Appendix 1 – Country Definitions by Gross National Income

Low middle and high income countries are defined by World Bank lending group definition based on Gross National Income (GNI):
https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

For the 2018 fiscal year, low-income economies are defined as those with a GNI per capita, calculated using the World Bank Atlas method, of $1,005 or less in 2016; lower middle-income economies are those with a GNI per capita between $1,006 and $3,955; upper middle-income economies are those with a GNI per capita between $3,956 and $12,235; high-income economies are those with a GNI per capita of $12,236 or more.

Inclusion criteria
Studies from the following countries will be included:
Afghanistan, Albania, Algeria, American Samoa, Angola, Argentina, Armenia, Azerbaijan, Bangladesh, Belarus, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Central African Republic, Chad, China, Columbia, Comoros, Democratic Republic of the Congo, DRC, Republic of the Congo, Costa Rica, Cote d'Ivoire, Ivory Coast, Croatia, Cuba, Djibouti, Dominica, Dominica Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Ethiopia, Fiji, Gabon, Gambia, Georgia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Indonesia, Islamic Republic of Iran, Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Kiribati, Democratic People's Republic of Korea, Kosovo, Kyrgyz Republic, Lao PDR, Laos, Lebanon, Lesotho, Liberia, Libya, Macedonia Republic, Madagascar, Malawi, Malaysia, Maldives, Mali, Marshall Islands, Mauritania, Mauritius, Mexico, Micronesia, Moldova, Mongolia, Montenegro, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Romania, Russian Federation, Rwanda, Samoa, Sao Tome and Principe, Senegal, Serbia, Sierra Leone, Solomon Islands, Somalia, Somaliland, South Africa, South Sudan, Sri Lanka, St. Lucia, Saint Lucia, St. Vincent and Grenadines, Saint Vincent and the Grenadines, Sudan, Suriname, Swaziland, Syrian Arab Republic, Syria, Tajikistan, Tanzania, Thailand, Timor-Leste, East Timor, Togo, Tonga, Tunisia, Turkey, Turkmenistan, Tuvalu, Uganda, Ukraine, Uzbekistan, Vanuatu, Venezuela, Vietnam, West Bank and Gaza, Republic of Yemen, Zambia, Zimbabwe

Exclusion criteria
Studies from the following high income countries will be excluded:
The Bahamas, Bahrain, Barbados, Belgium, Bermuda, British Virgin Islands, Brunei Darussalam, Canada, Cayman Islands, Channel Islands, Chile, Curacao, Cyprus, Czech Republic, Denmark, Estonia, Faroe Islands, Finland, France, French Polynesia, Germany, Gibraltar, Greece, Greenland, Guam, Hong Kong SAR-China, Hungary, Iceland, Isle of Man, Israel, Italy, Japan, Korea, Kuwait, Latvia, Liechtenstein, Lithuania, Luxembourg, Macao SAR-China, Malta, Monaco, Netherlands, New Caledonia, New Zealand, Northern Mariana Islands, Norway, Oman, Palau, Poland, Portugal, Puerto Rico, Qatar, San Marino, Saudi Arabia, Singapore, Sint Maarten (Dutch part), Slovak Republic, Slovenia, Spain, St Kitts and Nevis, St Martin (French part), Sweden, Switzerland, Taiwan-China, Trinidad and Tobago, Turks and Caicos Islands, United Arab Emirates, United Kingdom, United States, Uruguay, Virgin Islands (US).

Appendix 2 – Expert Recommendations for Implementing Change (ERIC) definitions of 73 strategies categorized by domain

Strategy	Definition
Domain: Use evaluative and iterative strategies	
1. Assess for readiness and identify barriers and facilitators	Assess various aspects of an organization to determine its degree of readiness to implement, barriers that may impede implementation, and strengths that can be used in the implementation effort
2. Audit and provide feedback	Collect and summarize clinical performance data over a specified time period and give it to clinicians and administrators to monitor, evaluate, and modify provider behavior
3. Purposely reexamine the implementation	Monitor progress and adjust clinical practices and implementation strategies to continuously improve the quality of care
4. Develop and implement tools for quality monitoring	Develop, test, and introduce into quality-monitoring systems the right input—the appropriate language, protocols, algorithms, standards, and measures (of processes, patient/consumer outcomes, and implementation outcomes) that are often specific to the innovation being implemented
5. Develop and organize quality monitoring systems	Develop and organize systems and procedures that monitor clinical processes and/or outcomes for the purpose of quality assurance and improvement
6. Develop a formal implementation blueprint	Develop a formal implementation blueprint that includes all goals and strategies. The blueprint should include the following: 1) aim/purpose of the implementation; 2) scope of the change (e.g., what organizational units are affected); 3) timeframe and milestones; and 4) appropriate performance/progress measures. Use and update this plan to guide the implementation effort over time
7. Conduct local needs assessment	Collect and analyze data related to the need for the innovation
8. Stage implementation scale up	Phase implementation efforts by starting with small pilots or demonstration projects and gradually move to a system wide rollout
9. Obtain and use patients/consumers and family feedback	Develop strategies to increase patient/consumer and family feedback on the implementation effort
10. Conduct cyclical small tests of change	Implement changes in a cyclical fashion using small tests of change before taking changes system-wide. Tests of change benefit from systematic measurement, and results of the tests of change are studied for insights on how to do better. This process continues serially over time, and refinement is added with each cycle
Domain: Provide interactive assistance	
11. Facilitation	A process of interactive problem solving and support that occurs in a context of a recognized need for improvement and a supportive interpersonal relationship
12. Provide local technical assistance	Develop and use a system to deliver technical assistance focused on implementation issues using local personnel
13. Provide clinical supervision	Provide clinicians with ongoing supervision focusing on the innovation. Provide training for clinical supervisors who will supervise clinicians who provide the innovation
14. Centralize technical assistance	Develop and use a centralized system to deliver technical assistance focused on implementation issues
Domain: Adapt and tailor to context	
15. Tailor strategies	Tailor the implementation strategies to address barriers and leverage facilitators that were identified through earlier data collection
16. Promote adaptability	Identify the ways a clinical innovation can be tailored to meet local needs and clarify which elements of the innovation must be maintained to preserve fidelity
17. Use data experts	Involve, hire, and/or consult experts to inform management on the use of data generated by implementation efforts

18. Use data warehousing techniques	Integrate clinical records across facilities and organizations to facilitate implementation across systems
Domain: Develop stakeholder inter-relationships	
19. Identify and prepare champions	Identify and prepare individuals who dedicate themselves to supporting, marketing, and driving through an implementation, overcoming indifference or resistance that the intervention may provoke in an organization
20. Organize clinician implementation team meetings	Develop and support teams of clinicians who are implementing the innovation and give them protected time to reflect on the implementation effort, share lessons learned, and support one another's learning
21. Recruit, designate, and train for leadership	Recruit, designate, and train leaders for the change effort
22. Inform local opinion leaders	Inform providers identified by colleagues as opinion leaders or "educationally influential" about the clinical innovation in the hopes that they will influence colleagues to adopt it
23. Build a coalition	Recruit and cultivate relationships with partners in the implementation effort
24. Obtain formal commitments	Obtain written commitments from key partners that state what they will do to implement the innovation
25. Identify early adopters	Identify early adopters at the local site to learn from their experiences with the practice innovation
26. Conduct local consensus discussions	Include local providers and other stakeholders in discussions that address whether the chosen problem is important and whether the clinical innovation to address it is appropriate
27. Capture and share local knowledge	Capture local knowledge from implementation sites on how implementers and clinicians made something work in their setting and then share it with other sites
28. Use advisory boards and workgroups	Create and engage a formal group of multiple kinds of stakeholders to provide input and advice on implementation efforts and to elicit recommendations for improvements
29. Use an implementation advisor	Seek guidance from experts in implementation
30. Model and simulate change	Model or simulate the change that will be implemented prior to implementation
31. Visit other sites	Visit sites where a similar implementation effort has been considered successful
32. Involve executive boards	Involve existing governing structures (e.g., boards of directors, medical staff boards of governance) in the implementation effort, including the review of data on implementation processes
33. Develop an implementation glossary	Develop and distribute a list of terms describing the innovation, implementation, and stakeholders in the organizational change
34. Develop academic partnerships	Partner with a university or academic unit for the purposes of shared training and bringing research skills to an implementation project
35. Promote network weaving	Identify and build on existing high-quality working relationships and networks within and outside the organization, organizational units, teams, etc. to promote information sharing, collaborative problem-solving, and a shared vision/goal related to implementing the innovation
Domain: Train and educate stakeholders	
36. Conduct ongoing training	Plan for and conduct training in the clinical innovation in an ongoing way
37. Provide ongoing consultation	Provide ongoing consultation with one or more experts in the strategies used to support implementing the innovation
38. Develop educational materials	Develop and format manuals, toolkits, and other supporting materials in ways that make it easier for stakeholders to learn about the innovation and for clinicians to learn how to deliver the clinical innovation
39. Make training dynamic	Vary the information delivery methods to cater to different learning styles and work contexts, and shape the training in the innovation to be interactive

40. Distribute educational materials	Distribute educational materials (including guidelines, manuals, and toolkits) in person, by mail, and/or electronically
41. Use train-the-trainer strategies	Train designated clinicians or organizations to train others in the clinical innovation
42. Conduct educational meetings	Hold meetings targeted toward different stakeholder groups (e.g., providers, administrators, other organizational stakeholders, and community, patient/consumer, and family stakeholders) to teach them about the clinical innovation
43. Conduct educational outreach visits	Have a trained person meet with providers in their practice settings to educate providers about the clinical innovation with the intent of changing the provider's practice
44. Create a learning collaborative	Facilitate the formation of groups of providers or provider organizations and foster a collaborative learning environment to improve implementation of the clinical innovation
45. Shadow other experts	Provide ways for key individuals to directly observe experienced people engage with or use the targeted practice change/innovation
46. Work with educational institutions	Encourage educational institutions to train clinicians in the innovation
Domain: Support clinicians	
47. Facilitate relay of clinical data to providers	Provide as close to real-time data as possible about key measures of process/outcomes using integrated modes/channels of communication in a way that promotes use of the targeted innovation
48. Remind clinicians	Develop reminder systems designed to help clinicians to recall information and/or prompt them to use the clinical innovation
49. Develop resource sharing agreements	Develop partnerships with organizations that have resources needed to implement the innovation
50. Revise professional roles	Shift and revise roles among professionals who provide care, and redesign job characteristics
51. Create new clinical teams	Change who serves on the clinical team, adding different disciplines and different skills to make it more likely that the clinical innovation is delivered (or is more successfully delivered)
Domain: Engage consumers	
52. Involve patients/consumers and family members	Engage or include patients/consumers and families in the implementation effort
53. Intervene with patients/consumers to enhance uptake and adherence	Develop strategies with patients to encourage and problem solve around adherence
54. Prepare patients/consumers to be active participants	Prepare patients/consumers to be active in their care, to ask questions, and specifically to inquire about care guidelines, the evidence behind clinical decisions, or about available evidence-supported treatments
55. Increase demand	Attempt to influence the market for the clinical innovation to increase competition intensity and to increase the maturity of the market for the clinical innovation
56. Use mass media	Use media to reach large numbers of people to spread the word about the clinical innovation
Domain: Utilize financial strategies	
57. Fund and contract for the clinical innovation	Governments and other payers of services issue requests for proposals to deliver the innovation, use contracting processes to motivate providers to deliver the clinical innovation, and develop new funding formulas that make it more likely that providers will deliver the innovation
58. Access new funding Place innovation on fee for service lists/formularies	Access new or existing money to facilitate the implementation
59. Place innovation on fee for	Work to place the clinical innovation on lists of actions for which providers can be

service lists/formularies	reimbursed (e.g., a drug is placed on a formulary, a procedure is now reimbursable)
60. Alter incentive/allowance structures	Work to incentivize the adoption and implementation of the clinical innovation
61. Make billing easier	Make it easier to bill for the clinical innovation
62. Alter patient/consumer fees	Create fee structures where patients/consumers pay less for preferred treatments (the clinical innovation) and more for less-preferred treatments
63. Use other payment schemes	Introduce payment approaches (in a catch-all category)
64. Develop disincentives	Provide financial disincentives for failure to implement or use the clinical innovations
65. Use capitated payments	Pay providers or care systems a set amount per patient/consumer for delivering clinical care
Domain: Change infrastructure	
66. Mandate change	Have leadership declare the priority of the innovation and their determination to have it implemented
76. Change record systems	Change records systems to allow better assessment of implementation or clinical outcomes
68. Change physical structure and equipment	Evaluate current configurations and adapt, as needed, the physical structure and/or equipment (e.g., changing the layout of a room, adding equipment) to best accommodate the targeted innovation
69. Create or change credentialing and/or licensure standards	Create an organization that certifies clinicians in the innovation or encourage an existing organization to do so. Change governmental professional certification or licensure requirements to include delivering the innovation. Work to alter continuing education requirements to shape professional practice toward the innovation
70. Change service sites	Change the location of clinical service sites to increase access
71. Change accreditation or membership requirements	Strive to alter accreditation standards so that they require or encourage use of the clinical innovation. Work to alter membership organization requirements so that those who want to affiliate with the organization are encouraged or required to use the clinical innovation
72. Start a dissemination organization	Identify or start a separate organization that is responsible for disseminating the clinical innovation. It could be a for-profit or non-profit organization
73. Change liability laws	Participate in liability reform efforts that make clinicians more willing to deliver the clinical innovation

Table 2 Summary of characteristics of studies meeting inclusion criteria

If studies included both HIC and LMIC data, they were included but only LMIC outcome data was extracted.

	Country	Study population	Study type	Number of implementation strategies reported (max = 73)	Number of implementation outcomes reported (max = 8)	Key Findings	Number of LMIC authors / total number of authors
Haynes et al (2009)[12]+	Jordan, India, USA, Tanzania, Philippines, Canada, England, New Zealand	Non-cardiac surgical patients from 8 hospitals (4 HIC, 4 LMIC) Total of 3733 pre- and 3995 post- SSC implementation, of which 1835 and 1975 respectively were from LMIC sites	Observational pre- and post-interventional design	14	2	Mortality rate fell from 2·1% to 1·0% (p=0·006) across LMIC sites Complication rate fell from 11·7 % to 6·8% (p<0·001) across LMIC sites	5/15
Weiser et al (2010)[61]+	Jordan, India, USA, Tanzania, Philippines, Canada, England, New Zealand	Non-cardiac urgent surgical patients from 8 hospitals (4 HIC, 4 LMIC) 1750 consecutive patients of which 611/842 pre- and 690/908 post-SSC were from LMIC sites)	Observational pre- and post-interventional design	14	1	Overall adherence to 6 measured safety steps improved from 18·6% to 50·7% (p= 0·0001). Mortality fell from 3·7% to 1·4% (p=0·0067) All complications fell from 18·4% to 11·7% (p=0·0001) *Separate HIC and LMIC data is not reported.*	0/6
Askarian et al (2011)[26]	Iran	All surgical patients from 1 hospital 144 pre- and 150 post SSC implementation	Observational pre- and post-interventional design	3	1	All complications fell from 22·9% to 10%.	3/3
Haynes et al (2011)[39]+	Jordan, India, USA, Tanzania, Philippines, Canada, England, New Zealand	A total of 538 operating room staff from 8 hospital sites (4 HIC, 4 LMIC), of which 180/281 pre, and 164/257 post were from LMIC sites	Pre- and post-intervention survey	14	2	Overall (HIC and LMIC data combined) use of the SSC resulted in improved score on the Safety Attitudes Questionnaire (SAQ). The degree of SAQ improvement correlated with a reduction in the postoperative complication rate.	5/15
Delgardo Hurtado et al (2012)[33]	Guatemala	147 operating room staff from 1 hospital	Descriptive study	0	5	Between 73·7% and 100% of nurses reported the SSC was used either always or almost always	6/6
Rivero Garcia et al	Mexico	93 cardiac surgery	Prospective	1	4	SSC use recorded in medical notes in 88% of	4/4

(2012)[68]		operating room staff, and 326 patients from 1 hospital	observational study			cases. 'Sign in' was completed in 95%, 'time out' in 89% and 'sign out' in 82% of cases, respectively	
Kasatpibal et al (2012)[41]	Thailand	4340 patients from 1 hospital	Prospective observational study	1	2	Compliance with various items on the SSC varied widely. Confirmation of patient identification and procedure was 91%, but surgical site marking was 19%. Assessment of difficult intubation and major blood loss was assess in every case, pulse oximetry used in 95%, antibiotic prophylaxis administered in 71%, and completion of surgical count in 97%.	6/6
Khorshidifar et al (2012)[43]	Iran	100 patients in 2 hospitals	Prospective observational study	0	1	SSC use was 76% Fidelity was >90% Complications in the SSC group were 18%, and in the non-SSC group 14%	3/3
Sayed et al (2012)[57]	Egypt	100 surgical patients from 1 hospital	Prospective observational study	0	2	Variability in proper completion of 'sign in' and 'time out', (from 0-100% depending on SSC item assessed). 'Sign out' was completed in 100% of cases.	6/6
Yuan et al (2012)[67]	Liberia	All surgical patients from 2 hospitals 232 pre- and 249 post SSC implementation	Observational pre- and post-interventional design	9	1	No significance difference in mortality following introduction of the SSC. SSC use was associated with reduced likelihood of all complications (adjusted OR: 0·45; 95% CI: 0·26 – 0·78), and SSI (adjusted OR: 0·28; 95% CI 0·15-0·54)	1/6
Becret et al (2013)[29]	Djibouti	All surgical patients from 1 hospital 259 pre- and 111 post SSC implementation	Observational pre- and post-interventional design	3	3	Use of SSC increased from 49% to 100% Fidelity increased from 24% to 99%	6/6
Kwok et al (2013)[45]++	Moldova	All surgical patients from 1 hospital 2145 pre- and 2212 post SSC implementation	Observational pre- and post-interventional design	17	2	Adherence to all safety processes increased from 0% to 66·9% ($p < 0·001$) All complications fell from 21·5% to 8·8% ($p < 0·001$) Infectious complications fell from 17·7% to 6·7% ($p < 0·001$) Mortality fell from 4·0% to 3·1% but was not statistically significant ($p = 0·151$)	2/9

Pancieri et al (2013)[52]	Brazil	30 operating room staff from 1 hospital	Descriptive qualitative study	2	3	100% of staff wanted to introduce the checklist to their operating theatres. 80% reported it improved safety. 86% reported it made no difference to communication.	4/4
Baradaran Binazir et al (2014)[27]	Iran	All surgical patients from 1 hospital 100 pre- and post SSC implementation	Observational pre- and post-interventional study	4	0	Complications fell from 30% to 12% (p=0·002) SSI fell from 13% to 7% (p=0·157)	5/5
Bashford et al (2014)[28]	Ethiopia	Operating room staff and 289 patients from plastic surgery department of 1 hospital	Prospective observational study, mixed methods design	16	5	SSC use was 83% at one month but fell to 65% at 8 months. Fidelity fell to 21% at 8 months.	1/6
El Mhamdi et al (2014)[69]	Tunisia	All surgical patients from 1 hospital 185 pre- and 323 post SSC implementation	Observational pre- and post-interventional study	10	0	Mortality fell from 2·7% to 1·9% SSI fell from 13·5% to 1·3%	6/6
de Freitas et al (2014)[37]	Brazil	135 surgical patients from 2 hospitals 375 patients (163 urological and 212 gynaecological) from 2 hospitals	Prospective observational study	5	2	Overall SSC use was 61%. SSC completed in full in 4% of cases. 'Sign in' was completed in 3·5%, 'time out' in 13·3% and 'sign out' in 27·9% of cases, respectively	6/6
Prakesh et al (2014)[53]	India	152 surgical patients from 1 hospital 72 in SSC group and 80 in control group	Case control study	0	1	Overall complication rates were 15·3% and 5·0%; and SSI were 1·3% and 8·3% in the SSC and control groups respectively	5/5
Chaudhary et al (2015)[30]	India	Hepatobiliary and gastrointestinal patients from 1 hospital 700 consecutive patients (350 patients in each group)	Randomised control trial	0	2	SSC group had reduction in mortality (5·7% vs 10%, p=0·04), post-operative wound (4·5% vs 8·5%, p=0·04) and abdominal (19·7% vs 28%, p=0·01) infection; and bleeding (0·5% vs 2·8%, p=0·03)	6/6

Kim et al (2015)[44]++	Moldova	Surgical patients from 1 hospital 2106 patients 1-4 months after implementation (short-term follow up), and 637 patients at 20-22 months post-SSC implementation (long-term follow up)	Longitudinal observational interventional design	17	1	Comparing results from short- and long term follow up: average rate of SSC completion of the SSC increased from 88% to 92%; mortality remained the same (3·1%); surgical complications fell from 8·8% to 6·1% (p=0·03); Infectious complications fell from 6·7% to 4·4% (p=0·03); and surgical site infections fell from 4·7% to 2·8% (p=0·05).	2/11
Lilaonitkul et al (2015)[47]	Uganda	3341 surgical and obstetric patients from 1 hospital	Observational pre- and post-interventional design	24	3	SSC use increased from 29·5% to 85% Surgical counting increased from 25% to 83%. Mean all-or-none completion rate was 69%.	4/7
Mazeiro et al (2015)[48]	Brazil	20 orthopaedic patients from 1 hospital and 22 operating room staff	Prospective observational study	4	2	SSC use was 100%. Adherence to the basic safety processes varied from near zero (antibiotic administration and assessment of the risk of blood loss) to over 90% (verification of patient identification, assessment of difficult intubation risk, completion of the surgical count)	4/4
McGinlay et al (2015)[49]	Romania	15 operating room staff from 1 hospital after using the SSC in 40 paediatric surgical patients	Prospective observational study	1	3	SSC was used in 55% of cases. Adherence to the basic safety process was over 70% except completion of surgical count was 55%.	1/3
Melekie et al (2015)[50]	Ethiopia	282 surgical patients and 82 operating room staff from 1 hospital	Prospective observational study	6	4	SSC was used in 39·7% of cases When used, SSC completeness rate was 63·4% for full completion and 36·6% for partially completion. Completion of 'sign in', 'time out' and 'sign out' was 69·5%, 64·6% and 54·3% respectively.	2/2
Oak et al (2015)[51]	India	3000 paediatric surgical patients from 1 paediatric hospital	Prospective longitudinal observational study over 2 years	0	3	SSC use was 98·2%. SSC was completely filled in 97·5% of all cases No major perioperative errors or events were noted.	4/4
Toor et al (2015)[59]	Pakistan	All surgical patients from 1 hospital 303 pre- and 310 post SSC	Observational pre- and post-interventional design	0	1	Adherence to appropriate antibiotic use increased from 37·6% to 91%. Post-operative infections fell from 32·7% to 15·2%	6/6

		implementation					
Santana et al (1) (2016)[56] +++	Brazil	Operating room staff from 3 hospitals 257 pre- and 215 post-SSC implementation	Pre- and post-intervention survey	3	2	Statistically significant improvement in the perception of safety and collaboration within the perioperative team following introduction of the SSC. The SCC was considered quick and easy to use by most staff. At least 90% of staff agreed the checklist helps to prevent errors.	3/3
Santana et al (2) (2016)[55] +++	Brazil	All surgical patients from 3 hospitals 1141 pre- and 1052 post-SSC implementation	Observational pre- and post-interventional design	3	2	No significant differences in mortality and morbidity after SSC implementation Compliance was greater than 90% in 9/19 checklist items, greater than 70% in a further 5/19 items, and less than 25% in 4/19 items	4/4
Anwer et al (2016)[25]	Pakistan	3470 general surgical patients from 1 hospital	Prospective observational study	2	3	SSC use increased year on year from 20·4% in year 1, to 89·9% in year 4. SSI reduced year on year from 7·0% to 2·1% There was no change in mortality	4/4
Lacassie et al (2016)[46]	Chile	All surgical patients from 1 hospital 29250 pre- and 29250 post-SSC implementation	Retrospective review using propensity scoring methods to compare pre and post SSC implementation period, after controlling for selection bias	5	2	Mortality fell from 0·82% to 0·65% [odds ratio (OR) 0·73; 95% CI, 0·61–0·89].	5/5
Close et al (2017)[31] ++++	Madagascar	Operating room staff from 21 hospital 427 pre- and 183 post SSC implementation	Pre- and post-intervention survey, concurrent embedded mixed-methods design.	17	3	A 3-day multidisciplinary SSC training programme promoted personal and organisational change towards improved patient safety with improvements noted in teamwork (77%), communication (61%), organisation (72%), infection control (60%), and safer anaesthesia (56%).	10/10
Diedhiou et al (2017)[34]	Senegal	632 surgical patients from 1 hospital	Prospective observational study	1	2	SSC was used in 75% of cases. When used, there was effective communication in 73% of cases, and full completion of all items in 60%	9/9
Ellis et al (2017)[35]	Ethiopia	89 general surgical,	Observational pre- and	13	4	In general surgical patients, SSC use increased	3/5

		obstetric and gynaecology patients from 1 hospital	post-intervention design			from 50% to 94%, full completion increased from 23% to 60% In obstetrics and gynaecology patients, SSC use increased from 50% to 100%, full completion increased from 0% to 60%.	
Garland et al (2017)[38]	Cambodia	695 surgical patients from 1 hospital	Observational pre- and post-intervention design	10	3	Communication; verification of equipment including instrument sterility and patient monitoring; and estimation of blood loss were consistently completed in over 99% of cases. Appropriate antibiotic administration and final surgical count were less consistently completed (68% and 22% respectively).	9/12
Ribeiro et al (2017)[54]	Brazil	24,421 surgeries from 1 hospital	Retrospective review covering a 5 year period.	6	3	Full completion rate was 58·5% with no significant change over time. 31/34 items were completed over 95% of the time.	5/5
Shankar (2017)[58]	India	1778 surgical patients from 1 hospital	Prospective observational study	1	3	The SSC detected errors and allowed rectification of intraoperative processes. Participants reported it was simple and quick to use. All doctors felt the use of the SSC should continue in the hospital.	1/1
White et al (2017)[63]	Republic of Congo (Congo-Brazzaville)	Operating room staff in 1 hospital 17 pre- and 7 post SSC implementation	Pre and post intervention survey, mixed-methods design	11	5	6 basic safety procedures were being performed at rates of 57% to 86% all or most of the time.	5/5
Yu et al (2017)[66]	China	All surgical patients from 4 hospitals Complete information from 30,654 operations Implementation quality obtained from 1852 pre- and 1822 post SSC adaptations 2211 staff survey responses	Observational pre and post interventional design, and staff surveys	14	4	Across all 4 sites the completion rates for 'sign in ' were 80·4-100%; 'time out' 40-88·8%; and 'sign out' 10·2-59·5%. After clinically-led adaptation completion rates rose to over 80% in all 4 sites After SSC adaptation attitudes towards the SSC improved, there were fewer hasty or casual checks, and greater participation from surgeons (increasing from 24·6 to 64·5%). 80% of staff thought the SSC agreed on the need for regular SSC use.	6/6

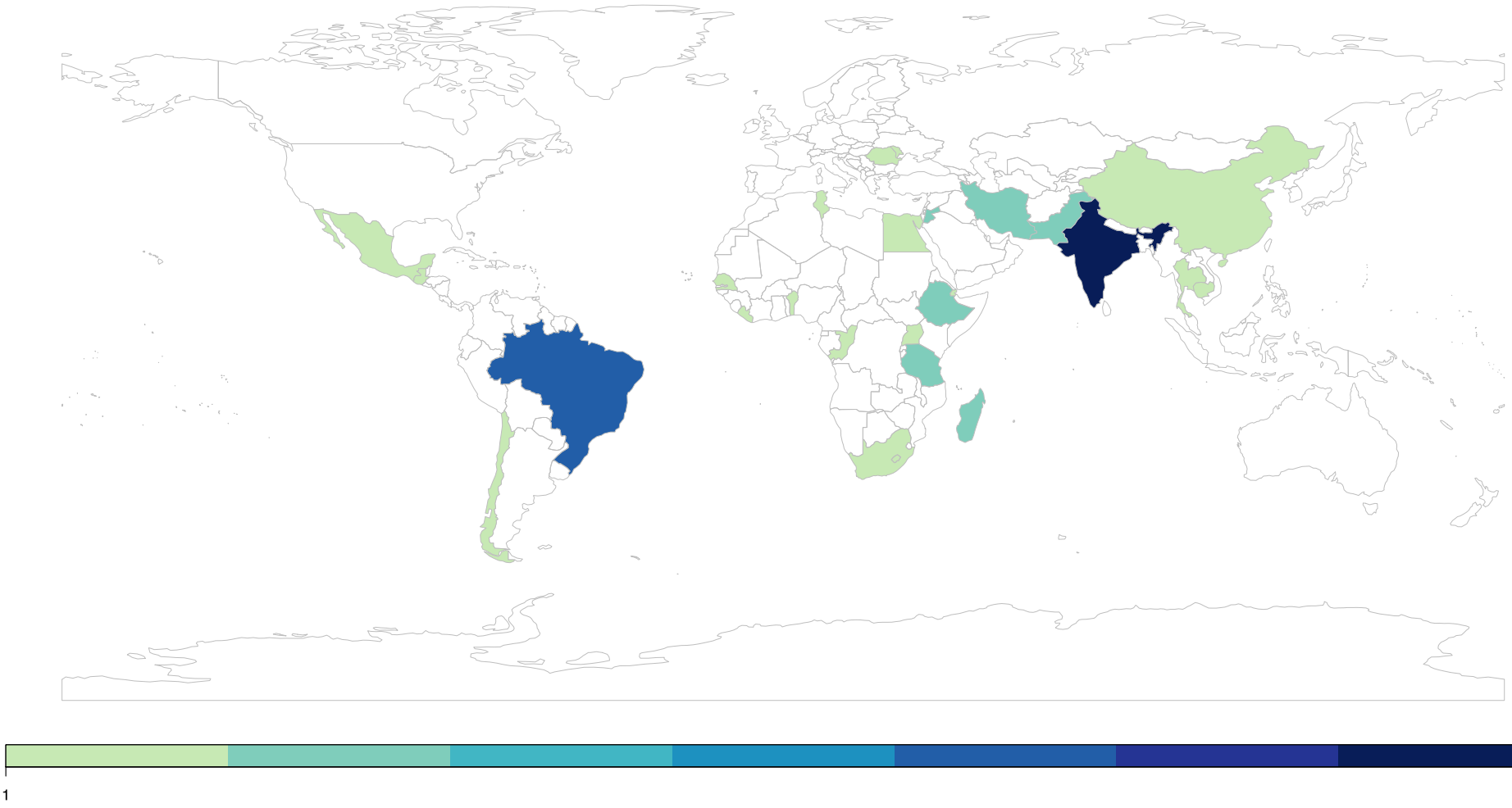
Ambulkar et al (2018)[24]	India	600 surgical patients from 1 hospital	Prospective observational study	0	2	SSC was used in 84·8% of cases 'Sign in' was completed in 100%; 'time out' in 78%; and 'sign out' in 77% of cases	4/4
Dabholkar et al (2018)[32]	India	Operating room staff from the otorhinolaryngology department in 1 hospital 63 pre- and 63 post SSC implementation	Observational pre and post interventional design	3	2	SSC improved team members' awareness of need to verify patients' identity (17% to 86%; p<0·0001); SSC improved team communication (73% to 92%; p=0·0087)	6/6
Fatima et al (2018)[36]	Pakistan	50 general surgical patients from 1 hospital	Prospective observational study	0	2	High fidelity was observed in 46·6% of cases.	4/4
Igaga et al (2018)[40]	Uganda	859 surgical patients from 5 hospitals	Prospective observational study	0	2	Overall SSC use was 41·7% (ranging from 11·9% to 89·8%) No association between compliance and mortality or length of hospital stay	5/5
Kasatpibal et al (2018)[42]	Thailand	89 operating room staff 33 hospitals	Qualitative design Focus group discussions (39 nurses) Interviews (50 surgical personnel)	0	5	Barriers to SSC use were related to infrastructure (language, unclear policy, staff shortages, inadequate computer support, traditional culture) and patients (tiredness and language e.g. foreign patients).	6/7
Verwey et al (2018)[60]	South Africa	194 staff from 2 hospitals	Post-intervention survey	0	4	95% of staff perceived that the SSC improved patient safety, prevented errors or reduced morbidity and mortality.	2/2
White et al (2018)[62] ++++	Madagascar	Operating room staff from 19 hospitals 427 pre- and 183 post SSC implementation	Pre and post-intervention mixed-methods embedded design	17	2	SSC was used in 78% of cases. Adherence to the basic safety processes ranged from 54% (assessing the risk of difficult intubation) to 72% (surgical count)	11/11
White et al (2) (2018)[65] ++++	Madagascar	175 operating room staff from 14 hospitals	Concurrent triangulation mixed methods design	17	5	SSC was used in 74% of cases. Adherence to the basic safety processes ranged from 47% (assessing the risk of difficult intubation) to 88% (using a pulse oximeter) SSC use was associated with improved job satisfaction, safety culture and adherence to basic safety processes	6/10
White et al (2019)[64]	Benin	Operating room staff from 36 hospitals	Longitudinal embedded mixed methods pre- and post-	21	7	SSC use increased from 31·1% to 88% at 4 months and 86% at 18 months. Adherence to basic safety processes was 85 –	7/10

		543 pre-, 178 at 4 months post, and 100 at 18 months post SSC implementation	intervention design			99%. SSC acceptability, appropriateness, adoption and feasibility scored highly	

Abbreviations: SSC, Surgical Safety Checklist; SSI, Surgical Site Infections; HIC, high-income country; LMIC, low- and middle-income country; USA, United States of America; SSI, surgical site infection; OR, odds ratio

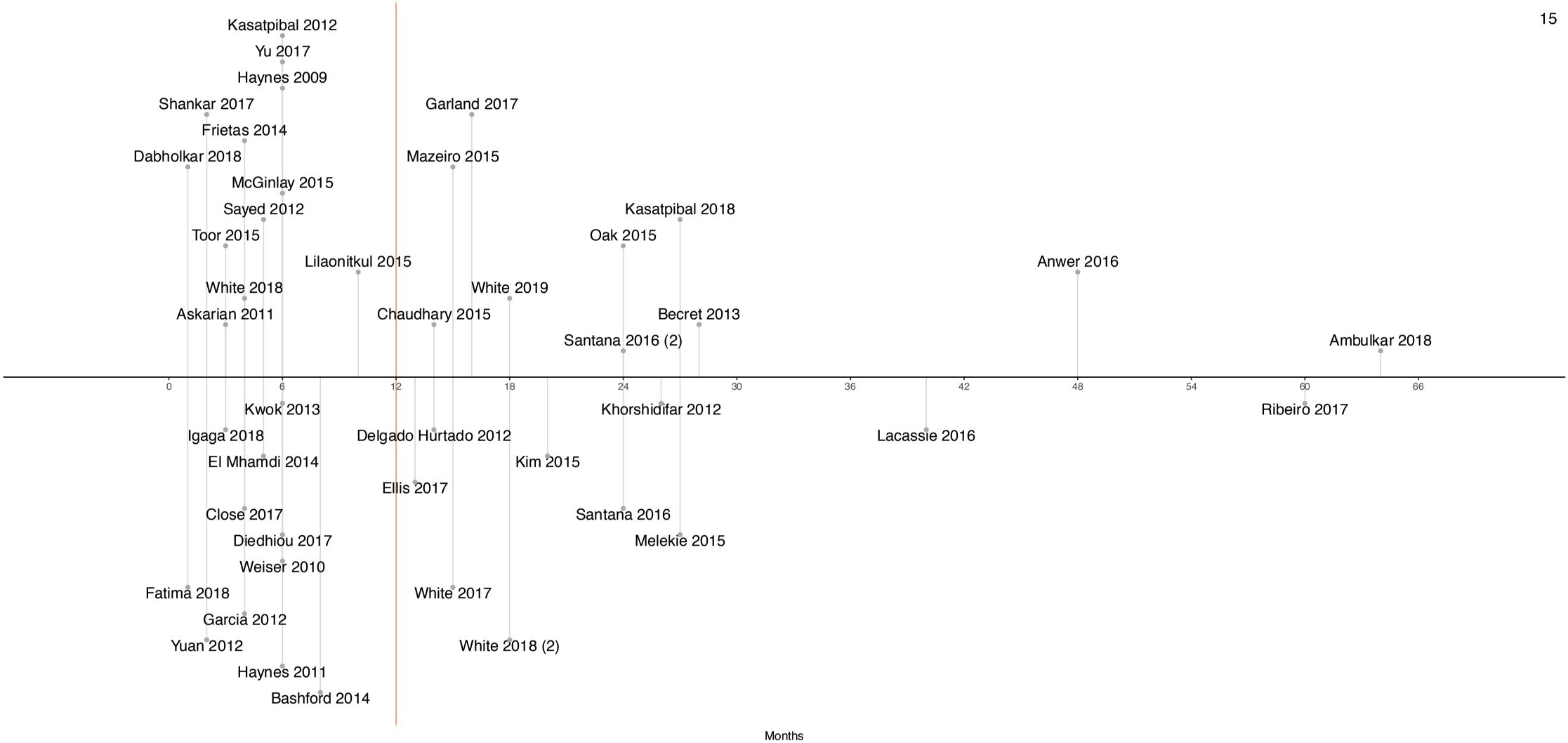
+ same study, separate published papers (Haynes 2009, Weiser 2010, Haynes 2011)
++ same study, separate published papers (Kwok 2013, Kim 2015)
+++ same study, separate published papers (Santana 2016, Santana (2) 2016)
++++ same study, separate published papers (Close 2017, White 2018, White (2) 2018)

World map showing number and location of included papers

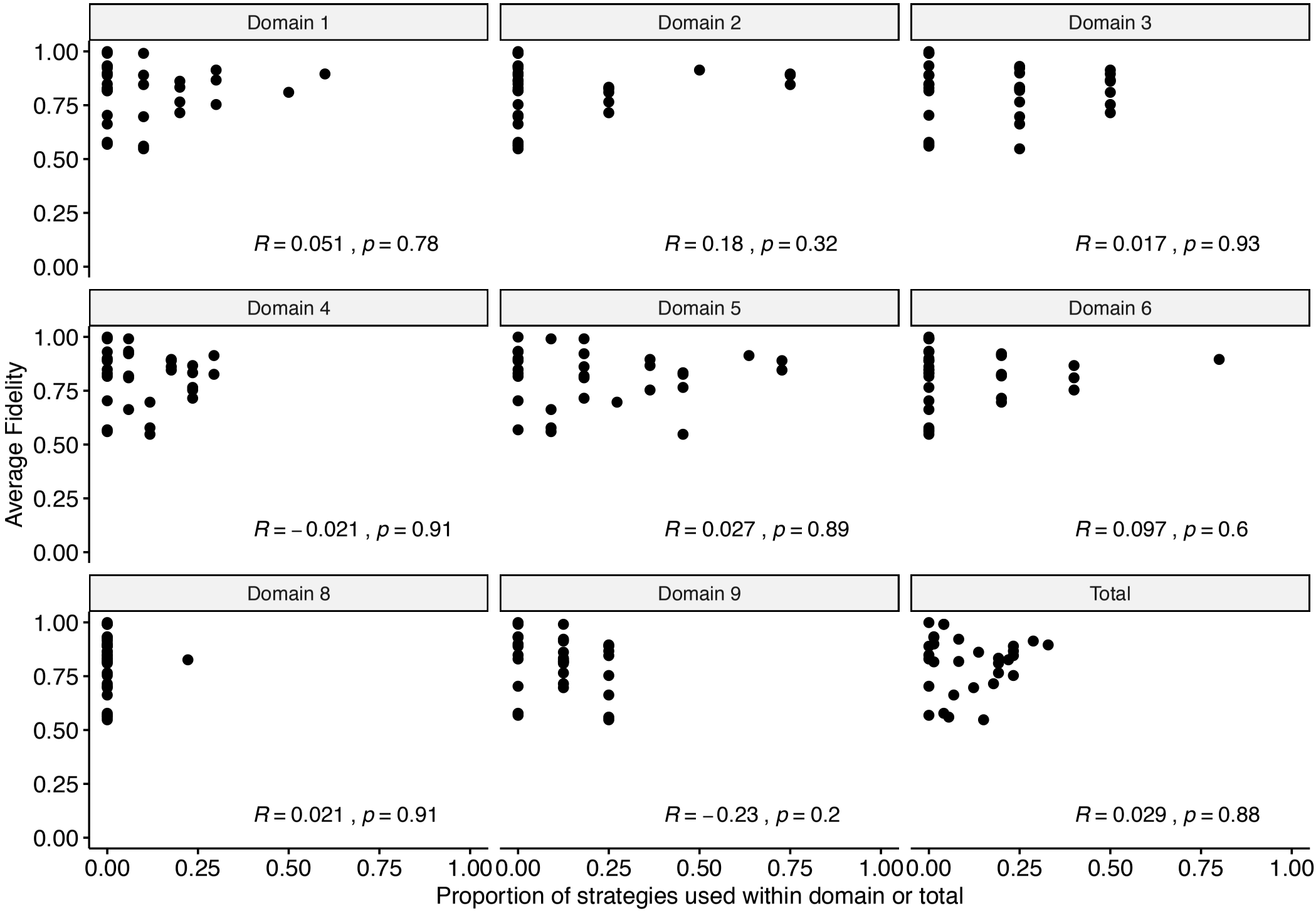


Timeline between checklist implementation and evaluation

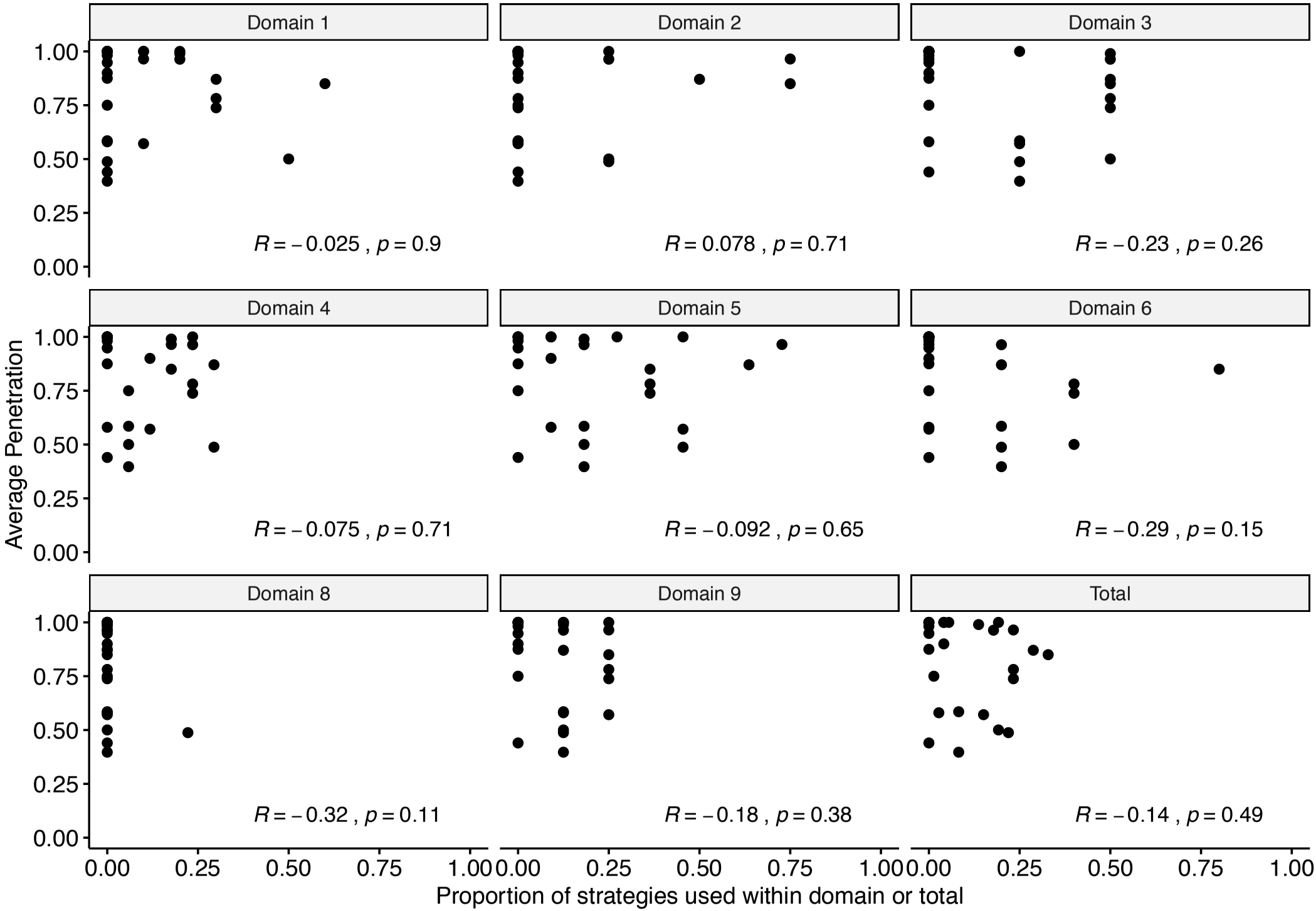
Red line at twelve months denotes evaluation of sustainability of checklist



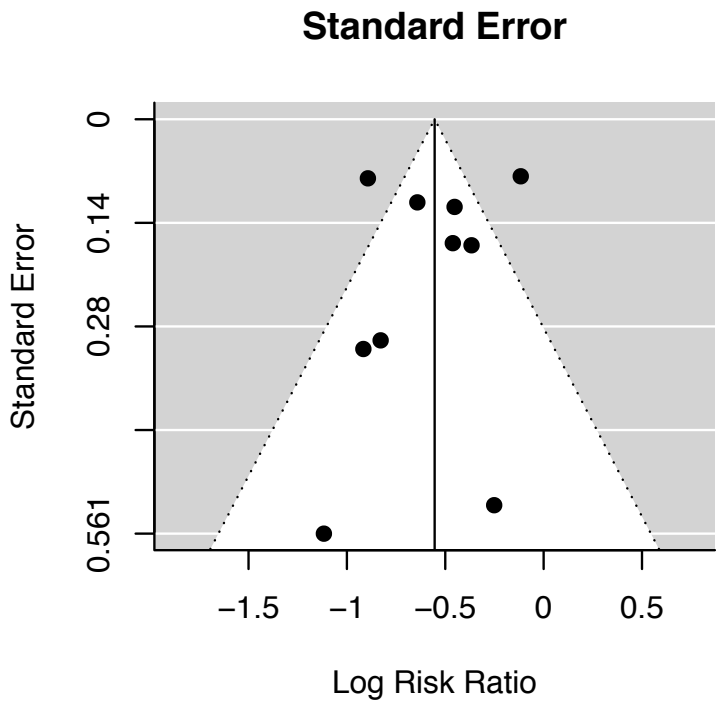
Relationship between implementation strategy (categorised as domains 1 – 9) and fidelity, illustrated by scatter plots and correlation coefficients

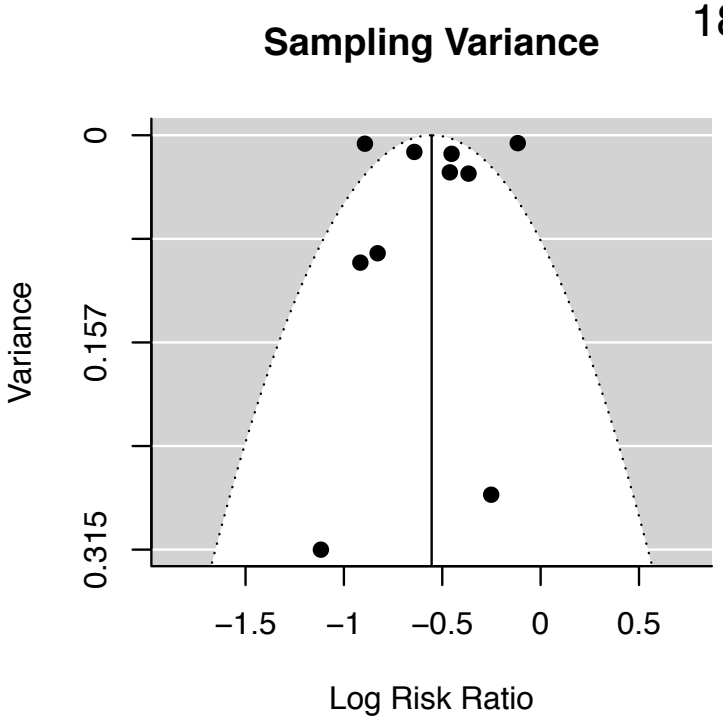


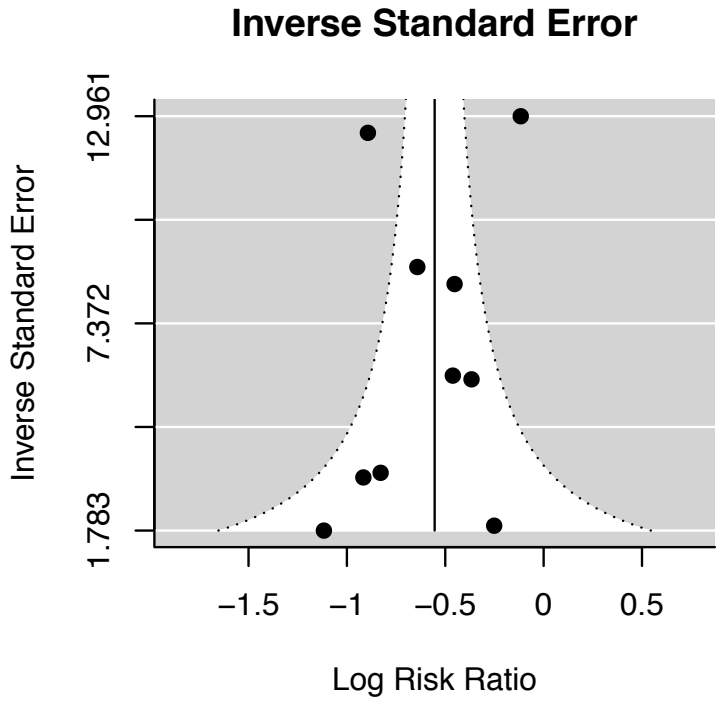
Relationship between implementation strategy (categorised as domains 1 – 9) and penetration, illustrated by scatter plots and correlation coefficients

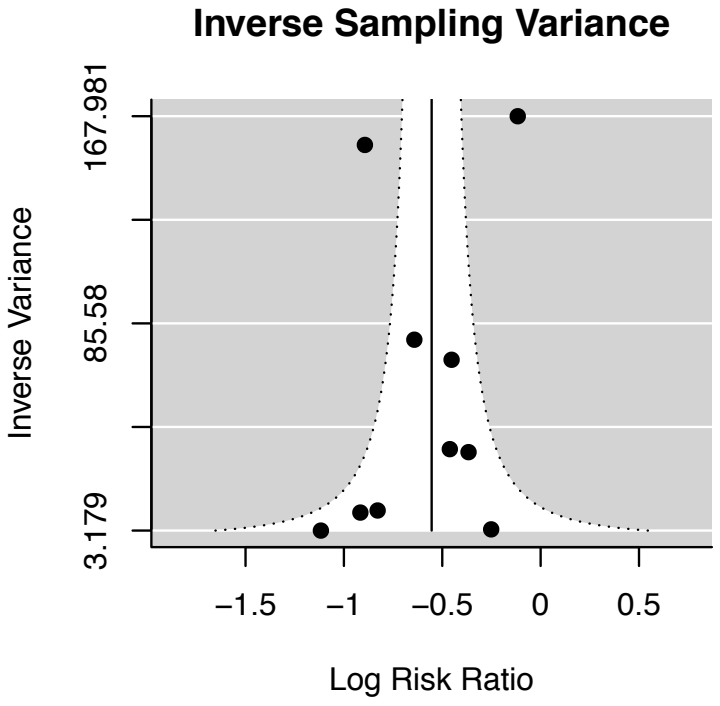


All complications



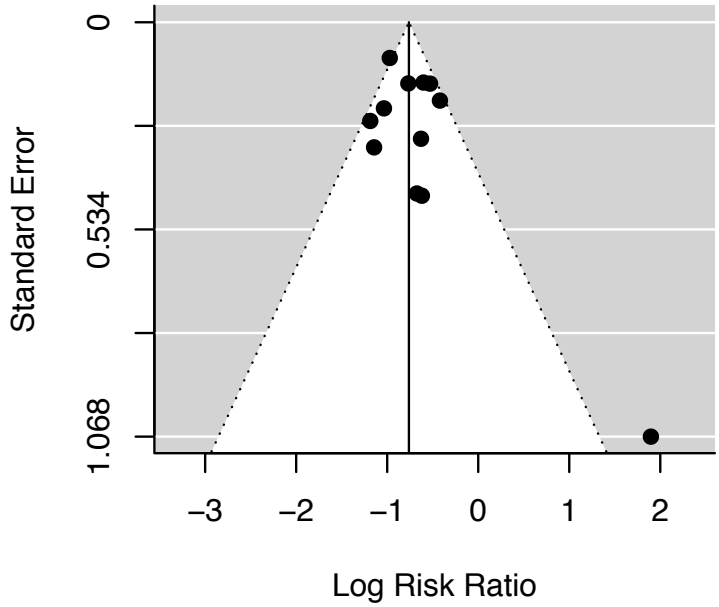




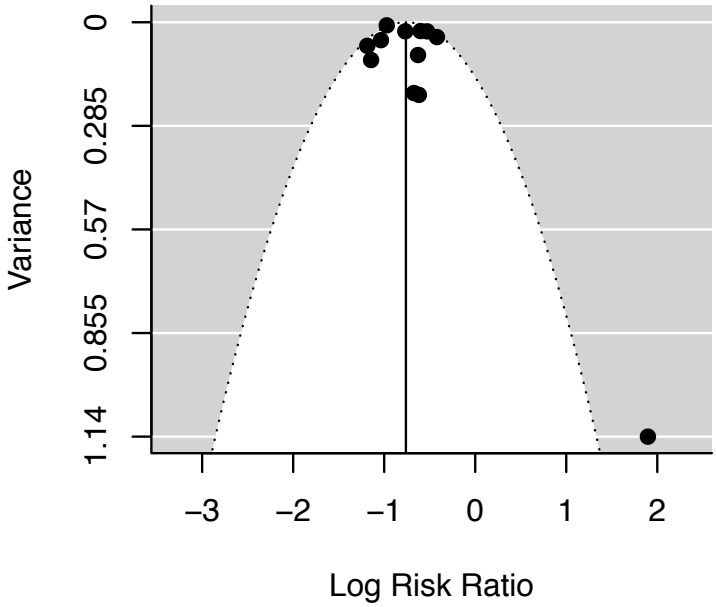


Infection

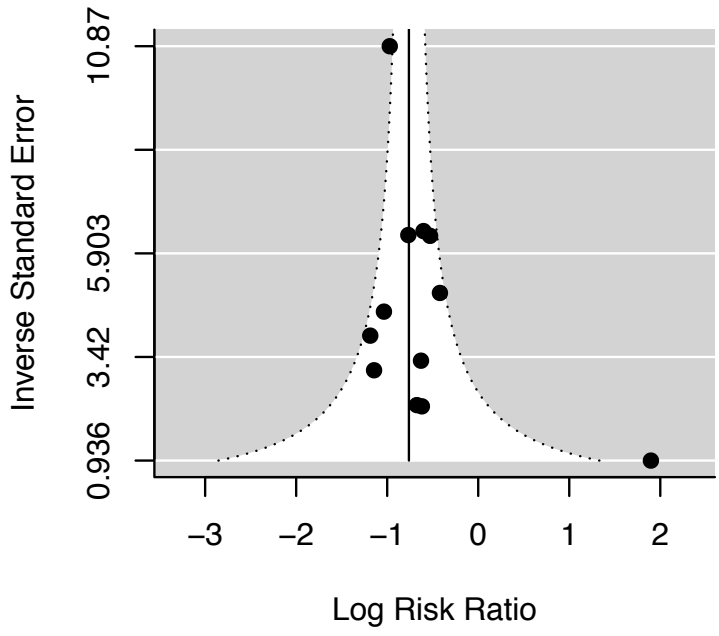
Standard Error



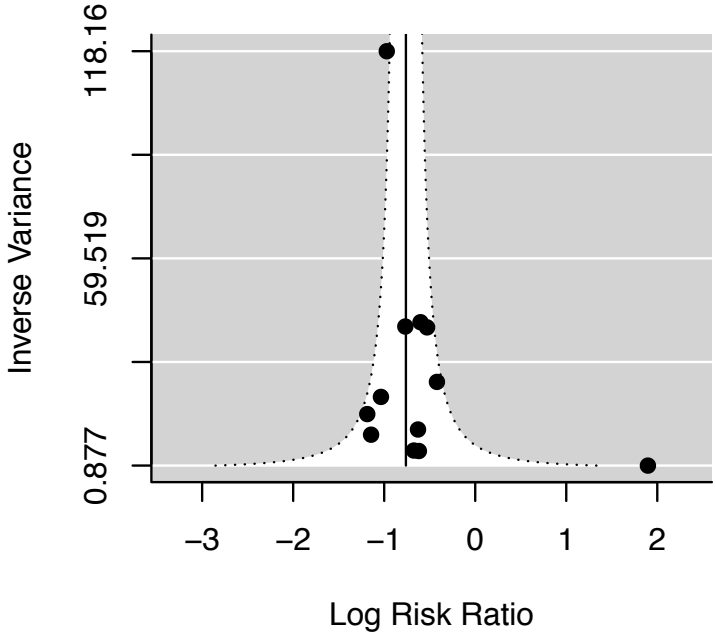
Sampling Variance



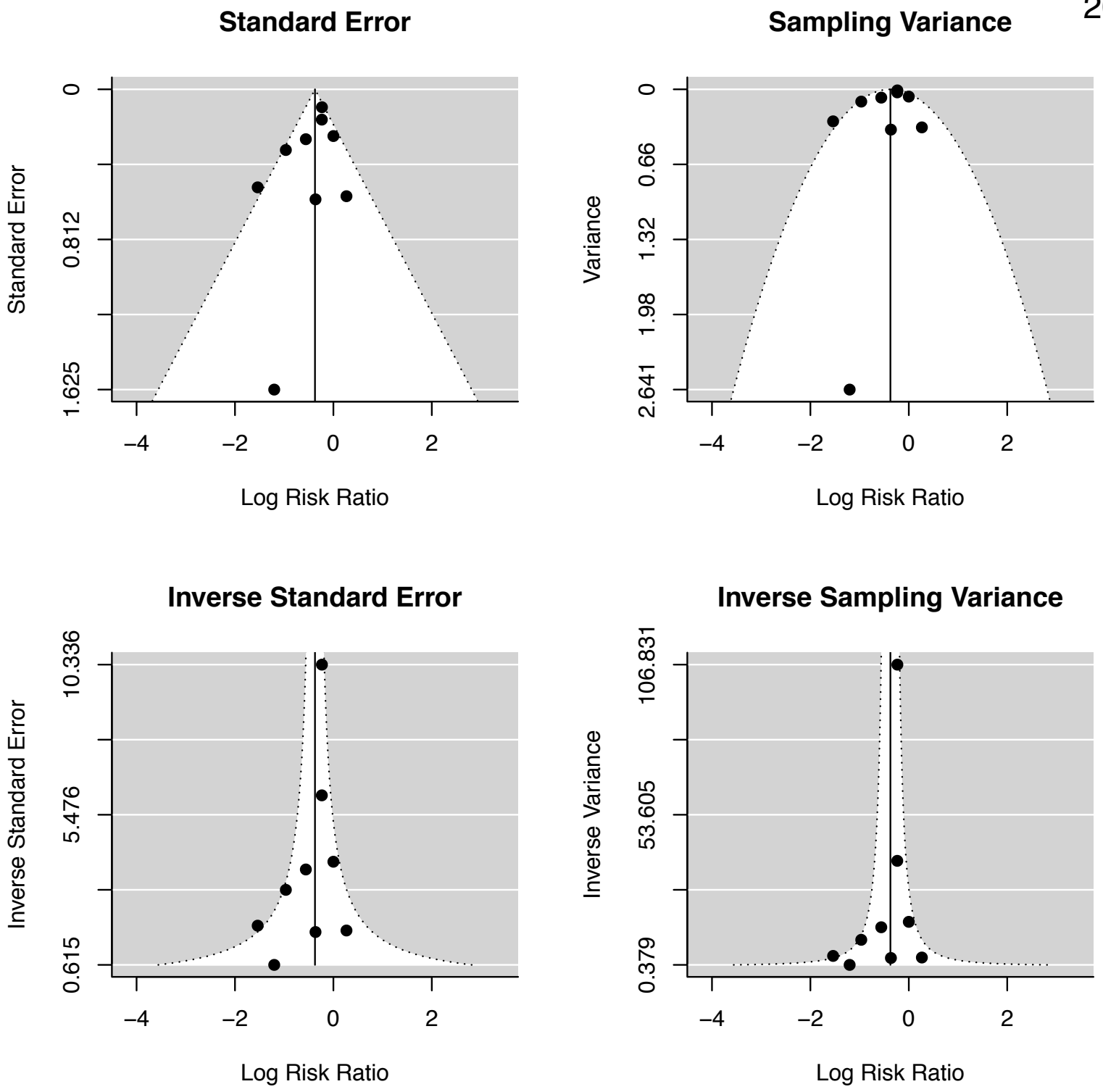
Inverse Standard Error



Inverse Sampling Variance



Mortality


Standard Error
Standard Error
0
0.812
1.625
−4
−2
0
2
Log Risk Ratio
Sampling Variance
Variance
0
0.66
1.32
1.98
2.641
−4
−2
0
2
Log Risk Ratio
Inverse Standard Error
Inverse Standard Error
10.336
5.476
0.615
−4
−2
0
2
Log Risk Ratio
Inverse Sampling Variance
Inverse Variance
106.831
53.605
0.379
−4
−2
0
2
Log Risk Ratio