School-wide positive behavior ınterventions and supports: cooperative learning environment in the school creates a positive, supportive culture (Ross et al. 2012). Besides, a significant impact of school-wide positive behaviour ınterventions and supports on teacher well-being occurs through the development of team skills, collaboration, and positive relationships. In addition, effective practices lead to teachers' feelings and the more supportive (Ross et al. 2012).
- The university context needs to be changed and improved to meet students' needs, foster students' psychological well-being, and impact teachers (Kibret and Tareke 2017).

Institutional Initiatives

Teachers believed in streamlining planning and managing the pressures in teaching with the support of leaders and administrators. They emphasised that the organisational strategies should improve over time. They feel that new entrants in the profession need help to manage the workflow and pressures during their training and early career and stay committed to the job (Kaur and Singh 2019). Furthermore, teachers identified that the institution should:

- Provide a supportive work culture.
- Provide facilities to teachers to manage their well-being and personal growth.
- Develop a problem-solving culture at the workplace.
- Facilitate the development of teachers at vulnerable times.
- Provide a means of sharing best practices across schools (Kaur and Singh 2019).

*Implications for Students*

Teachers' well-being and positive psychological capital based on relevant educational psychology reviews have a pivotal role in students' academic educational intervention and effective coping strategies (e.g., Sharrocks 2014, Selvaraj 2015, Malureanu and Enachi-Vasluianu 2019).

Positive psychology intervention has important implications for students like designing strategies that focus on psychological capital. For example, hope, efficacy, resilience, and optimism are the leading strategies of subjective well-being and are some suggestions for consideration by college student teachers, personnel and administrators (Selvaraj 2015).

The outcomes of interactive strategies of promoting well-being are beneficial for the students: formation of positive identity, proper management of thoughts and emotions, the development of efficient learning abilities, all leading in the end to robust social integration and contribution (Malureanu and Enachi-Vasluianu 2019).

*Implications for Policy Makers*

Educational policies are rooted in an overemphasis on institutional well-being leading to dangerous imbalances in teaching and teacher education across the globe (Margolis et al. 2014, Negash 2006). As a result, mindfulness-based wellness education programs in teacher education should be restructured, focusing on bringing present awareness to a teacher's well-being. This program also supports teachers in developing their ability to regulate emotions and improve motivation and stress levels (Margolis et al. 2014). Regarding this, Mccallum et al. (2017) depicted that mindfulness-based wellness education will help promote resilience, energy, motivation, and teacher self-efficacy, producing positive outcomes for the individual teachers and the individual teachers at the community level.

There are different programs across the globe that are greatly enhancing teachers' well-being. For example, more intentionally linking of institutional concepts

with the realities of the classrooms, supporting teaching as a clinical profession and encouraging pre-service teachers to reflect on areas of resistance to facilitate more immediate improvements to teacher well-being and quality (Margolis et al. 2014).

Other fantastic policy recommendations to enhance teacher well-being given by Eurofound (2013) which are policy interventions targeting the health, well-being, and safety of employees, employment quality, the average relationship of work and welfare, and conducive working conditions.

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