

Path to Action – Closing the Gap to Make Patient Blood Management the New Norm(al) as Viewed by Implementors in Diverse Countries

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17

18 **ABSTRACT** (316 words)

19 **Background:** Patient Blood Management (PBM) is an evidence-based approach in surgery and
20 emergency care which aims to minimize the risk for blood loss and the need for blood
21 replacement for each patient through a coordinated multidisciplinary care process before,
22 during, and after surgery. In combination with blood loss, anemia is the main driver for
23 transfusion and an independent risk factor for adverse outcomes including morbidity and
24 mortality. Hence, identifying and correcting anemia as well as minimizing blood loss are
25 important pillars of PBM. Evidence demonstrates that PBM significantly improves outcomes
26 and safety while reducing cost by macroeconomic magnitudes. Despite its huge potential to
27 improve healthcare systems, PBM is not yet adopted broadly. The aim of this study is to
28 analyze the collective experiences of a diverse group of PBM implementors across countries
29 reflecting different healthcare contexts and to use these experiences to develop a guidance
30 for initiating and orchestrating PBM implementation for stakeholders from diverse
31 professional backgrounds.

32 **Methods:** Semi-structured interviews were conducted with 1-4 PBM implementors from 12
33 countries in Asia, Latin America, Australia, Central and Eastern Europe, the Middle East, and
34 Africa. Responses reflecting the drivers, barriers, measures, and stakeholders regarding the
35 implementation of PBM were summarized per country, and key observations extracted. By
36 clustering the levels of intervention for PBM implementation, a PBM implementation
37 framework was created and populated.

38 **Results:** A set of PBM implementation measures were extracted from the interviews with
39 the implementors. Most of these measures relate to one of six levels of implementation
40 including government, healthcare providers, funding, research, training/education, and

41 patients/public. Essential cross-level measures are multi-stakeholder communication and
42 collaboration.

43 **Conclusion:** This implementation matrix resulting from this research helps to decompose the
44 complexity of PBM implementation into concrete measures on each implementation level. It
45 provides guidance for diverse stakeholders to independently initiate and develop strategies
46 to make PBM a national standard of care, thus closing current practice gaps and matching this
47 unmet public health need.

48

49 **KEY WORDS**

50 PATIENT BLOOD MANAGEMENT, TRANSFUSION, PATIENT OUTCOMES, PRACTICE CHANGE, CULTURE
51 CHANGE, IMPLEMENTATION,

52

53 *4498 words*

54 **Background**

55 Of the millions of patients hospitalized yearly, a large proportion is anemic at admission.
56 Preoperative anemia rates range from 20-75% (1), and hospital acquired anemia often adds
57 to the problem (2). In most cases, anemia is not considered a clinically significant condition,
58 remains unnoticed, and therefore uncorrected in hospitalized patients.

59 However, a large body of evidence shows that anemia, blood loss, and transfusion are
60 independent risk factors for adverse outcomes including morbidity, mortality and average
61 length of hospital stay (3–6). Patient Blood Management is a concept to reduce and preempt

62 the detrimental impact of anemia, blood loss, and transfusion. It is defined as “an evidence-
63 based bundle of care to optimize medical and surgical patient outcomes by clinically managing
64 and preserving a patient's own blood”(7). The ‘bundle of care’ in Patient Blood Management
65 entails a process to systematically identify, evaluate, and manage a patient’s own blood
66 before during and after surgery and thereby, to minimize the risk of blood loss and the need
67 for allogenic red blood cell transfusion. The multi-professional, multimodal and individualized
68 approach involves general practitioners, hematologists, anesthesiologists, intensive care
69 specialists, surgeons, and others. The term ‘Patient Blood Management’ was coined in
70 2005(8), but the concept has been emerging since a much longer time (9,10). Meanwhile,
71 large multicentric observational studies and randomized controlled trials demonstrated that
72 Patient Blood Management significantly improves morbidity, mortality, and average length of
73 hospital stay, while reducing overall cost of care (11–14). Clinical thought leaders urge that
74 Patient Blood Management should be implemented as standard of care, and reduction of
75 allogeneic blood product utilization should serve as a marker for success (15,16). In 2010, the
76 World Health Organization (WHO) endorsed Patient Blood Management (17) and the fourth
77 Strategic Objective of the ‘WHO Action framework for blood products 2020-2023’ released in
78 February 2020 calls for ‘Effective implementation of patient blood management’(18).

79 However, despite compelling evidence and ongoing WHO policy drive, practical guidance for
80 healthcare providers and national authorities(15,19–21) and clinical guidelines and
81 recommendations across numerous specialties and national health systems(16,22–30),
82 implementation of Patient Blood Management is still far behind the expectations for good
83 and safe clinical practices.

84 The implementation of Patient Blood Management is hampered by barriers mostly related to
85 the difficulty of changing traditional “physician’s attitudes” towards transfusion(31) and
86 “transfusion behavior”(32–34). Even hard-hitting crises such as the HIV-pandemic in the
87 1970s and 1980s with tens of thousands infected from contaminated donor blood, the huge
88 death toll, billions of dollars in financial losses from lawsuits and compensations and criminal
89 charges (35) only had a transient impact on changing long standing transfusion practice(36).
90 What was called at the time “transfusion alternative strategies” showed compelling results
91 and could have been helpful to reduce overall blood utilization with similar outcomes (37–
92 40), but went largely unnoticed (3). Instead, the focus remained solely on improving blood
93 product safety through introducing donor blood testing methods with unprecedented cost
94 per quality adjusted life year (QALY) between 4.7 and 11.2 million US-\$, representing 94-224
95 times the then commonly accepted threshold in public health decision making (50,000 US-
96 \$/QALY) (41,42). Meanwhile, and despite rapidly accumulating clinical evidence for adverse
97 transfusion outcomes and favorable Patient Blood Management outcomes (43), numerous
98 Patient Blood Management guidelines (16,22–30), WHO endorsement (17), call for Patient
99 Blood Management (18), and several national policy recommendations, the global
100 implementation of Patient Blood Management is still alarmingly slow. Huge inter-center and
101 inter-country transfusion variability indicates, that blood utilization is rather driven by culture
102 and behavior than evidence (33,34,44–46).

103 Continuing to ignore the cumulative evidence puts life, well-being and safety of millions of
104 hospitalized patients at risk. Delaying Patient Blood Management implementation also means
105 that healthcare systems forego savings of macro-economic magnitudes from a system-wide
106 implementation of Patient Blood Management (14). This is even more alarming in countries
107 striving towards Universal Healthcare Coverage and with severe resource constraints. In 2016,

108 Eichbaum et al compared the Patient Blood Management implementation status in four
109 countries using a six-questions survey and observed considerable variation between countries
110 driven both by differences in health contexts and disparities in resources (47). They concluded
111 that comparing Patient Blood Management strategies across low-, middle-, and high-income
112 countries should foster mutual learning and implementing innovative, evidence-based
113 strategies for improvement.

114 Following this recommendation, a more in-depth questionnaire was developed in this study
115 to gather the experiences of a diverse group of implementors of Patient Blood Management
116 across countries with different economic and healthcare contexts. The first aim of this study
117 was to identify the status-quo and approach of the implementation in each of the surveyed
118 countries, the drivers, barriers, measures, and stakeholders to be involved. The second aim
119 of the study was to analyze this information and synthesize it into an implementation
120 framework for Patient Blood Management which can serve as a comprehensive guidance how
121 to implement Patient Blood Management.

122 **Methods**

123 Semi-structured interviews mostly lasting 45-60 minutes were conducted between November
124 2019 and May 2020 with a multi-disciplinary group of 36 Patient Blood Management
125 implementors leading the implementation of Patient Blood Management in their respective
126 environment. The twelve countries from Latin America, Central and Eastern Europe, Australia,
127 Asia, Middle East and Africa were selected to reflect experiences from high income and Low-
128 and Middle-Income Countries (LMIC), different levels and types of healthcare resources and
129 system (national/ private funders, public / private providers), and different developmental
130 stages of Patient Blood Management (from early stage to fully integrated on policy level). All

131 interviewees were actively involved in implementing Patient Blood Management, and they
132 were selected from the network of the authors, the International Foundation Patient Blood
133 Management(48), and the local networks of the industry or other interviewees. The selection
134 aimed to represent different clinical disciplines (e.g., hematologists, anesthesiologists,
135 surgeons) and perspectives (e.g., clinical specialists, blood bank, policy, Patient Blood
136 Management coordinator, industry). The Swiss and the Australian setting served as reference
137 cases for a country with a national policy for Patient Blood Management (Australia) and a
138 hospital with advanced implementations status (Univ. Hospital of Zürich in Switzerland). All
139 interviews followed the structure of a newly developed questionnaire ([Additional File 1](#)). One
140 question required rating of predefined barriers between 0 (not important) and 4 (very
141 important), all other nine questions were formulated open without prompting specific
142 answers. The survey was first piloted with eleven interviewees. Most interviews were
143 conducted via web-communication (GoToMeeting™) by a single interviewer (AP Holtorf, Dr.
144 rer. nat, female, without pre-existing relationship to the interviewees) in English language,
145 two interviews were conducted by a second qualified male interviewer in Chinese language
146 after detailed briefing by the main interviewer. The interview questionnaire was provided to
147 the interviewees at least one week before the interviews. During the interviews, the
148 interviewees consented to note-taking, recording, and publication of the results. The notes
149 were revised using the recordings and the interviewees had the opportunity to review, correct
150 or complement their initial responses.

151 The content analysis and synthesis to provide the implementation matrix followed six
152 qualitative and quantitative steps: 1.) Responses per country were extracted to a structured
153 summary document (from two to four interviews per country except for Switzerland with
154 one). 2.) Responses from all countries regarding status-quo, approach of the implementation,

155 and 3.) drivers, barriers, measures, and stakeholders for Patient Blood Management were
156 categorized and transferred in an electronic spreadsheet. 4.) The categorized responses from
157 step three were ranked for the frequency of mentions. 5.) Accelerating and inhibiting factors
158 were pooled and translated into implementation measures. 6.) The measures were grouped
159 by the interventional levels (policy/government, funding, research, healthcare provision,
160 training/education, and public / patients). Steps 1 to 5 were conducted by the main
161 interviewer and step 6 collaboratively by the authors.

162 Results

163 Demographics

164 Thirty-six Patient Blood Management implementors, named “Patient Blood Management
165 Implementation Group” with 15 women and 21 men from 12 countries, were interviewed
166 following eleven pilot interviews (total of 47). The respective perspectives are depicted in
167 [Table 1](#).

168

169 [Table 1](#)

170

171 Current Status and Approach in Implementing Patient Blood Management (Question 3)

172 The country-level responses for the current level of Patient Blood Management
173 implementation and the approaches (top-down, bottom-up, or both approaches
174 simultaneously) are summarized in [Table 2](#). Australia, after initial bottom-up implementation
175 in several leading public and private institutions, has fully implemented Patient Blood
176 Management supported by national institutions including the National Blood Authority (NBA),

177 the Australian Commission on Safety and Quality in Healthcare, the Western Australia
178 Department of Health, and the Australian Red Cross Blood Service. In South Korea, Patient
179 Blood Management was implemented in few institutions about a decade ago, followed by a
180 broader strategic approach supported by national authorities. In China, Turkey and Mexico,
181 Patient Blood Management implementation originated with leading clinicians (“champions”)
182 of large national institutions and is now increasingly recognized by the authorities. In South
183 Africa, the implementation of Patient Blood Management is led by the South African National
184 Blood Service and supported by a national Patient Blood Management expert group (21).
185 Croatia, Greece and Lebanon seek the dual pathway, although the current political situation
186 in Lebanon has put all governmental support to a halt. Brazil, Saudi Arabia, and Switzerland
187 currently rely on local clinician-led initiatives (bottom-up).

188

189 *Table 2*

190

191

192 Drivers for the implementation of Patient Blood Management (Question 7A)

193 In *Figure 1*, the most prominent of the eleven drivers mentioned unprompted during the
194 interviews were patient outcomes (26 mentions), cost savings (23 mentions), preventing or
195 better dealing with blood shortages (16 mentions from Sth. Korea, Turkey, Mexico, China,
196 Brazil), improving patient safety or reducing complications (15 mentions from Brazil, China,
197 Sth. Korea, Saudi Arabia, Turkey). Several experts mentioned national policy (8), education
198 and awareness (concerning the risks of transfusion and benefits of Patient Blood
199 Management) (7), and a quality assurance system (6).

200 *Shorter length of hospital stays, better use of resources, and reduction of waste* were only
201 mentioned once each. *Patient demand* was considered to become a driver once the risks
202 related to transfusion and the benefits Patient Blood Management were recognized more
203 broadly in the general population.

204

205 *Figure 1: Drivers for Patient Blood Management*

206

207 **Barriers for the Implementation of Patient Blood Management (Question 6)**

208 Except for Australia, where Patient Blood Management is already widely adopted into
209 practice, the need to *change work practice* was rated as the most prominent barrier for the
210 implementation of Patient Blood Management as shown in [Table 3](#). The need for
211 *collaboration and communication* was rated equally important across the countries, followed
212 by the *lack of experience with Patient Blood Management, the feasibility to integrate Patient*
213 *Blood Management into the current processes, and strong belief in transfusion.*

214

215 *Table 3*

216

217 **Accelerators and inhibitors for the implementation of Patient Blood Management**

218 **(Question 7E)**

219 The responses for factors accelerating or supporting Patient Blood Management
220 implementation fell into 24 categories as shown in [Figure 2 \(left part\)](#). *Generation of local*
221 *data and evidence, education and training for Patient Blood Management, a national Patient*

222 *Blood Management policy, and strong thought leadership*, were the most frequently
223 mentioned factors. *Blood scarcity, funding, awareness of transfusion risks, incentives for*
224 *Patient Blood Management engagement, belief and commitment of care personnel, and*
225 *quality assurance obligation* were also frequently mentioned. During the final six interviews
226 between February and May 2020, the COVID-19 pandemic was newly mentioned as potential
227 accelerator due to increased blood scarcity and potential blood safety issues.

228

229 *Figure 2: Accelerators and Inhibitors for Patient Blood Management*

230

231 The inhibitors or delaying factors fell into 22 categories (see [Figure 2, right part](#)) with the most
232 frequently mentioned being low awareness, no funding for set-up cost, education gaps, and
233 stickiness of the old practice (even stronger if combined with the responses for the closely
234 related *resistance against change*), *lack of interdisciplinary commitment*, and *resistance*
235 *against change*.

236

237 Stakeholders (Question 7B)

238 Sixty-three percent of the interviewees (29 of 46) identified policy makers (National Health
239 Council, Ministry of Health, etc.) as important stakeholders in Patient Blood Management
240 implementation. As shown in [Figure 3](#), the majority also listed either specialists in general
241 (22), or specific specialists (12 x anesthesiologists, 7 x hematologists, 5 x surgeons), 35% (16
242 of 46) included the hospital management. Other stakeholders (professional societies, national
243 or regional blood banks, payers, nursing staff, enthusiastic champions, hospital pharmacists,

244 patients/patient organizations, pharmaceutical companies, researchers/academics, hospital
245 champion, general practitioners were mentioned less frequently or only in other parts of the
246 interview (medical schools, non-governmental organizations, or the public at large).

247

248 *Figure 3: Stakeholders Influencing Patient Blood Management Implementation*

249

250 **Deduction and clustering of implementation measures**

251 After translating accelerators and inhibitors into actionable measures and clustering these
252 measures by the type (level) of intervention, six levels for intervention were identified:
253 government/policy, funding, research, healthcare providers, education/training, and
254 public/patients. On each of the six levels specific measures contribute to the implementation
255 of Patient Blood Management as reflected in [Table 4](#) with reference to the concrete examples
256 reported by the implementors.

257

258 *Table 4*

259

260

261 **Discussion**

262 **The Challenge**

263 Unless translated into the daily routine and organizational culture, evidence is of limited value
264 (49). To bridge the gap and effectuate the necessary culture change, it is essential to

265 understand the drivers and barriers for Patient Blood Management as well as the
266 stakeholders' roles and responsibilities. An essential challenge in replacing the long-standing,
267 well-organized, product-centered culture of transfusion medicine by the patient-centered
268 model of Patient Blood Management is that most diverse stakeholders need to communicate,
269 collaborate and overcome the complexity of the Patient Blood Management implementation
270 process. This starts with their specific contribution to the systemic implementation as
271 summarized into the implementation matrix displayed in *Figure 4*, which was derived from
272 the full and detailed collection of measures identified from the interviews (*Table 4*). We will
273 discuss each level of the table in more detail in the passages following below.

274

275 *Figure 4*

276

277 Using the Implementation Matrix to Develop Patient Blood Management Strategies

278 The Patient Blood Management-implementation matrix, as derived from the interviews,
279 guides Patient Blood Management implementors in systematically identifying effective
280 measures for Patient Blood Management implementation depending on the economic and
281 healthcare context in their country. These measures will be discussed in more detail along six
282 implementation levels.

283

284 Government Level

285 Patient Blood Management is expected to improve quality of care, reduce dependency on
286 donor blood, and contribute to better access to healthcare and equity (evidence-based blood

287 preservation for all patients/citizens in the country). In Western Australia, hospital stays were
288 reduced by almost 70,000 days over 5 years (14). Suchlike improvement enhances capacity of
289 care and consequently, patient access, and resource utilization. Likewise, the savings due to
290 Patient Blood Management allow for better allocation of scarce resources, thus increasing
291 productivity of the healthcare sector. This should motivate national policy makers to prioritize
292 Patient Blood Management.

293 National policy makers and senior representatives of the Health Ministry are important
294 stakeholders in coordinating Patient Blood Management implementation nationally (see
295 [Figure 3](#)). Reporting and incentivization of key performance indicators, accreditation of
296 healthcare providers for Patient Blood Management, Patient Blood Management certification
297 of clinicians, and funding and facilitating the development of multi-disciplinary national
298 Patient Blood Management guidelines form essential structural elements for driving Patient
299 Blood Management implementation nation-wide.

300 However, structural changes on government level usually require long time. One
301 implementor stated “it takes more than seven years to introduce a policy in our country”.
302 Creating a sense of urgency through multiple stimuli, including success stories demonstrated
303 in pilots and the generation, publication, or communication of the evidence, can help to
304 overcome the inertness for introducing a new medical model perceived as being complex(9).

305

306 Healthcare Provider Level

307 Patient Blood Management offers the rare opportunity to improve patient outcomes while
308 reducing resource utilization and cost (14,50,51). The healthcare provider related measures
309 reported by the implementors start with the identification of local champions and allies from

310 clinical and non-clinical departments to create the sufficient momentum and mass for the
311 implementation. The securing of funding, information technology (IT) infrastructure and
312 support to enable Patient Blood Management data collection, reporting and benchmarking
313 was deemed equally necessary as establishing multi-professional teams, Patient Blood
314 Management committees, program coordinators and nurses. As recommended previously by
315 others (19,52) and aligned with recognized approaches to change (53,54), implementors
316 preferred a piloting approach (“harvest low hanging fruit”) accompanied by the development
317 of internal capability, aiming to gain practical experience and to optimize the Patient Blood
318 Management processes in the local context. Other important modules on the provider level
319 were developing Patient Blood Management standard operating procedures, defining key
320 performance indicators, and measuring outcomes.

321 Electronic clinical decision support systems for controlling transfusions were deemed
322 effective, also if combined with systems to incentivize and reward the progression towards
323 Patient Blood Management. Electronic transfusion decision support systems can effectively
324 reduce transfusion rate and index in the daily routine(55,56) and serve as a ‘nudging’
325 mechanism. ‘Nudging’ denotes “non-regulatory and non-monetary interventions for
326 changing behavior that steer people in a particular direction while preserving their freedom
327 of choice”(57,58). This includes automated or targeted reminders, individual performance
328 reviews based on local data collection and analysis, or Patient Blood Management dashboards
329 as reported elsewhere(59).

330

331 Training and Education Level

332 To avoid asymmetry of information and conflicting behaviors within the hospital, training, and
333 communication on Patient Blood Management needs to address the entire clinical staff
334 including clinical specialists, nurses, pharmacists, and others influencing decisions related to
335 managing patients' blood. Implementors suggested that clinical knowledge and skills for
336 Patient Blood Management must be embedded in both under- and postgraduate education
337 (curricula in medical schools, accredited continuous medical education, Patient Blood
338 Management academies, and e-learning- and information-platforms). However, except for
339 Western Australia, Patient Blood Management is currently not part of the undergraduate
340 curriculum of medical students. Like Patient Blood Management preceptorships, educational
341 and training activities for Patient Blood Management, are currently organized for post-
342 graduates, often initiated by the implementors and local Patient Blood Management
343 champions, and mostly industry sponsored. Implementors should liaise with the leadership
344 of academia and medical schools to firmly integrate Patient Blood Management into the
345 undergraduate education in alignment with the federal Ministries of Health and Education,
346 where applicable.

347

348

349 Research Level

350 Patient Blood Management offers a broad spectrum of new experimental, clinical,
351 epidemiological, and health-economic research opportunities, as evidenced by the growing
352 number of research publications. Benchmarking and reporting of key performance indicators
353 for Patient Blood Management yield valuable insights concerning clinical and economic

354 outcomes related to Patient Blood Management. Further research as well as national and
355 international exchange will help to improve Patient Blood Management techniques as also
356 highlighted by international thought leaders (29,52,59,60). Most importantly, as an essential
357 prerequisite, the implementors demanded to generate and communicate local evidence
358 (prove of outcomes and cost-effectiveness in the local context at local cost structures) to link
359 the implementation across hospitals and to foster policies on the national level.

360

361 Funder Level

362 Public funders may benefit from Patient Blood Management through reduced average length
363 of hospital stay and lower resource consumption, resulting in cost containment and better
364 resource use. Private funders may expect higher profitability, in particular with diagnosis
365 related groups (DRG) or value-based reimbursement systems (e.g., accountable care): in DRGs
366 with high anemia prevalence and potentially high blood loss such as obstetrics, cardiovascular
367 surgery or oncology, the total cost per episode of care have shown to decrease over time,
368 thus leading to reduced tariffs (61). For Germany, overall yearly cost-savings with elective
369 surgery were calculated to be €1,029 million - almost 1.58% of the total national hospital
370 budget(62).

371 Even in fee-for-service settings, funders may benefit from Patient Blood Management:
372 currently, they might reimburse hospitals for the number of transfusions administered, while
373 patients pay for their anemia treatment out-of-pocket. Where transparent, implementors in
374 the interviews reported increasing cost of blood components (per unit) due to increasing
375 measures for quality and safety testing. Once funders begin incentivizing (pre-operative)
376 anemia management as an essential part of Patient Blood Management, they foster better

377 outcomes, fewer complications, and shorter hospital stays, thus reducing the overall
378 reimbursement cost per episode of care as compared to the currently established transfusion
379 preferences(63,64). The cost of quality assurance and administering these blood products is
380 a multifold of the actual acquisition cost and therefore, represents a substantial cost volume
381 for the hospital and consequently for the funder, even where allogeneic blood products are
382 covered by national funds and are considered 'free'(65,66).

383 Appropriate reimbursement of Patient Blood Management including anemia management
384 was a strong request in our interviews, and implementors even proposed to incentivize
385 Patient Blood Management for healthcare providers. Given the documented savings potential
386 with Patient Blood Management (14,62,67–70), it should be a priority for implementors to
387 inform, educate and engage funders on this important issue. Following the example of the
388 German health insurance BARMER (61), insurers may even help underpinning the Patient
389 Blood Management value using their own data to demonstrate savings with improved
390 outcomes.

391

392 Patient Level

393 According to the implementors, Patient Blood Management and its benefits are largely
394 unknown to patients, despite being the 'big winners' from Patient Blood Management with
395 significantly improved clinical outcomes, safety, and reduced average length of hospital stay.
396 Patients usually seek medical treatment based on a proper diagnosis and expect to be treated
397 with safe and effective medical or surgical interventions. Unless being informed by their
398 treating physician and being involved for shared decision making, they would not know that
399 Patient Blood Management improves their chances for earlier discharge from hospital and

400 reduces their risk for hospital acquired infection or even mortality. Patient advocates could
401 contribute by creating Patient Blood Management awareness, but also by educating for and
402 defending patients' rights. Collaborating and likewise, supporting national campaigns to
403 emphasize safety and the beneficial outcomes of Patient Blood Management, could foster
404 shared clinical decision making and informed consent. Some implementors even saw the
405 potential for patient advocates to approach funders to incentivize and support Patient Blood
406 Management.

407 Potential risks were expected by one implementor when entering the public domain too early
408 and thus, creating demand before physicians would be sufficiently familiar with Patient Blood
409 Management and its benefit. Another implementor cautioned, that too much information on
410 transfusion risks may negatively impact on the willingness to donate blood. Involvement of
411 patients or patient advocates should be planned thoroughly within the country culture and
412 context. However, the aim to *involve patients more in their own care*(71), the strive for
413 *'person-centered healthcare'*(72), and the priority of increased patient safety(73–75)
414 conforms to physicians' obligations towards educating and informing patients about all risks
415 and benefits of available treatment options. Medico-legal experts increasingly caution that
416 widespread disregard of transfusion associated risks for adverse outcomes may result in
417 litigation against those neglecting physicians and specialists (76). Informing the public and
418 the patients in collaboration with patient advocacy groups can be a powerful element of the
419 Patient Blood Management implementation strategy. Engaging the public and patients will
420 not only result in more demand for Patient Blood Management but also improve patient
421 satisfaction and foster participatory medicine.

422

423 Guided Implementation

424 In some of the countries described in this survey, Patient Blood Management was
425 implemented simultaneously from bottom-up (e.g., from a department level or
426 hospital/clinical level) and top-down (driven by policy and/or hospital administrative
427 leadership) (see [Table 2](#)) with large variation in the closeness of the interaction between
428 policy and operational levels. In other countries, implementation progresses just through the
429 bottom-up pathway, predominantly initiated, and led by individuals or small groups with
430 different clinical background or innovation managers. To effectively coordinate and execute
431 a statewide or even national implementation project across all six interdependent layers
432 requires governance (14,20,77). Following the example of Western Australia (14,77), the EU
433 Guide for Health Authorities (20) suggests that National Patient Blood Management Steering
434 Committees, preferably under the authority of the Health Ministry, should coordinate
435 planning and provisioning of Patient Blood Management resources, structural requirements,
436 and national and international Patient Blood Management research efforts. Transitional tasks
437 forces were proposed to develop national Patient Blood Management reimbursement
438 schemes and managing Patient Blood Management transition costs (i.e. costs to manage the
439 ‘paradigm shift’). Likewise, National Patient Blood Management Steering Committees could
440 facilitate broad and homogeneous adoption, supported by accompanied by national
441 programs or committees for guidelines development, data collection, benchmarking, and
442 analytics.

443 The experiences and expectations of the implementors confirmed the importance of adapting
444 to the local healthcare and cultural context and aligning with the local / national healthcare
445 priorities and funding situation. Implementation success depends on good change strategies.

446 Resistance from the old transfusion paradigm due to ignorance and conflicting incentives
447 needs to be overcome, and the Patient Blood Management paradigm must be anchored in
448 the healthcare delivery culture.

449 Kotter's model for managing change embraces eight essential accelerators: establishing a
450 sense of urgency, creating a guiding coalition, developing a change vision, communicating the
451 vision for buy-in, empowering broad-based action, generating short-term wins, never letting
452 up, and incorporating changes into the culture(78,79). Concurrent action, well adapted to the
453 local context, across all eight change accelerators while rapidly building a network of change
454 agents should maximize its adoption and impact(79).

455 Adaptation to the local context depends on access to and inclusion of the key stakeholders
456 and influencers within the own healthcare environment. Implementors need to identify the
457 stakeholders in implementing Patient Blood Management and understand what motivates
458 each of them to support, engage, or contribute(19–21).

459 The implementation matrix (*Figure 4*) may serve as a guidance in planning, even if starting
460 with a small pilot. Following Realist Evaluation approach(80) the user should, on each level,
461 assess what works (best) in the local context, when, and which stakeholders should be
462 involved for successfully creating the implementation path for Patient Blood Management in
463 the country or organization.

464 Limitations

465 The following limitations should be considered for this research. The selected countries
466 cannot be fully representative for all countries and healthcare systems across the world.
467 However, they were from five continents and included healthcare systems of high or lower

468 income, and the interviewees were professionals leading and/or promoting Patient Blood
469 Management in the healthcare sector of their respective environment. The impact of the
470 various implementation measures across six levels could not be determined. Once Patient
471 Blood Management will be established in more countries and healthcare systems, key
472 performance indicators might be linked to specific measures and rated, thus showing their
473 relative importance.

474 Conclusion

475 With the objective of learning from the practical experiences with the implementation of
476 Patient Blood Management, structured interviews were conducted with a multi-disciplinary
477 group of Patient Blood Management implementors in twelve countries reflecting initial,
478 advanced, and full level of implementation. There was consensus that patients would benefit
479 most from Patient Blood Management, with improved outcomes including morbidity,
480 mortality, quality of life, average length of hospital stay, and patient safety. The expected
481 improvements in outcomes and cost savings as well as more efficient use of (blood) resources
482 were identified as the core drivers. The need for *changing work practice* and for *collaboration*
483 *and communication* and the *lack of experience with Patient Blood Management* were rated
484 as most important barriers for Patient Blood Management. After converting the identified
485 accelerators and inhibitors for Patient Blood Management into actionable implementation
486 measures, six levels for intervention were identified, including government, healthcare
487 providers, education, funders, research, and patients. This forms the framework for a six-level
488 implementation matrix, describing all measures and expected outcomes as reported by the
489 implementors.

490

491

492 Abbreviations

493 Countries:

494 AUS Australia

495 BRA Brazil

496 CHN Peoples Republic of China

497 HRV Croatia

498 GRC Greece

499 KOR Republic of Korea

500 LBN Lebanon

501 MEX Mexico

502 SAU Kingdom of Saudi Arabia

503 ZAF South Africa

504 CHE Switzerland

505 TUR Turkey

506 Other:

507 CME Continuing Medical Education

508 GP General Practitioner

509 LMIC Low- and Middle-Income Country

510 MoH Ministry of Health
511 PBM Patient Blood Management
512 QoL Quality of Life
513 SoC Standard of Care
514 WHO World Health Organization

515

516 **Declarations**

517 **Ethics approval and consent to participate**

518 No ethical approval was sought because the research did not entail systematic collection or
519 analysis of data in which human beings are exposed to manipulation, intervention, or
520 observation (WHO Manual (Section XV.2)). All interviewees were professionals who were
521 informed about and agreed to the purpose of the interviews before and at the beginning of
522 the interview. No personal data beyond the interviews with the implementors were used. The
523 interview guide underwent internal compliance review by the pharmaceutical company
524 interviewee in each of the participating countries.

525 **Consent for publication**

526 All interviewees consented to and supported the use of the information for this research and
527 publication. All main authors have consented to the publication.

528 Availability of data and materials

529 The results are presented in aggregated form. The original data are accessible through the
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Table Legends and Tables

Table 1: Demographics of the interviewees. (1 expert could represent more than 1 perspectives. Therefore, the numbers in the columns can add up to more than the number of experts). The survey was piloted with representatives of pharmaceutical companies being actively involved in Patient Blood Management (Abdi Ibrahim, Genesis Pharma, Hikma, Sandoz Pharma, Takeda, Vifor Pharma)

	Australia	Brazil	China	Croatia	Greece	Lebanon	Mexico	Saudi Arabia	South Africa	South Korea	Turkey	Switzerland	Total
	AUS	BRA	CHN	HRV	GRE	LBN	MEX	SAU	ZAF	KOR	TUR	CHE	
Number of Interviews	3	3	2	3	4	3	4	4	2	4	3	1	36
Hematologist	1	2			1			4	2	1			11
Anesthesiologist			1	3	1	1	1				2	1	10
Blood bank		1			2			4	1	1			9
Surgeon	1				1		1			3	1		7
Obstetrics Gynecology			1			2	1				1		5
Critical Care							2				1		3
Cardiovascular Medicine							1				1		2
Public Health / Health research							1				1		2
Ministry of Health										1	1		2
Nurse	1												1
Laboratory Medicine										1			1
Engineer		1											1
Patient advocate		1											1
Pharmaceutical Industry (Pilot Interviews)	1	1	1	1	1	1	1		1	1	1	1	11

Table 2: Summary of interview responses to the questions relating to the current status and approach to implementing Patient Blood Management on the national or local level. ‘Mature’ describes a high level of implementation; ‘Advanced’ denotes a strategic, coordinated approach towards general implementation; ‘Initiation’ describes the occurrence of few individual initiatives with low level

of coordination. Abbreviations: BB = Blood Bank; EU = European Union; MoH = Ministry of Health; N.A. = Not available; NBA = National Blood Authority; PBM = Patient Blood Management

	Australia	Brazil	China	Croatia	Greece	Lebanon	Mexico	Saudi Arabia	South Africa	South Korea	Switzerland	Turkey	
	AUS	BRA	CHN	HRV	GRE	LBN	MEX	SAU	ZAF	KOR	CHE	TUR	
Stage	MATURE; National Policy; Broad uptake	INITIATION; Scattered individual leadership	ADVANCED; National Drive	INITIATION; Specialist society drive	INITIATION; National drive through BB	INITIATION; individual initiatives	INITIATION; national project and coordinator	INITIATION; in some hospitals / institutions	INITIATION; individual initiatives.	ADVANCED; implementation project; strong PBM society	INITIATION / ADVANCED; in some hospitals / institutions	ADVANCED; Broad awareness through cross-specialty implementation project	
Approach	Top Down	NBA; States Legal framework, standards & guidance Quality certification	N.A.	National Health Commission, PBM as part of blood supply & demand strategy	MoH informed Some coordination by specialist society (network)	National BB (with MoH) and in cooperation with hospital managers	Original political drive suspended due to political situation	National project with Quality certification	National interest group, but not much coordination	N.A.	National drive: collaboration program for pilots, data collection, and setting standards	Limited due to strong federal healthcare policy structure	EU Project for PBM implementation
	Bottom up	Initially driven by individual leadership and multi-disciplinary teams in hospitals	Individual Leadership	Clinical champions in leading pilot hospitals	Clinical/ departmental champions	Individual initiatives in some hospitals / institutions	Individual initiatives in some hospitals / institutions	Coordinated bottom up	Introduced in some hospitals / institutions	Individual initiatives	Individual initiatives in single hospitals since 10 years	Strong in a few leading hospitals based on individual leadership	Leading institutions, broad awareness through specialist societies

Table 3: Rating of Barriers for Implementation by perceived severity of the barrier. The rating was between 0 (is no barrier) and 4 (high barrier). The barriers were sorted by the average rating (top to bottom decreasing). (N = 35) Color coding: red for average country values of 3 or higher, white for values between 2.01 and 2.99, and green for values of 2 or lower.

Barriers	Australia	Brazil	China, PR	Croatia	Greece	Lebanon	Mexico	Saudi Arabia	Sth Africa	Sth Korea	Switzerland	Turkey	Average	STDev
Change of work practice	1.0	3.7	3.5	3.3	3.3	3.3	3.8	3.0	3.5	2.5	3.0	3.3	3.1	0.74
Collaboration / communication	4.0	3.0	4.0	2.5	3.5	3.3	1.8	3.3	3.0	2.8	2.0	3.0	3.0	0.69
No / limited PBM experience	3.0	3.0	2.0	2.5	2.7	3.0	2.5	3.3	3.3	3.3	4.0	2.5	2.9	0.52
Process / Feasibility	3.5	3.0	3.0	3.0	2.0	3.0	2.5	2.5	3.0	3.3	3.0	2.2	2.8	0.44
Strong belief in transfusion	0.5	2.7	1.0	3.5	1.8	3.0	4.0	2.8	3.0	3.8	3.0	3.0	2.7	1.06
Number of stakeholders	1.5	2.7	0.0	2.8	2.5	4.0	2.3	2.8	2.0	1.5	2.0	3.7	2.3	1.05
Cost	0.5	3.0	2.5	2.5	2.0	4.0	2.5	1.8	2.0	2.5	2.0	1.5	2.2	0.85
Sustainability	2.5	1.0	0.0	2.0	1.3	2.7	1.0	2.3	1.0	1.8	3.0	2.0	1.7	0.87
'Competition' w. other interventions	0.5	1.3	1.0	0.0	1.5	0.7	1.0	1.8	2.0	1.8	2.0	1.7	1.3	0.64

Table 4: Summary of measures to consider for implementing PBM, sorted by level of intervention: Government (national and/or regional), funding, research, healthcare provision, training/education, and patients

GOVERNMENT LEVEL (national or regional)			
Measures	Rational / Expectations	Examples	Points to consider
National Policy	<ul style="list-style-type: none"> National initiatives and guidance push the hospitals towards PBM implementation 	<ul style="list-style-type: none"> AUS: National policy for PBM and national measures to support implementation TUR: Close collaboration of PBM leaders with MoH; qualification for a 3-yr EU grant dedicated to a systematic country-wide implementation of PBM(1) 	<p>CHALLENGES</p> <ul style="list-style-type: none"> Changing of policy priorities; political instability (LBN) Policy priority of shifting from tertiary hospitals to primary care level antagonizes the pre-

		<ul style="list-style-type: none"> • CHN: officially addressed the importance of PBM to improve clinical practice(2) 	<p>operative PBM interventions (CHN)</p> <ul style="list-style-type: none"> • National policy not a game changer in countries with decentralized healthcare (CHE)
Blood Shortage	<ul style="list-style-type: none"> • Actual and anticipated blood shortage is recognized on a policy level and requires action; donation volume is shrinking, the demand for blood is increasing (aging population) • Donor deferrals due to new or re-emerging pathogens; cancelled blood collections due to lockdown during epidemics • Family replacement schemes: mandatory donations may increase risk and limit access 	<ul style="list-style-type: none"> • ZAF, CHN, MEX: Frequent supply issues • HRV, GRE: Seasonal shortages • KOR, ZAF: Shortage and COVID-19 virus risk¹ • BRA: Zika-Virus (3); supply issues in public system • AUS, TUR: Shortage predicted • LBN, GRE, MEX: Replacement modus • CHN: 30% Reciprocal blood donation 	<p>REMARKS</p> <ul style="list-style-type: none"> • Impact of COVID-19 pandemic on blood supply (4)
Strong PBM Thought Leadership	<ul style="list-style-type: none"> • Fosters a broader country-wide acceptance and change • Liaise on policy level, engage with payers, engage specialist societies, and introduce medical curricula 	<ul style="list-style-type: none"> • KOR: Korean PBM Society with multi-disciplinary leadership function • TUR: EU-funded project for PBM implementation across Turkey 	<p>REMARK</p> <ul style="list-style-type: none"> • May be difficult for few individuals to cover that scope and thus, formation of a high-level work or

¹ The risk of COVID-19 viral infection only became apparent starting in January 2020. Hence, this threat was only mentioned in the last interviews (KOR, ZAF, SAU)

			interest group may be advisable
PBM Incentives	<ul style="list-style-type: none"> • Attract clinicians to become part of the change • Increase level of experience and familiarity with PBM 	<ul style="list-style-type: none"> • CRO: participation in international clinical study • TUR, KOR, MEX, ZAF: National pilots & research opportunities 	REMARKS <ul style="list-style-type: none"> • Involve practitioners actively in research • Recognition of individual initiative through active engagement and authorship
National Guidelines	<ul style="list-style-type: none"> • Adapting international guidelines to local healthcare context can be essential for acceptance • National guidance will facilitate coordinated and homogeneous activities across the country 	<ul style="list-style-type: none"> • ZAF, TUR, KOR, MEX, BRA, HRV, CHN: ongoing projects to locally adapt international guidelines 	RISK <ul style="list-style-type: none"> • Scattered / fragmented approaches will make it difficult to consolidate in best practice
FUNDING LEVEL			
Measures	Rational / Expectations	Examples	Points to Consider
Alignment of policy and funding	<ul style="list-style-type: none"> • Consensus for a reimbursement and funding solution 	<ul style="list-style-type: none"> • KOR: Center for Disease Control in the MoH and the Health Insurance and Reimbursement Agency (HIRA) committed to PBM related projects (1) auditing the current level of transfusion appropriateness in each hospital, and (2) funding 	CHALLENGES <ul style="list-style-type: none"> • Heterogeneity in access to healthcare and its funding requires different approaches for funding and reimbursement of PBM (MEX, LBN)

		dedicated projects on PBM implementation in the country	
Reimbursement	<ul style="list-style-type: none"> • Increase the willingness to invest in establishing PBM • Adjust reimbursement systems to incentivize improved health outcomes and efficiency and disincentivize transfusion volume(5,6). 	<ul style="list-style-type: none"> • KOR, MEX, AUS, TUR: Funding national pilot or full implementation projects • BRA: volume-dependent reimbursement to hospitals (fee for service) incentivizes a high use of transfusions; but first examples of capitation-based hospital reimbursement emerge (supportive for PBM) 	<p>CHALLENGES</p> <ul style="list-style-type: none"> • Potential other sources of funding (NGOs, special international projects) • Funding always compromised during (economic) crises
Cost transparency for blood; Cost 'fairness'	<ul style="list-style-type: none"> • Mandate full cost transparency of transfusion and PBM to allow for cost-effective allocation of (public) funds 	<ul style="list-style-type: none"> • GRE, HRV: Not knowing the cost of blood products or artificially low cost impedes adoption of PBM 	<p>REMARKS</p> <ul style="list-style-type: none"> • Even if at zero cost to the hospital, blood products are not for free from a societal perspective
Funding and resources in hospital	<ul style="list-style-type: none"> • Secure funding necessary for setting up the infrastructure (including point-of-care testing devices, cell salvage equipment, pre-operative anemia clinic, continuous medical education (CME) and training • Identify and remove disincentives 	<ul style="list-style-type: none"> • HRV, GRE, LBN, MEX: Difficulties in securing funding despite principal support for the concept • BRA, LBN: Fee for service disincentivizes PBM (imbalance between profitability and patient health) • Alignment across budgets: e.g. pharmacy budget vs other cost 	<p>REMARKS</p> <ul style="list-style-type: none"> • Use measures / local data to demonstrate the realistic budget needs, ROI, time frame required.(7)
RESEARCH LEVEL			
Measures	Rational / Expectations	Examples	Points to Consider

Quality measurement/assurance	<ul style="list-style-type: none"> • Use of quality measures, to track blood use (i.e., units ordered, used, and discarded per hospital, ward, type of intervention and individual specialists) to shift focus to patient needs and outcomes 	<ul style="list-style-type: none"> • KOR, MEX, CHE, AUS: pursuing quality and performance measurement initiatives 	<p>REMARKS</p> <ul style="list-style-type: none"> • Performance measures empowers local transfusion committees and PBM implementation task forces
Collecting and publishing local data	<ul style="list-style-type: none"> • Demonstrating impact of PBM with local data on clinical outcomes, adverse events or complications, • Capturing and reporting local epidemiology data (prevalence) • Quantify opportunities, risks, and cost for PBM in the local setting; ideally as multi-disciplinary intra- or inter-hospital collaboration 	<ul style="list-style-type: none"> • AUS, CHE, KOR: local data collection systems initiated or established to enable reporting, benchmarking, or performance analysis • TUR: publication of local data(8) 	<p>REMARKS</p> <ul style="list-style-type: none"> • Local evidence helps to refute that the international experience may not be transferrable to the local context • Local research motivates participants to gain expertise and to become part of the change
Health-economic analyses	<ul style="list-style-type: none"> • To convince stakeholders of the cost-effectiveness of PBM, analyses must be based on local data (cost / outcomes) 	<ul style="list-style-type: none"> • Health-economic evidence from AUS, CHE, GER, and the USA(9,10) 	<p>CHALLENGE</p> <ul style="list-style-type: none"> • Current H/E evidence from countries with specific economic and health-economic settings and may not be generalizable
International support and collaboration	<ul style="list-style-type: none"> • Cross-fertilize and share the learnings transnationally 	<ul style="list-style-type: none"> • International collaboration is frequent, e.g. strong engagement of IFPBM & SABM, ZAF w. National Blood Authority in AUS, KOR w. AUS, BRA w. SABM. 	<p>REMARKS</p> <ul style="list-style-type: none"> • Includes international teaching, web-based services, advisory exchange, or involvement

			of experts in another country's task forces.
HEALTHCARE PROVIDER LEVEL			
Measures	Rational / Expectations	Examples	Points to Consider
Communication	<ul style="list-style-type: none"> • Strengthen belief and commitment of clinical staff • Re-align all stakeholders around the transfusion process 	<ul style="list-style-type: none"> • GRE: Generation of an intra-hospital consensus and protocol with reporting system for restrictive blood use • MEX, ZAF, AUS: continuous communication, involvement, and feedback by coordinator / initiator in hospital, • ZAF, MEX: Chat-group in a social media platform to report local experiences, announce events, and post relevant publications, questions. and suggestions 	A common vision and buy-in by those who need to change their practice is essential to achieve change(12)
Identify allies, build teams	<ul style="list-style-type: none"> • To increase clout and trust across specialties • Foster multi-disciplinary collaboration, mutual endorsement and support 	<ul style="list-style-type: none"> • LBN: Expanding across specialties already in initial phase added great impetus MEX, TUR: Multidisciplinary PBM Academies; LEB, KOR, ZAF: Multidisciplinary Iron Academies 	REMARK <ul style="list-style-type: none"> • PBM is a team effort(7,13,14) • Supports forming a guiding coalition(12)
Prior experience with PBM	<ul style="list-style-type: none"> • Expand the knowledge and openness for PBM by involving care personnel from different 	<ul style="list-style-type: none"> • Pilot projects in several hospitals/wards to involve and expose them to PBM methods 	REMARKS <ul style="list-style-type: none"> • Overcome the stickiness of the old practice(15) and resistance to change

	disciplines in implementation projects		
Ensure support from hospital administration	<ul style="list-style-type: none"> • Design/align the organization to enable optimal and sustainable PBM across specialties • Secure funding for staff, systems support (IT), other resources • Get approval to establish a multi-disciplinary PBM committee 	<ul style="list-style-type: none"> • Most initiatives reported that alignment with hospital administration / CEO was improving chances for success • HRV, GRE: Activities under departmental responsibility may not need agreement by hospital management. • LBN, SAU, HRV, LBN: To get funding for establishing PBM was difficult and therefore done within the existing resources (overtime) • BRA, MEX: dedicated project management ensures planning and roll out across specialties / departments 	<p>REMARKS</p> <ul style="list-style-type: none"> • While small changes could be introduced individually or within one specialty the full potential can only be achieved with multi-disciplinary change • Understand the economic and system incentives and to be in close communication to collaboratively identify the path to implementation (milestones, tasks, and responsibilities)
Local champion (Medical Director or project coordinator for PBM)	<ul style="list-style-type: none"> • Responsible for planning, organizing and directing PBM, supporting specialists, and ensuring continuous data collection, reporting and benchmarking, 	<ul style="list-style-type: none"> • HRV, GRE, MEX: general role in training, education, information, protocol development • BRA: Change management • AUS, CHE: organize PBM at patient level (case management) 	<p>REMARKS</p> <ul style="list-style-type: none"> • PBM coordinator can be a success factor for sustainability (AUS, CHE)
Hospital protocols (SOPs)	<ul style="list-style-type: none"> • Tailor PBM protocols to the specific hospital context and routines 	<ul style="list-style-type: none"> • HRV, GRE, TUR, MEX, BRA: Several interviewees reported the development of local protocols before the 	

	<ul style="list-style-type: none"> • Increase local ownership across the disciplines, interdisciplinary commitment 	availability of National Guidelines	
Data collection, reporting & benchmarking system	<ul style="list-style-type: none"> • Shows impact, measures gaps, and helps to improve quality of care 	<ul style="list-style-type: none"> • ZAF, KOR: currently developing a monitoring system in hospital(s) 	
Nudging clinicians & stimulating competition	<ul style="list-style-type: none"> • Using IT or quality reporting systems to motivate and remind physicians to practice PBM • Using the competitive nature of people to motivate them to excel in PBM 	<ul style="list-style-type: none"> • AUS, CHF, MEX, ZAF reported use or plan to use competitive forces or ‘nudging instruments’ to remind practitioners to improve their PBM practices (reminders, league tables) 	<p>REMARKS</p> <ul style="list-style-type: none"> • Include IT and/or quality specialists in developing the local procedures for mapping into data collection and analytical support tools • Nudging = nonregulatory and nonmonetary interventions that steer people in a particular direction while preserving their freedom of choice” (16,17)
Involving the entire care team	<ul style="list-style-type: none"> • Alignment, participatory processes 	<ul style="list-style-type: none"> • ZAF: Importance of involving nurses who have high influence on the patient care • GRE: Importance of aligning the ordering of blood products. 	<p>REMARKS</p> <ul style="list-style-type: none"> • Includes nursing, hospital pharmacy, blood ordering process to ensure common goals
Seizing local opportunities for improvement	<ul style="list-style-type: none"> • Create momentum: Use opportunities in own environment for starting with specific aspects of PBM 	<ul style="list-style-type: none"> • HRV, LBN: Start within ward/ department 	<p>REMARKS</p> <ul style="list-style-type: none"> • Even small ‘wins’ will motivate people

	<ul style="list-style-type: none"> • Move forward faster and prove success 	<ul style="list-style-type: none"> • ZAF: start with communication & education of hospital specialists • MEX, BRA: pilots 	
TRAINING & EDUCATION LEVEL			
Measures	Rational / Expectations	Examples	Points to Consider
Education and Training for PBM	<ul style="list-style-type: none"> • Identify and address knowledge gaps among specialists • Update under-and postgraduate curricula 	<ul style="list-style-type: none"> • AUS: Integration in medical school (University of Western Australia) curriculum & exams • MEX, ZAF, TUR: PBM academies and/or continued medical education (CME) for practitioners • AUS, ZAF: online training material(18) 	<p>REMARKS</p> <ul style="list-style-type: none"> • Training of all specialists concerned (incl. anesthesiologist, intensive care specialists, surgeons, hematologists, oncologists, gastroenterologists, obstetricians & gynecologists) and nursing staff in relation to benefits of PBM, • Avoid asymmetry in information to prevent that ‘eminence wins over evidence’ in the choice of therapy
Increase Awareness Transfusion Risks	<ul style="list-style-type: none"> • Overcome eminence-based practice (“transfusion is always beneficial”) and increase the knowledge about the associated risks 	<ul style="list-style-type: none"> • Global: Many of the specialists who administer transfusions during surgery (surgeons, anesthesiologists) often don’t see the mid- or long-term complications (infections, 	<p>REMARKS</p> <ul style="list-style-type: none"> • Necessitates re-education of all participants in the transfusion decision • Requires information, education, and reminders across specialties

		immune reactions, thrombosis).	(publications and newsletters, conferences, social media-channels)
Medico-legal aspects and protective measures as part of PBM training	<ul style="list-style-type: none"> Strengthen the assertiveness of physicians relating to PBM 	<ul style="list-style-type: none"> BRA: Litigation is commonly used by patients to get access to procedures which they perceive to be beneficial 	
PATIENT & PUBLIC LEVEL			
Measures	Rational / Expectations	Examples	Points to Consider
National information campaigns	<ul style="list-style-type: none"> Develop awareness for PBM Encourage patients to discuss PBM at their doctor's appointment Prevent litigation against physicians following guideline-compliant restrictive transfusion strategies Decrease patient demand blood transfusion 	<ul style="list-style-type: none"> KOR, LBN, ZAF: Initiated or conducted national awareness campaigns through important media channels BRA: Litigation is commonly used by patients to get access to procedures which they perceive to be beneficial 	<p>RISKS</p> <ul style="list-style-type: none"> If done too early, doctors might be overwhelmed by patient demand Too much information on transfusion risks may negatively impact the willingness of the public to donate blood <p>REMARK</p> <ul style="list-style-type: none"> Involving patients, collaborating with patients, and informing the public may improve understanding and reduce the risk for litigation

PAG initiatives	<ul style="list-style-type: none"> • Co-create national information campaigns (PBM thought leaders, politicians, PAGs) • Explore patient experiences and preferences • Engagement / advocating for PBM insurance coverage • Achieve comprehensive patient education on risks and benefits of all treatment options (including transfusion) for anaemia, blood loss and coagulopathy • Ensure fully informed consent and/or shared decision making • PAGs to request PBM certification and/or hospitals accreditation 	<ul style="list-style-type: none"> • HRV, KOR: Initial contacts • TUR: In contact with 5 NGO's, who receive regular information • GRE, LBN, HRV, KOR, BRA: increasing demand for participatory medicine and shared decision making by PAGs and/or healthcare policy 	<p>REMARKS</p> <ul style="list-style-type: none"> • PAG-patient interaction relating to transfusion and/or PBM not yet common • Co-creation / co-production: researchers, practitioners and the public join efforts and share responsibilities to develop, implement, monitor, evaluate and re-develop interventions(19)
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Abbreviations: Ministry of Health (MoH), Society for the Advancement of Blood Management (SABM, <https://sabm.org>), Return on Investment (ROI); Country Abbreviations: Australia (AUS), Brazil (BRA), Peoples Republic of China (CHN), Croatia (HRV), Greece (GRC), Republic of Korea (KOR), Lebanon (LBN), Mexico (MEX), South Africa (ZAF), Switzerland (CHE), Turkey (TUR), Patient Advocacy Group (PAG), International Foundation Patient Blood Management (IFPBM), Society for the Advancement of Blood Management (SABM)

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Figure Headings and Legends (Figures in separate Files)

Figure 1: Drivers for Patient Blood Management

Legend for Figure 1: Quantitative evaluation of all drivers mentioned by the interviewees when asked the question "What could be the main drivers for Patient Blood Management – Why is Patient Blood Management needed?". The responses were spontaneous and unprompted. (N = 46) The driving factors were sorted by the total number of mentions (top to bottom decreasing). Education & Awareness is abbreviated for 'education and awareness relating to the risks of transfusion and the benefits of Patient Blood Management'.

Figure 2: Accelerators and Inhibitors for Patient Blood Management

Legend for Figure 2: Quantitative evaluation of factors mentioned by the interviewees when asked for the factors which would accelerate (Accelerators) or delay or inhibit (Inhibitors) the implementation of Patient Blood Management from their perspective. The responses were spontaneous and unprompted. (N = 46) The items were sorted by the total number of mentions (top to bottom decreasing).

Figure 3: Stakeholders Influencing Patient Blood Management Implementation

Legend for Figure 3: Quantitative evaluation of categories mentioned by the interviewees to the question "Who in your opinion will be the essential stakeholders who will have to be involved / convinced?". The responses were spontaneous and unprompted. (N = 46) The stakeholder types were sorted by the total number of mentions (top to bottom decreasing). Medical education, Non-governmental organization (NGO) and the Public were not mentioned as important stakeholders specifically, but they were mentioned in other parts of the interview as important groups and therefore were added for completeness.

Figure 4: Patient Blood Management Implementation Matrix

Legend for Figure 4: Implementation matrix summarizing the aims, measures, and expected outcomes of comprehensive Patient Blood Management across six implementation levels. This implementation matrix is derived from the full table of measures (Table 4)

^{a)} *Equity: access to evidence-based blood preservation for all patients/citizens in the country*

Figures

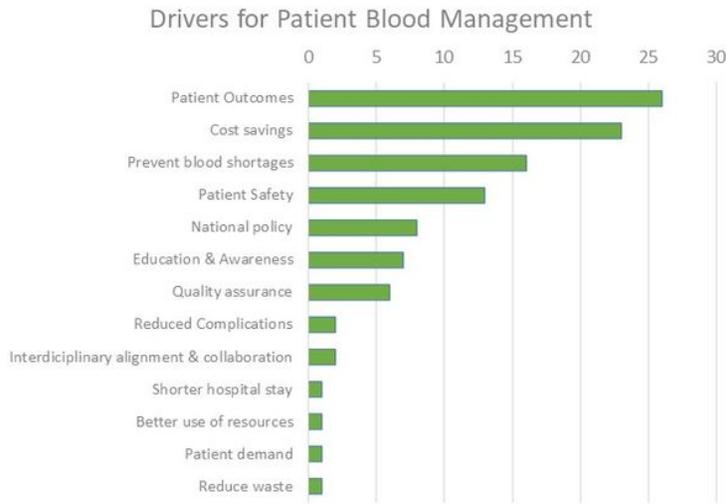


Figure 1: Quantitative evaluation of all drivers mentioned by the interviewees when asked "What could be the main drivers for Patient Blood Management – Why is Patient Blood Management needed?". The responses were spontaneous and unprompted. (N = 46) The driving factors were sorted by the total number of mentions (top to bottom decreasing). Education & Awareness is abbreviated for 'education and awareness relating to the risks of transfusion and the benefits of Patient Blood Management'.

Figure 1

Drivers for Patient Blood Management. Quantitative evaluation of all drivers mentioned by the interviewees when asked the question "What could be the main drivers for Patient Blood Management – Why is Patient Blood Management needed?". The responses were spontaneous and unprompted. (N = 46) The driving factors were sorted by the total number of mentions (top to bottom decreasing). Education & Awareness is abbreviated for 'education and awareness relating to the risks of transfusion and the benefits of Patient Blood Management'.

Accelerators and Inhibitors for Patient Blood Management

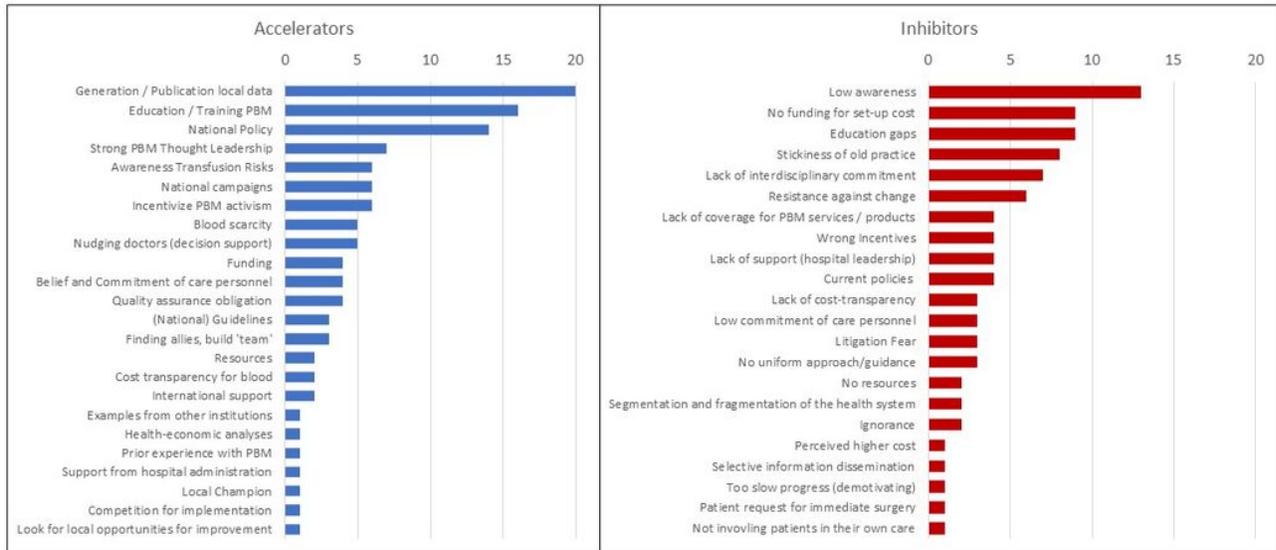


Figure 2: Quantitative evaluation of factors mentioned by the interviewees when asked for the factors which would accelerate (Accelerators) or delay or inhibit (Inhibitors) the implementation of Patient Blood Management from their perspective. The responses were spontaneous and unprompted. (N = 46) The items were sorted by the total number of mentions (top to bottom decreasing).

Figure 2

Accelerators and Inhibitors for Patient Blood Management Quantitative evaluation of factors mentioned by the interviewees when asked for the factors which would accelerate (Accelerators) or delay or inhibit (Inhibitors) the implementation of Patient Blood Management from their perspective. The responses were spontaneous and unprompted. (N = 46) The items were sorted by the total number of mentions (top to bottom decreasing).

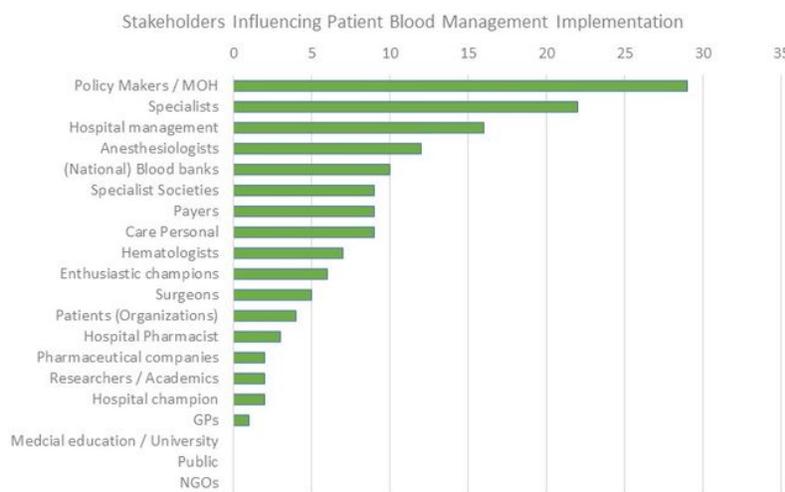


Figure 3: Quantitative evaluation of categories mentioned by the interviewees when asked for the important stakeholders to consider in the implementation of PBM from their perspective. The responses were spontaneous and unprompted. (N = 46) The stakeholder types were sorted by the total number of mentions (top to bottom decreasing). Medical education, Non-governmental organizations (NGOs) and the Public were not mentioned as important stakeholders specifically, but they were mentioned in other parts of the interview as important groups and are therefore added for completeness.

Figure 3

Stakeholders Influencing Patient Blood Management Implementation Quantitative evaluation of categories mentioned by the interviewees to the question “Who in your opinion will be the essential stakeholders who will have to be involved / convinced?”. The responses were spontaneous and unprompted. (N = 46) The stakeholder types were sorted by the total number of mentions (top to bottom decreasing). Medical education, Non-governmental organization (NGO) and the Public were not mentioned as important stakeholders specifically, but they were mentioned in other parts of the interview as important groups and therefore were added for completeness.

Patient Blood Management Implementation Matrix

	STRUCTURAL MEASURES	PROCEDURAL MEASURES	OUTCOMES
Government	Aim: Coordinate a nation-wide drive for evidence-based Patient Blood Management practices National Policy National cross-specialty guidelines National implementation project PBM as part of quality certification		Improved equity ^a ; Less need for donor blood Improved quality of care
Funding	Aim: Invest in most efficient clinical pathways for Patient Blood Management and Transfusion Blood cost transparency Balance cost & savings of PBM vs. transfusion across budget silos Establish funding options, incentives		Cost containment; Improved profitability
Research Evidence	Aim: Measure cost and outcomes related to Patient Blood Management and transfusion practices Metrics, Data, Benchmarking Publications: HEOR with PBM in national context Expanding the knowledge base International Exchange Research: Transfusion use & risks		Augmented evidence for context-related best practice, outcomes, and cost
Healthcare Provision	Aim: Implement best practice through pilots (data-based) and multi-disciplinary engagement Hospital champion, PBM coordinator Find allies, build cross-functional team Pilots implementations, (Local) Proof of concept Local procedures IT: Decision support, monitoring & nudging Incentives & Rewards Seize opportunities (Low-hanging fruit)		Improved Quality; Improved patient outcomes and safety
Medical Education	Aim: Teach best practice consistently across the clinical community Change of curriculum in Medical University: PBM as SoC Re-education / CME across specialty associations; PBM academies Social media use: Educational videos / content, chat-groups		PBM consolidated as new standard of care; Improved consistency of PBM practice
Patient Public	Aim: Increase demand and acceptance for patient-centered best practices Participatory medicine Enable patients or carers to actively participate in the therapeutic decision Collaborate with PAG's National awareness campaigns		Improved patient satisfaction; Shared decisions; Informed consent

Vertical labels on the left: Multi-Stakeholder collaboration: Specialty Societies, Task-Force, Work-Group

Vertical label on the right: Communicate & Educate: Clear messages

Figure 4: Implementation matrix summarizing the aims, measures, and expected outcomes of comprehensive Patient Blood Management across six implementation levels. This implementation matrix is derived from the full table of measures (Table 4).
 Abbreviations: Continuing Medical Education (CME), Health Economics and Outcomes Research (HEOR), Information Technology (IT), Patient Advocacy Group (PAG), Patient Blood Management (PBM), Standard of Care (SoC).
 (a) Equity: access to evidence-based blood preservation for all patients/citizens in the country

Figure 4

Patient Blood Management Implementation Matrix Legend for Figure 4: summarizing the aims, measures, and expected outcomes of comprehensive Patient Blood Management across six implementation levels. This implementation matrix is derived from the full table of measures (Table 4) a) Equity: access to evidence-based blood preservation for all patients/citizens in the country

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [AdditionalFile2completedCOREQchecklist20201120.pdf](#)
- [AdditionalFile1Questionnaire20200908.pdf](#)