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Review

Which Triple Aim related measures are being used to evaluate population management initiatives? An international comparative analysis

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ABSTRACT

Introduction: Population management (PM) initiatives are introduced in order to create sustainable health care systems. These initiatives should focus on the continuum of health and well-being of a population by introducing interventions that integrate various services. To be successful they should pursue the Triple Aim, i.e. simultaneously improve population health and quality of care while reducing costs per capita. This study explores how PM initiatives measure the Triple Aim in practice.
Method: An exploratory search was combined with expert consultations to identify relevant PM initiatives. These were analyzed based on general characteristics, utilized measures and related selection criteria.
Results: In total 865 measures were used by 20 PM initiatives. All quality of care domains were included by at least 11 PM initiatives, while most domains of population health and costs were included by less than 7 PM initiatives. Although their goals showed substantial overlap, the measures applied showed few similarities between PM initiatives and were predominantly selected based on local priority areas and data availability.
Conclusion: Most PM initiatives do not measure the full scope of the Triple Aim. Additionally, variety between measures limits comparability between PM initiatives. Consensus on the coverage of Triple Aim domains and a set of standardized measures could further both the inclusion of the various domains as well as the comparability between PM initiatives.

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1. Introduction

Health care systems around the world are being challenged to reform by rising costs and disparities in the provided quality of care [1]. In order to realize sustainable and higher quality health care systems, so-called population (health) management (PM) initiatives are being introduced. These initiatives aim to achieve this goal by focusing on the health needs of a specified population across the continuum of health and well-being by introducing multiple interventions that integrate services related to health and social care, as well as prevention and welfare [2]. This approach addresses the current need for preventing or postponing chronic diseases as well as the push away from fee-for-service toward accountable care [3]. In order to realize sustainable and higher quality health care systems, PM initiatives should pursue the Triple Aim, i.e. simultaneously strive to improve population health and quality of care while reducing cost growth [4]. Hence, evaluations of the Triple Aim dimensions (population health, quality of care and cost) are needed to adapt and improve PM initiatives.

Evaluating the three dimensions of the Triple Aim appears to be difficult in practice since the concepts of (population) health, quality of care and costs are not unanimously defined and measures for these concepts are under construction [5–10]. For example, Kindig and Stoddart [11] define population health as "the health outcomes of a group of individuals, including the distribution of such outcomes within the group", while Young [12] regards population health as "a conceptual framework for thinking about why some people are healthier than others and the policy development, research agenda and resource allocation that flow from this". Further adding to this complexity is the introduction of new concepts regarding health and quality of care [13,14] as well as the rise of new types of measures, such as patient reported outcome measures (PROMs) and patient reported experience measures (PREMs) [15]. Several papers provide guidance on how to measure population health, quality of care and costs [2,16–18]. Frameworks suggested by these papers provide many possible measures, potentially implying a large measurement burden and lack of comparability between PM initiatives. To explore how to best deal with the many possibilities, it is of interest to have insight into the currently applied measures for evaluating PM initiatives. Recently, an overview of applied health and health care performance measures was given by the Institute of Medicine (IOM) [18]. The IOM studied current measures used in the United States and found that a large number of various measures are utilized to evaluate health and health care. However, it is unclear whether these results are in line with the applied measures used in PM initiatives in and outside the United States. This is due to the IOM's focus on general health care rather than PM and the differences between the United States and other OECD countries in health care performance and organization [19–21].

As a result, insight into how PM initiatives measure the Triple Aim in practice is still needed. This study aimed to create this insight for PM initiatives that focus on the general population, as these are most likely to integrate multiple domains and entail the continuum of health and well-being [22,23]. Hence, this study explored which measures are used in practice to evaluate PM outcomes within the general population reflecting population health, quality of care and costs, and looked for emerging patterns and outliers.

2. Material and methods

2.1. Search strategy

Initially, literature searches were performed in order to explore the value of a systematic review (Appendix 1). This showed that current PM initiatives' evaluations were not (yet) published in Medline. Therefore, PM initiatives were identified using a two-step exploratory search strategy that was performed during the period March to August 2015. The first step was to consult websites of research institutions involved in PM research (such as King's Fund, Commonwealth Fund, Nuffield Trust, World Health Organization and the Institute of Health care Improvement (IHI)) for publications related to PM and the Triple Aim. Next, a manual search on the Internet was performed using the search terms 'population health', 'population health management', 'population management' and 'integrated care'. A list of relevant PM initiatives was compiled, which was subsequently evaluated by all authors in order to add missing known PM initiatives.

In the second step, the list of PM initiatives was sent to eight experts in the field of PM. These experts were asked to review the list to see if any relevant PM initiatives were missing. The suggestions provided by five experts (Appendix 2) were explored to create the final list of potential PM initiatives before scoring.

For analysis, information of included PM initiatives was collected by consulting websites of associated institutions and organizations. All available information related to the selected PM initiatives was screened, including documents, articles, webpages and presentations. If this did not provide the necessary information, published papers were searched using search terms related to the PM initiative (e.g. affiliated authors). Initiatives that did not publicly provide all information needed for scoring were asked to provide additional information by email. Finally, the quality of the initiatives' (public) reporting was assessed based on the standards created by Nothacker et al. [24]. The found sources of each initiative were searched for the presence of the following seven standards: description of the measures development process, measures appraisal, measures specification, description of the intended use of the measures, measures testing/validation, measures review/re-evaluation, and composition of the measures developmental team.

2.2. Inclusion criteria

PM initiatives were included in the study if they met the following six criteria. First, PM initiatives had to focus on a general, non-disease-specific population. Second, the initiatives had to either (a) use interventions that covered at least two areas of care (prevention, health care, social care

and/or welfare) and/or (b) try to achieve Triple Aim. Criterion 2b was added due to the studies' focus on the Triple Aim, hereby labeling initiatives improving the Triple Aim within at least one area of health care as PM for the purpose of this study. The third criterion stated that the country in which the initiative took place must have been classified as an OECD high-income country by the World Bank list of economies [25]. By focusing on high-income countries, the comparability between initiatives improved. Fourth, the initiative had to be evaluated and a description of this evaluation, including the measures used, population and the goal of the initiative had to be available. Fifth, needed information had to be available in English, Dutch and/or German, and sixth, the evaluation had to be conducted at least once in the last five years.

2.3. Review process

The review process consisted out of three steps and was conducted by one researcher (RH) and checked by a second (HD). Any disagreements were resolved by consensus.

First, general features from the included PM initiatives were subtracted, including year of implementation, country, involved actors, target population (criteria and size), goals, included areas of care (health care, social care, prevention and/or welfare), organizational structure and implemented programs/interventions.

Second, the following characteristics of PM initiatives' evaluations were identified: the involved research institutions, research population, control group, data sources, method, theoretical constructs (e.g. the dimensions of the Triple Aim), measures and their use, and measure selection.

Subsequently, the measures were classified using the Triple Aim dimensions and domains provided by the framework by Struijs et al. [2] (Fig. 1). In this framework population health comprises the domains health outcomes, disease burden, behavioral and physiological factors, participation and functioning/quality of life. Quality of care, which encompasses care experiences, consists out of the domains safety, timeliness, responsiveness, effectiveness and accessibility. The costs dimension is divided in direct and indirect costs. Direct costs consisted out of the domains costs of care, volume and the costs of the PM organization, indirect costs out of the domain productivity losses. This framework was selected as it refined the framework by Stiefel and Nolan [16] to cover the full scope of PM (e.g. costs of PM initiatives were included) and reflect the latest adaptations of the Triple Aim dimensions (e.g. participation was added to the population health dimension). Each measure was assigned to its single most relevant domain within the framework. Furthermore, the framework was not restrictive, allowing for alterations, such as adding domains, if deemed appropriate based on the results. Within each domain, measures were grouped into subdomains to compress the number of measures and create an overview for analyses. The relation between dimensions, domains, subdomains and measures is visualized in Fig. 1. Measures were further characterized and clustered by measure type; these included process, outcome and structure as defined by Donabedian [26], and patient reported outcome measures (PROMs) or patient reported experience measures (PREMs) [15].

3. Results

3.1. Search results

The search strategy produced 62 potential PM initiatives; 20 were found in grey literature [27–30], 6 in published articles [31,32], 13 originated from author discussions and 23 from experts' suggestions. These 23 suggestions also included PM initiatives found in literature provided by experts [23]. A total of twenty PM initiatives met the six inclusion criteria and were included in the study (Appendix 2). The 42 excluded initiatives were mostly rejected because they did not have a specified population or an available evaluation strategy (Appendix 2).

3.2. Description of PM initiatives

Of the twenty included PM initiatives, eleven originated in the United States (Table 1). Other countries were England ($n = 3$), New Zealand ($n = 2$), Canada ($n = 1$), Germany ($n = 1$), Scotland ($n = 1$) and Spain ($n = 1$). Thirteen PM initiatives were (local) governmental programs, while an insurance company created one. Six initiatives were constructed by other private organizations such as Intel or HealthPartners. Most PM initiatives ($n = 13$) started between 2008 and 2013 and target populations were predominantly based on place of residence ($n = 11$). The Triple Aim was stated as a goal in eight PM initiatives. However, PM initiatives that did not mention the Triple Aim, did describe the individual dimensions or comparable goals (population health ($n = 5$), quality of care ($n = 12$), cost ($n = 8$)). Implemented interventions to achieve these goals were primarily based on integration of services ($n = 11$) and changes to funding methods ($n = 5$). The quality of public reporting varied substantially between PM initiatives. Three initiatives checked all seven boxes included in the quality assessment, but most were only able to meet three standards or less. Since it was one of the search criteria, all initiatives provided some specification of the measures used, but less than half ($n = 9$) described numerators and denominators of each measure. In addition, measures appraisal ($n = 5$) or measures testing/validation ($n = 9$) was missing in the majority of initiatives. Appendix 3 provides a more extensive description of the PM initiatives, including the quality assessment.

3.3. Measurement of the dimensions and (sub)domains

The 20 PM initiatives combined, used 865 measures of which 103 measures related to population health, 585 to quality of care and 177 to costs. An overview of the number of initiatives found per domain can be seen in Fig. 2.

3.3.1. Population health

The most often evaluated domain was 'health outcomes' ($n = 13$), in which the subdomains 'mortality' ($n = 8$) and 'overall health status' ($n = 7$) were most frequently measured (Table 2). Ten PM initiatives evaluated the 'behavioral and physiological factors' domain. Nine of these considered

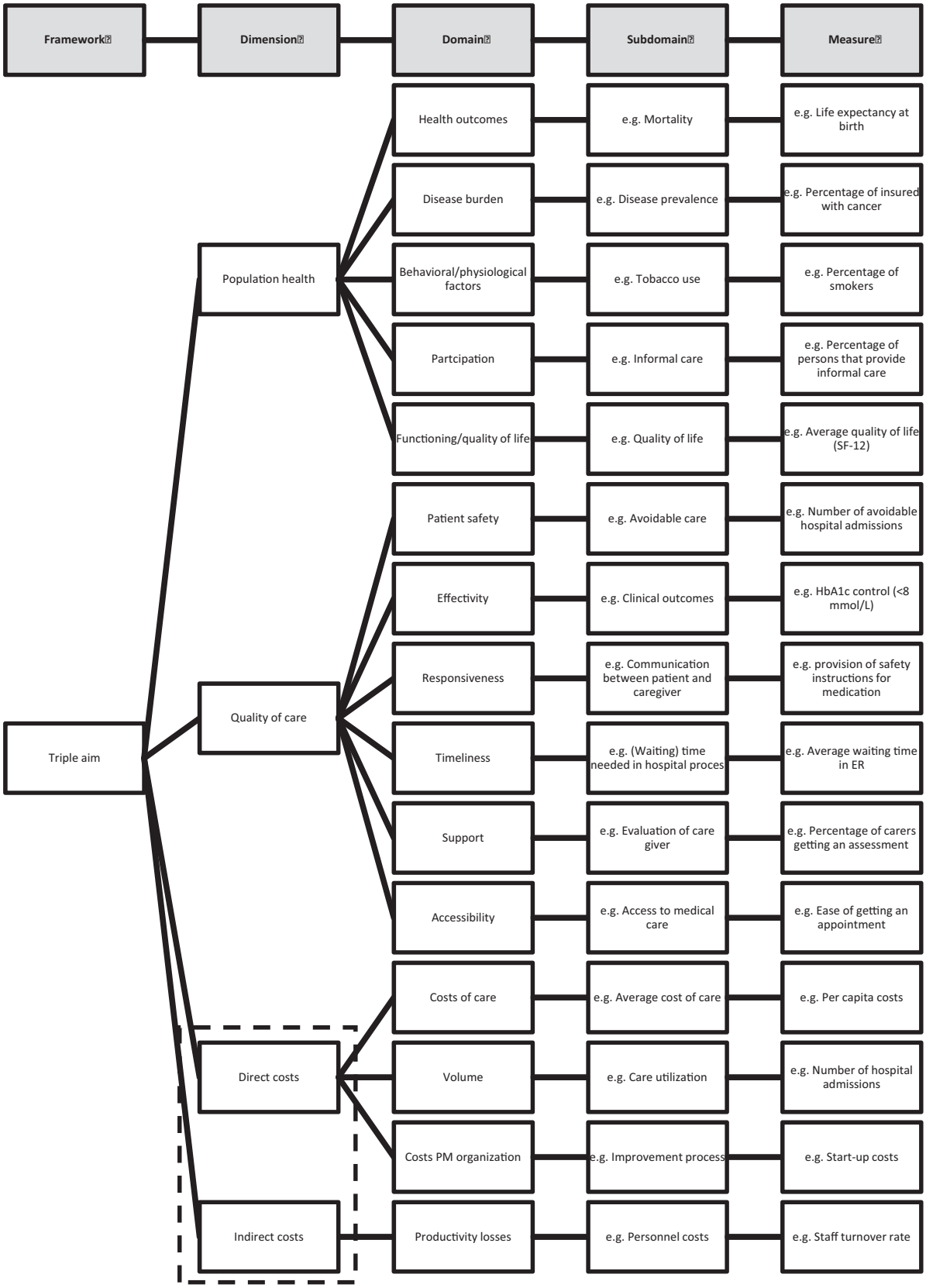

Fig. 1. Overview of levels in Triple Aim based framework by Struijs et al. [2].

Table 1
Description of the included population management initiatives.

Initiative [including references]	Country, year of implementation	Actors	Target population	Goals	Design (organizational structure and implemented programs)
Alberta Health Services – Edmonton Zone (AHS) [33–35]	Canada, 2012	Private organizations, health care providers	Specific groups in the Edmonton zone, selected based on care use and housing situation	Advance the Triple Aim for high need and high cost patients	AHS focuses on several populations; the older, tri-morbid adults, frail older adults, young adults with addictions and mental health concerns, child-bearing women, high-needs children and complex infants and toddlers. Five projects aimed at each of the subpopulations were introduced. AHS is part of the IHI Triple Aim cohort
Alternative Quality Contract (AQC) [36–38]	United States, 2009	Insurance company, private organizations	Insured population that uses a primary care physician (PCP) who participates in an AQC group	The AQC pursues the Triple Aim by enabling caregivers to provide the right care at the right time in the most appropriate setting, and by reducing expense trends for participating organizations	Care providers can opt-in to participate in AQCs. The AQC is a global payment model that combines set per-patient payments with shared savings. The global budget entails all services and costs for a particular patient
Bellin Health of Green Bay [23,39,40]	United States, 2002	Private organizations	Employees of Bellin Health and their spouses	Achieve the Triple Aim with a focus on costs	The model used by Bellin Health is called the Total Health Model. Employees and their spouses receive health insurance benefits, health care coaching, and an annual health risk appraisal (HRA)
Bidasoa Integrated Health Organization (IHO)[41–43]	Spain, 2011	Government, health care providers	Population of Bidasoa	Improve quality of care using evidence based practice and coordination between levels, and improve efficiency while being patient-centered	IHOs consist out of a hospital matched with primary care organizations, based on their geographical area. IHOs have a single source of funding, common goals and risk stratification for primary and secondary care. Bidasoa is based on culture, clinical practice and governance. Implementations such as Continuity of Care Units, Technical Boards and shared electronic records are used
Canterbury District Health Board (DHB) [44]	New Zealand, 2011	Government	Population of the Canterbury District	Achieve integrated care to do the right thing for the patient and the system by letting people take responsibility for their own health, providing continuity and improving responsiveness to episodic events	Canterbury DHB focuses on home care, services in the community, regional collaborations and networks and managed specialization. Projects could be classified by projects connecting health systems, supporting vulnerable populations and delivering clinically, and financially viable health services
Clinical Commissioning Groups (CCG's) [45–47]	England, 2012	Government, autonomous governmental organizations	Population of a specific geographic area	Increasing focus on patient- and public-centered care and improving outcomes, autonomy, accountability, and efficiency, while cutting bureaucracy	General practitioners (GP) become members of CCGs; they cooperate to plan and design local health services, govern the CCGs, and they are an independent statutory body. They control the budget and buy local health care services on behalf of the local population. There are currently 211 CCGs is England with varying approaches
Coordinated Cared Model (CCO) [32,48–51]	United States, 2012	Government, private organizations	Medicaid clients in Oregon	Improve health, quality, reliability, availability and continuity of care	CCOs are regional entities responsible for managing a global budget and coordinating health services for Medicaid in Oregon. CCOs try to achieve the goals by integrating, local accountability, and standards for safe and effective care. Most CCOs have introduced community health workers or community agencies into their network

Table 1 (*Continued*)

Initiative [including references]	Country, year of implementation	Actors	Target population	Goals	Design (organizational structure and implemented programs)
Counties Manukau District Health Board (DHB) [52–55]	New Zealand, 2011	Government	Populations of the local authorities in Auckland, Waikato and Hauraki District	Become the best health care system in Australasia in 2015 by balancing excellence and sustainability	A four-year strategic framework was created in which six strategies were described based on the domains of the Triple Aim. For example, better health outcomes for all, system integration and ensuring financial sustainability. The accompanying implementations were electronic medication conciliation, fall and infection prevention and the 20,000 days campaign
Gesundes Kinzigtal [56–58]	Germany, 2006	Local physicians network, health care management company, insurance companies	People insured by a specific insurance company in the Kinzigtal region	Achieve the Triple Aim; improve insurer's contribution margin and the health status as well as the quality of life of the population	One organization is responsible for the spending and care of two sickness funds populations. They are rewarded by using shared savings and are financially accountable for all members of the sickness funds. Since 2006, thirty care and preventive programs were introduced
Health Care Marketplace Collaborative [28,59,60]	United States, 2009	Private organizations	Intel employees in the United States and their dependents	Provide better, faster and more affordable care	Intel hired Virginia Mason to train personnel in lean and best practice processes. This way proven value streams from Virginia Mason were adapted and implemented in other health care systems for patient screening, illnesses and six medical conditions
Health Partners Best Care [28,61,62]	United States, 2004	Insurance company, health care providers	Members of the insurance company	Achieve the Triple Aim by improving reliability, customization/tailoring of care and by ensuring easy access and coordination	Examples of implementations were the introduction of an online IT and information-sharing system, evidence-based care, generic prescribing, best practice for MRI, support of patients after discharge, same-day mammography and phone-based 24-h nurse care
Healthy Shelby [63,64]	United States, 2007	Private organizations, health care providers	Residents of Memphis and Shelby County	Achieve the Triple Aim and increase business growth, quality of life and community health, and reduce health care burden	The Memphis Forward Initiative is focused on collective action by the different actors in the community. Healthy Shelby is part of this initiative and decided to focus on three areas: infant mortality, chronic disease and living well/dying well. Projects were implemented for each of the areas of focus
Medicare Shared Savings Program (MSSP) (including advanced payment and Pioneer model) [31,65–67]	United States, 2011	Government, private organizations	Populations assigned to Accountable Care Organizations (ACOs)	Achieve the Triple Aim by promoting accountability, incenting higher value care, improving coordination and infrastructure, and redesign the care processes	ACOs can choose to participate in the MSSP; the shared savings are linked to quality and savings requirements. The ACOs can choose their own implementations to fulfill these requirements, which are based on quality measures
Minnesota Health Model [32,68–71]	United States, 2013	Government, private organizations	Populations assigned to ACOs in Minnesota	To ensure patients receive patient-centered primary care and providers include the community, participate in accountable care and payment models to take responsibility for the populations' health	The model is based on (primary) health care homes, community care transitions and Accountable communities for Health, that need to include an ACO. Local stakeholder get flexibility on how they implement these building blocks

Table 1 (*Continued*)

Initiative [including references]	Country, year of implementation	Actors	Target population	Goals	Design (organizational structure and implemented programs)
National Health Service (NHS) Highland [72–75]	Scotland, 2010	Government	Population of Highland region	Provide safe, sustainable, compassionate, effective, affordable and efficient delivery of health and social care and improve population health, while reducing health inequalities	NHS Highland uses the Health Care System Approach focused on person-centered care while reducing waste and harm, and managing variation. One of the implemented projects was the Care Pathways, a route capturing all activities for patients from start to finish. Others include lifestyle interventions and vaccinations
NHS Kernow [76,77]	England, 2013	Government	Residents of Cornwall and Isles of Scilly	Improve health, wellbeing and people's experience of care, and reduce the costs of care (Triple Aim)	Ten locality groups commission and assess the health care needs of the population. They receive an annual budget from the NHS England. Multiple projects were aimed at including the community, while others included better diagnosis by the GP to prevent avoidable admissions, among others
Pueblo Triple Aim Coalition (PTAC) [78–83]	United States, 2010	Non-profit organization, private organizations	Population of Pueblo County	Achieve a set of specific goals based on the Triple Aim; lower years of potential life lost, increase the clinical access and quality ranking, and reduce illness burden and preventable hospital stays	Three dominant programs that were implemented are obesity reduction (activity and food), lower teen unintended pregnancies (youth development) and smoking cessation (counseling and aid)
Regional Care Collaborative Organizations (RCCO) [32,84,85]	United States, 2011	Government	Accountable Care Collaborative enrollees	Ensure access to care, coordinate medical and non-medical care, improve member experience, and provide the necessary data to support these goals	RCCOs are contracted by Medicaid to create networks of PCPs they have to coordinate and to integrate care for Medicaid enrollees. RCCOs use varying strategies. Some examples include embedded care managers and funding pools at community level
St. Charles Health System [86–88]	United States, 2008	Private organizations	Population of central Oregon	"Create America's healthiest community, together" through better health, better care and better value	Each goal entails a set of projects. Better health, for example, has projects aimed at integrating data, partnerships with the community and patient-centered medical homes. In 2013 St. Charles Health System started a partnership with the Institute of Healthcare Improvement focusing on high risk patients
Torbay and Southern Devon Health and Care NHS Trust [89–91]	England, 2000	Government	Population of Torbay and South Devon	Deal with the rising demand and the diminishing budget while ensuring people receive the right care, in the right place, at the right time	The 'Mrs. Smith' model is revolves around an imaginary patient that helps visualize the needs of actual (future) patients. This model led among others to the implementation of 'joined-up care' between health and social care. The CCG, in cooperation with the Trust, has also implemented virtual wards, a method of preventive risk stratification

'lifestyle characteristics of the population' (e.g. smoking status) and four included the 'weight' subdomain. The domains 'disease burden' ($n = 5$), 'participation' ($n = 2$) and 'functioning/quality of life' ($n = 5$) were less prevalent. The number of measures used, varied greatly within each subdomain, ranging from 1 to 33 measures.

3.3.2. *Quality of care*

Sixteen PM initiatives used measures in the domain 'effectivity' (Table 3). Within this domain, the 'follow-up care' ($n = 10$) and 'provision of preventive screening' ($n = 9$) subdomains were used most frequently. 'Patient safety' and 'responsiveness' were evaluated by fifteen and sixteen PM initiatives respectively, with most focusing on 'complications' ($n = 11$) and 'communication between patient and caregiver' ($n = 9$). Thirteen PM initiatives evaluated the 'timeliness' domain and both 'accessibility' and 'support' were evaluated by eleven PM initiatives. Dominant subdomains within 'timeliness' and 'accessibility' were 'access to medical care' ($n = 8$) and '(waiting) time needed in hospital process' ($n = 9$). The number of measures per subdomain varied between a single measure and 69 measures.

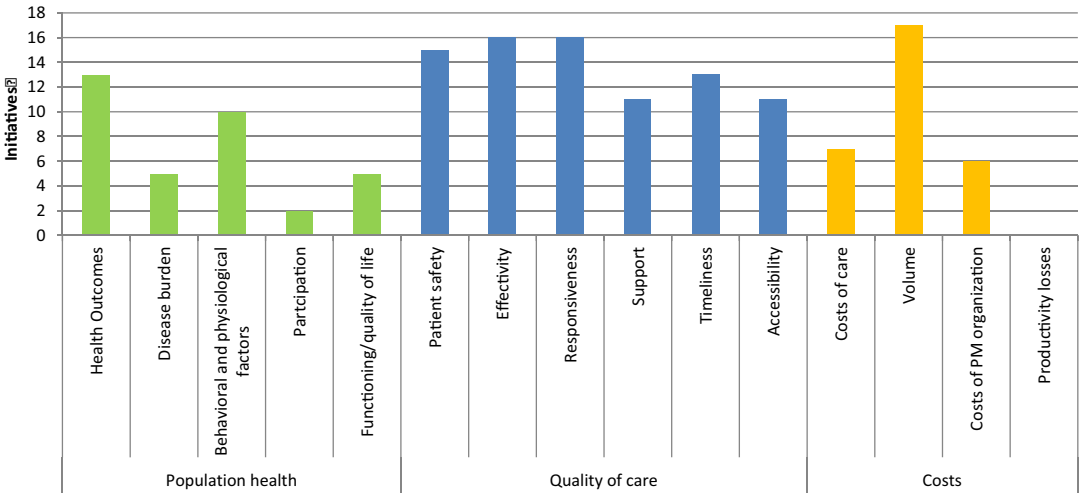

Fig. 2. Overview of number of initiatives found per domain.

3.3.3. Costs

In the costs dimension (Table 4) the most prevalent domain was 'volume' ($n = 17$), in which thirteen PM initiatives evaluate the 'care utilization' (e.g. number of GP visits per inhabitant). The domains 'costs of care' ($n = 7$) and 'costs of PM organizations' ($n = 6$) were less prevalent. The most often used subdomains within these two domains were 'average costs of care' ($n = 6$) in 'costs of care' and 'financial performance' ($n = 6$) in 'costs of PM organization'. For each of the subdomains, 1–24 measures were used. The 'productivity losses' domain was not measured by any PM initiative.

3.4. Measure level

Appendix 3 shows the measures from each PM initiative categorized by dimension, domain and subdomain as well as whether it was a process measure, outcome

Table 2
Domains, subdomains and measures used for population health.

Domain	Subdomains	# of initiatives evaluating subdomain	# of measures in subdomain	Example of used measures in subdomain
Health outcomes *Measured by 13 initiatives*	Mortality	8	11	Under 75 mortality form cardiovascular diseases
	Overall health status	7	8	Change in health
	Life expectations	2	2	Life expectancy at birth
	Medication utilization	1	1	Share of the population with multi-medication
Disease burden *Measured by 5 initiatives*	Disease prevalence	4	19	Proportion of patients with diabetes diagnosis
	Disease incidence	3	3	Chlamydia rate per 100,000 residents
	Care utilization	1	1	Illness burden (measures relative health of a group based upon the number and types of health care services used)
	Comorbidity	1	3	Proportion of insured with multi-morbidity
Behavioral and physiological factors *Measured by 10 initiatives*	Lifestyle characteristics of the population	9	33	The percentage of the population (15+) who smoke
	Weight	5	9	Obesity prevalence
	Mortality	1	1	Percentage of driving deaths with alcohol involvement
	Provision of preventive care	1	1	MMR (measles, mumps and rubella) vaccine uptake rate
Participation *Measured by 2 initiatives*	Dependent patient prevalence	1	1	Proportion of insured with working disability
	Social inclusion	1	1	Social inclusion (of mental health and addiction clients)
Functioning/quality of life *Measured by 5 initiatives*	Quality of life	4	6	Health-related quality of life for people with long term conditions
	Dependent patient prevalence	2	3	Proportion of insured with aid- and safety regulations

Table 3
Domains, subdomains and measures used for quality of care.

Domain	Subdomains	# of initiatives evaluating subdomain	# of measures in subdomain	Example of used measures in subdomain
Patient safety *Measured by 15 initiatives*	Complications	11	63	Number of Clostridium Difficile Health Care Associated Infections
	Protocols and guidelines	4	5	Rate of compliance with good hand hygiene practice
	Care instruction provided to patient	3	10	Percent of patients who reported that staff "always" explained about medicines before giving it to them
	(Un)safe use of medication	2	8	Proportion of insured with Benzodiazepines (>20 defined daily doses)
	Care utilization	2	2	Early elective delivery
	Mortality	2	5	Heart bypass surgery mortality
	Provision of correct treatment	2	2	% of patients that receive treatment in accordance with validated research
	Provision of preventive screening	2	2	% of inpatients (aged 75+) who received a falls assessment
	Communication between health care professionals	1	1	Safe use of abbreviations
Effectivity *Measured by 16 initiatives*	Follow-up care	10	35	Diabetes eye exam
	Provision of preventive screening	9	28	Proportion of women aged 50–69 years who have had a breast screen in the last 24 months
	Clinical outcomes	8	21	Percent of beneficiaries with diabetes whose HbA1c is in poor control (>9%)
	Medication utilization	6	19	Proportion of patients with CHD and beta blockers
	Mortality	6	14	Pneumonia mortality rate per discharge
	Avoidable care prevalence	4	8	Percentage of hospital readmissions within 30 days of discharge
	Patient receiving self-directed support	4	7	(Provision of) patient assessment for self-management
	Provision of lifestyle interventions	4	13	% Opiate or Crack Users in effective drug treatment
	Care utilization	3	10	Proportion of patients who had at least one hospitalization
	Optimal care	3	11	Optimal diabetes care
	Recovery	3	5	Depression remission at six months
	Pain control	2	2	Percent of patients who reported that their pain was "always" well controlled
	Provision of correct treatment	2	2	Proportion of Counties Manukau residents who have had a previous cardio vascular event who are on triple therapy
	Absence due to sickness	1	1	Proportion of back pain patients incapable to work because of low back pain for more than 14 days
	Composite measure (Functioning and Quality of life)	1	3	Functional status and quality of life outcome: total knee replacement
	Delivery of ineffective care	1	2	Ineffective pharmacotherapy in Alzheimer's disease
	Disease survival rate	1	2	One year survival from all cancers
	End-of-life care	1	1	End-of-life measure (percentage of time spend at home during the last six months of life)
	Integration of services	1	3	% of patients that stated that hospital and primary care coordination was good/very good
	Lifestyle characteristics of the population	1	1	% of babies exclusively breastfeeding on hospital discharge
	Patient knowledge	1	2	Knowledge of the patient (Consumer Assessment of Health care Providers and Systems)
Responsiveness *Measured by 16 initiatives*	Patient satisfaction	13	24	Patients who reported YES they would definitely recommend the hospital
	Communication between patient and caregiver	9	29	Percentage of surveyed patients that were 'very satisfied' with communication and coordination of experience
	Participation of patient in the care process	4	6	Shared decision making
	Integration of services	3	6	(Referring/) Connecting the patient to the community resources

Table 3 (*Continued*)

Domain	Subdomains	# of initiatives evaluating subdomain	# of measures in subdomain	Example of used measures in subdomain
	Patient experience of care environment	3	5	Percent of patients who reported that their room and bathroom were "Always" clean
	(Waiting) time needed in hospital process	2	2	Percent of patients who reported that they "always" received help as soon as they wanted
	Change rate of insurance company	1	1	Change rate (number of people changing insurance company)
	Complaints about care	1	2	Complaints: total number received – hospital
	Provision of preventive screening	1	1	Preventive care reminders and data
Support *Measured by 11 initiatives*	Communication between health care professionals	5	21	Documentation send prior to or within 60 after patient ED transfer
	Improvement process	5	29	Number of caregivers that complete the Soul and Science of Caring program
	Technology use	4	7	Electronic health records adoption
	Evaluation of care giver	3	4	% of carers receiving an assessment
	Absence due to sickness	2	2	Sickness absence of staff
	Integration of services	2	2	Engagement with community based providers
	Staff capacity	2	6	Staff turnover rate
	Communication between patient and caregiver	1	1	Innovation in interaction between patients and professionals
	Environmental impact	1	2	Carbon emissions of initiative
	Protocols and guidelines	1	1	(Agreement on) protocolization
	Workforce diversity	1	1	Improved workforce diversity as a percentage by ethnicity compared to population percentage by ethnicity
Timeliness *Measured by 13 initiatives*	(Waiting) time needed in hospital process	9	69	Waiting in the exam room
	Follow-up care	6	11	Proportion of diabetes patients with ophthalmologist contact in two years
	Provision of preventive screening	4	6	Proportion of patients referred urgently with high suspicion of cancer to first cancer treatment within 62 days
	Medicalization utilization	2	7	Aspirin at arrival at emergency department
	Provision of lifestyle interventions	2	4	% safeguarding referrals (reporting abuse) conferences within 30 days
	Patient receiving self-directed support	1	1	People with diabetes diagnosed less than a year referred to structured education
Accessibility *Measured by 11 initiatives*	Access to medical care	8	21	Getting an appointment for routine care
	Care utilization	4	16	% of adults (20–64) accessing to specialist mental health services
	Spread of caregivers	2	4	Ratio of population to primary care physicians in a county
	Access to non-medical facilities	1	2	Percentage of the population who live reasonably close to locations for physical activity, including parks or recreational facilities
	Communication between health care professionals	1	1	% of admissions into assessment, treatment and rehabilitation made by direct community referral
	Insurance coverage	1	2	Percentage of the population younger than age 65 without health insurance
	Participation of patient in care process	1	1	Seeing the doctor of your choice

measure, structure measure, PROM or PREM and by which PM initiatives it was applied. Of the 865 measures used in total, 187 measures could be classified as outcome measures, 524 as process measures, 49 as structure measures, 85 as PREMs and 20 as PROMs. Within the 56 subdomains, a variety of measures was used, many measuring roughly the same concepts as another measure. However, less than 10% of all measures could be matched exactly to a measure used by a different PM initiative, indicating that they generally did not have the same numerator and denominator. Measuring the HbA1c level of diabetes patients was one of the few examples of a measure that was used in multiple PM initiatives. Additionally, several measures were only applied by one of the PM initiatives as these aimed to evaluate progress of a specific part, a specific intervention or a particular goal of that PM initiatives. This led to five subdomains with just a single measure. For instance, 'workforce diversity' was only measured by Counties Manukau.

3.5. Selection of measures

The dimensions in which PM initiatives selected their measures were predominantly based on goals specific to

Table 4
Domains, subdomains and measures used for costs.

Domain	Subdomains	# of initiatives evaluating subdomain	# of measures in subdomain	Example of used measures in subdomain
Costs of care *Measured by 7 initiatives*	Average costs of care	6	11	Average costs of inpatient stay
	Substitution	2	2	Specialized care vs. primary care expenditure (%)
Volume *Measured by 17 initiatives*	Care utilization	13	57	Number of ED visits of population
	Avoidable care prevalence	11	24	Acute hospital readmissions
	Provision of preventive screening	11	36	Mammography screening
	Provision of lifestyle interventions	6	10	'Appetite for life' nutrition courses provided in the community
	Medication utilization	4	14	Regulation scope for generics
	Claims send to insurance company	1	3	Total medical claims
	Integration of services	1	1	Session with mental health and addiction counselors
	Patients receiving self-directed support	1	7	People supported by district nursing services
Costs PM organization *Measured by 6 initiatives*	Financial performance	6	9	Achievement of 1% surplus of health commissioned spend
	Improvement process	1	3	Delivery of Cost Improvement Program savings plan
Productivity losses *Measured by 0 initiatives*	–	0	0	–

the PM initiative ($n = 16$) and the Triple Aim ($n = 9$). The NHS England, for instance, selected measures for each of their Clinical Commissioning Groups related goals, such as 'preventing people from dying prematurely'. The criteria used to select measures within these overarching dimensions generally focused on measuring PM initiatives' priority areas ($n = 11$) and on that, where possible, measures should be deduced from other (national) evaluation frameworks ($n = 10$) (Table 5). These criteria suggest that local context plays a dominant role in the selection of measures. Furthermore, six PM initiatives stated that data for the measures should be easily available and five specified that providers needed to be able to see their own performance in a timely fashion.

4. Discussion

This study aimed to develop insight into how PM initiatives evaluate the Triple Aim by creating an international overview that extensively describes applied measures used by PM initiatives. Results illustrated that most measures were related to the quality of care dimension. This dimension was covered by all twenty PM initiatives and included the vast majority of measures. The dimensions population health and costs comprised far less measures and lacked a uniform coverage of their domains. The selection criteria for measures suggested that contextual factors of the PM initiatives often play a key role in evaluation of the Triple Aim.

Table 5
Selection criteria for measures.

Reason/criteria	Reported by # of initiatives
Measures have to match and measure priority areas	11
Measures, where possible, should be deduced from other (national) evaluation frameworks	10
Data must be easily available to include the measure	6
Measures have to be evidence based	4
There must be empirical evidence that the system level that is measured, is accountable for the largest part of the outcome of that measure	4
Providers have to be able to see their own performance in a timely fashion	4
Measures have to improve quality improvement	3
Providers have to partake in the development of the measures	3
Measures have to prioritize outcomes instead of process	2
Measures have to include a large enough population	1
Measures that measure the appropriateness of care should be used where possible	1
Measures must measure something that is considered as clinically important	1
Measures must show a large enough variability across providers	1
Measures for primary care have to be included	1
Measures must take overuse into account	1
Measures must be risk adjusted	1
Measures must represent a reasonable cross section of conditions and procedures	1

Similar to the results of the IOM report [18], this study found a large number of measures used in Triple Aim evaluations, which showed few similarities. Additionally, this study identified that in PM initiatives the focus of these measures tends not to be as broad as is proposed by existing frameworks, especially the population health dimensions takes a back seat. The frameworks of Struijs et al. [2] and the IHI [16] consisted out of three dimensions (population health, quality of care and costs), each with multiple domains (e.g. 'participation', 'patient experiences' and 'productivity'). Even though not all PM initiatives explicitly state the Triple Aim, it is still remarkable that not all three dimensions are as broadly evaluated as proposed by Berwick et al. [4]. This is particularly remarkable as it is assumed that only simultaneous pursuit and thus evaluation will ensure a sustainable and higher quality health care system [4].

Moreover, relatively new though relevant concepts, such as participation (population health dimension), productivity losses (costs dimension) and PREMs and PROMs, were also scarcely included in evaluations. In the population health dimension specifically, the absence of the 'participation' domain and the dominance of the 'health outcomes' domain indicate that measures based on a conservative idea of health are still dominant. This seems to contradict the realization that these traditional measures alone no longer suffice for evaluating (population) health [92]. Huber et al. [93], for example, defined health as "the ability to adapt and self-manage". They operationalized this concept by using more traditional measures, such as clinical outcomes and mental functioning, in combination with social participation and spiritual well-being measures [14]. These newer definitions of health have seemingly not yet found their way into current evaluations. A similar situation can be observed in the quality of care dimension. Here the concept of patient-centered care was introduced by the IOM's *Crossing the Quality Chasm* report [13]. The concept entails active engagement of patients in order to provide tailored care [94]. Patients should be included in the evaluation to effectively assess patient-centered care, but the underrepresentation of PROMs and PREMs demonstrates that improvements could be made here. Generally, these examples show that newer trends and mindsets are not yet included in PM evaluations, possibly due to operationalization issues, and may require more attention and discussion in the future in order to be incorporated.

Furthermore, it is notable that some measures show a tension between the Triple Aim dimensions, though this is not yet explicitly mentioned by the PM initiatives. Measures such as 'utilization of high cost imaging services' (e.g. MRI) should be reduced from a costs perspective. However, from a quality of care perspective, the use of these services could increase patient safety and effectivity as is the case in the diagnosis of breast cancer for example [95]. PM initiatives should be aware of this possible tension when they implement initiatives that pursue all three Triple Aim dimensions; improving one dimension does not always mean improvements in other dimensions. Porter [96] recognizes this conflict as well and suggests that the goal of a health care system should be to increase value, i.e. the health outcomes per dollar spent. Since value creation can be seen as the optimization of the Triple Aim [16], it could help PM initiatives make decisions when dealing with tension between dimensions.

The large number of different measures identified by this study and the IOM report [18] introduces a high measurement burden and limits comparison among PM initiatives. The IOM's attempt to solve these issues was the creation of fifteen core measures for the United States. However, in an international setting this may not be the most appropriate approach as contextual factors play a large role in measure selection. Therefore, a first step could be to reach international consensus on the inclusion of specific domains – not measures – across population health, quality of care and costs. This should encourage PM initiatives to each pursue and evaluate all three dimensions of the Triple Aim, which currently is not yet the case, while still having the possibility to choose their own locally applicable measures. Ideally, once consensus is reached, a standardized set of measures for each domain should be created from which PM initiatives can select measures that apply to them. Measures selected by a PM initiative within each domain could then be used to create a composite score for each domain [97]. Such a system would broaden evaluation strategies by ensuring coverage of all three dimensions of the Triple Aim and increase comparability while still considering contextual factors.

The quality assessment showed that the reporting of most PM initiatives was missing information regarding their evaluation process. The measure specifications and process descriptions, for example, were often lacking in detail and could benefit from improvement. These reports might not be held to the same standards as scientific literature, but reporting has become of increased importance due to the growing number of measures used in health care [18]. The amount of information currently available limits researchers and PM initiatives that would want to further deepen the material.

By performing an explorative study, it was possible to select the latest PM initiatives and include the most up-to-date evaluation strategies. Nevertheless, some PM initiatives might have been omitted due to the search strategy that was used. Furthermore, even though the inclusion criteria were applied as consistent as possible, some decisions were not clear-cut. For example, when looking at inclusion criteria 2b, it is debatable whether the Alternative Quality Contract pursues the Triple Aim. Additionally, selection criteria six ensured that the evaluations were conducted at least once. However, PM initiatives are continually evolving and changing and some of the latest developments might have been excluded as no evaluation is yet available. An example would be the Next Generation Accountable Care Organizations model [98,99]. However, these nuances and differences were limited, and probably have not affected conclusions.

This explorative study identified that measure selection was primarily based on contextual factors. As a consequence, PM initiatives might remain within traditional boundaries of organizations and domains as this data is often more easily available. Only if there is more awareness, effort and understanding to create new data or to link publicly available data from the social domain or

productivity to quality of care and costs data, will there be optimal insight into all three dimensions of the Triple Aim.

5. Conclusions

In summary, a great variety of measures is applied by PM initiatives to evaluate the Triple Aim. Currently used measures, mainly pragmatically determined, are predominantly related to quality of care and at the same time show a lack of similarities between PM initiatives. In general, this prevents a comprehensive evaluation of the Triple Aim dimensions and the ability to compare PM initiatives. In order to improve evaluations, PM initiatives should consciously assess all three dimensions of the Triple Aim. The data used should also go beyond organizational boundaries and should consider newer population-centered measures. Consensus on the coverage of domains and on a multiple-option set of standardized measures could further both the inclusion of the various domains as well as the comparability between PM initiatives.

Conflicts of interest

None reported.

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Appendix A. Supplementary data

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