MATERIAL FOR SUPPLEMENTARY DIGITAL CONTENT

**Methods**

We conducted a systematic literature review of peer-reviewed and ‘grey’ literature on integrated HIV-NCD services in low- and middle-income countries, based on PRISMA guidelines.[1] We searched Medline, EMBASE, Global Health database and Econlit from January 1st, 2007 to March 1st, 2018. Additionally, January, 2017 we surveyed collaborators (contributors to this supplement) for integrated platforms with economic data in LMIC pending publication. We contacted roughly six to eight research groups and received four responses. The World Bank’s definitions were used to identify low- and middle- income countries.

Studies were eligible for inclusion if they reported data on NCDs, including hypertension, diabetes, hyperlipidemia, cervical cancer screening and/or depression within HIV programs. Additional inclusion criteria included observational studies and randomized trails with an economic evaluation in at least one low- or middle-income country published in English. All reported costs were adjusted to United States dollar (US$) values for 2013.

Data on unit costs for integrated services were drawn from cost analyses. Reviewers attempted to draw primary cost data from other economic analyses (cost-effectiveness, cost-benefit, modeling), but none were found that reached inclusion criteria. We used the Drummond Checklist in creating guidelines to assess the quality of economic evaluation (Table S1).[2] A score was assigned to each study to measure quality of economic analysis as follows: + - 1-8 Drummond checkmarks; ++ - 9-12 Drummond checkmarks; +++ - >12 Drummond checkmarks.

Full-text review of eligible articles was done independently by the team, with at least two reviewers per article after the initial screen of citation titles and abstracts. Data was extracted separately by two researchers, who then reviewed their results for agreement. Any disagreements were reviewed by a third independent researcher and authors discussed the study to reach a consensus.

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| Table 1. PUBMED search strategy. |
| NCD terms | (noncommunicable disease\*[tw] OR non-communicable disease\*[tw] OR chronic disease/epidemiology[mh] OR chronic disease\*[ti] ORdepression[mh] OR depression[tw] OR substance-related disorders/epidemiology[mh] OR diabetes/diagnosis[mh] ORdiabetes/epidemiology[mh] OR diabetes[tw] OR overweight[mh] OR obesity[tw] OR obesity[mh] OR body mass index[mh] OR waist circumference[mh] ORhypertension/diagnosis[mh] OR hypertension/epidemiology[mh] OR hypertension[tw] OR tobacco use[mh] OR smoking[tw] ORsmoker\*[tw] OR cardiovascular diseases[mh] OR cardiovascular disease\*[tw] OR cardiovascular related disease\*[tw] ORhyperlipidemia OR Uterine Cervical Neoplasms[mh] OR Papillomavirus Infections[mh] OR cervical cancer\*[tw] OR cervical neoplasm\*[tw] OR human papilloma virus\*[tw] OR hpv[tw]) |
| HIV/AIDS terms | (hiv infections[mh] OR hiv services[tw] OR hiv care[tw] OR hiv[tiab]) |
| Integrated Program terms | (needs assessment[tw] OR program development[mh] OR program evaluation[mh] OR program\*[tw] OR adapting[tw] OR adaptation[tw]OR campaign\*[tw] OR community based[tw]OR community health services[mh] OR community health worker\*[tw] OR continuity care[tw] OR counseling[mh] OR delivery ofhealth care[mh] OR education[tw]OR epidemiologic methods[mh] OR  health plan implementation[mh] OR health promotion[mh] OR home based[tw] OR home careservices[mh] OR house calls[mh] OR integrated care[tw] OR mass screening[mh] OR mobile unit[tw] OR mobile units[tw] OR patientacceptance of health care[mh] OR pilot projects[mh] OR point-of-care systems[mh] OR prevalence[tw] OR rapid assessment[tw] ORreferral\*[tw] OR research[mh] OR rural health services[mh] OR scale up[tw] OR screen[tw] OR screens[tw] OR screening[tw] ORstrategies[tw] OR strategy[tw] OR surveys and questionnaires[mh] OR systems[tw] OR test[tw] OR tests[tw] OR tools[tw] ORmulti-disease[tw] OR comorbidity[mh] OR comorbidit\*[tw] OR co-morbidit\*[tw] OR multimorbidit\*[tw] OR Health Education[mh] OR Health Care Facilities, Manpower, and Services[mh] OR primary care [mh] OR Health Care Quality, Access, and Evaluation[mh] OR OR primary care[tw] OR primary healthcare[tw] OR primary health care[tw] OR diagnosis[tw] OR treatment\*[tw] OR therapy[tw] OR therapies[tw] OR medication adherence[tw] OR medication compliance[tw] OR retention[tw] OR Human Papillomavirus DNA Tests [mh] OR Papanicolaou Test[mh] OR papanicolaou\*[tw] OR HPV test\*[tw] OR early detection of cancer\*[tw] OR visual inspection with acetic acid\*[tw] OR VIA[tw]) |
| Cost terms | ("Costs and Cost Analysis"[Mesh] OR COST OR "Cost effective\*") |
| Filter for LMIC countries, languages, and publication dates | (Developing Countries OR Africa OR Asia OR Caribbean OR West Indies[tw] OR South America[tw] OR LatinAmerica[tw] OR Central America[tw] OR Afghanistan[tw] OR Albania[tw] OR Algeria[tw] OR Angola[tw] OR Antigua[tw] ORBarbuda[tw] OR Argentina[tw] OR Armenia[tw] OR Armenian[tw] OR Aruba[tw] OR Azerbaijan[tw] OR Bahrain[tw] OR Bangladesh[tw] ORBarbados[tw] OR Benin[tw] OR Byelarus[tw] OR Byelorussian[tw] OR Belarus[tw] OR Belorussian[tw] OR Belorussia[tw] ORBelize[tw] OR Bhutan[tw] OR Bolivia[tw] OR Bosnia[tw] OR Herzegovina[tw] OR Hercegovina[tw] OR Botswana[tw] OR Brazil[tw] ORBulgaria[tw] OR Burkina Faso[tw] OR Burkina Fasso[tw] OR Upper Volta[tw] OR Burundi[tw] OR Urundi[tw] OR Cambodia[tw] OR KhmerRepublic[tw] OR Kampuchea[tw] OR Cameroon[tw] OR Cameroons[tw] OR Cameron[tw] OR Cape Verde[tw] OR Central AfricanRepublic[tw] OR Chad[tw] OR Chile[tw] OR China[tw] OR Colombia[tw] OR Comoros[tw] OR Comoro Islands[tw] OR Comores[tw] ORMayotte[tw] OR Congo[tw] OR Zaire[tw] OR Costa Rica[tw] OR Cote d'Ivoire[tw] OR Ivory Coast[tw] OR Croatia[tw] OR Cuba[tw] ORCyprus[tw] OR Czechoslovakia[tw] OR Czech Republic[tw] OR Slovakia[tw] OR Slovak Republic[tw] OR Djibouti[tw] OR FrenchSomaliland[tw] OR Dominica[tw] OR Dominican Republic[tw] OR East Timor[tw] OR Timor Leste[tw] OR Ecuador[tw] OR Egypt[tw] ORUnited Arab Republic[tw] OR El Salvador[tw] OR Eritrea[tw] OR Estonia[tw] OR Ethiopia[tw] OR Fiji[tw] OR Gabon[tw] OR GaboneseRepublic[tw] OR Gambia[tw] OR Gaza[tw] OR Georgia Republic[tw] OR Georgian Republic[tw] OR Ghana[tw] OR Gold Coast[tw] ORGreece[tw] OR Grenada[tw] OR Guatemala[tw] OR Guinea[tw] OR Guam[tw] OR Guiana[tw] OR Guyana[tw] OR Haiti[tw] OR Honduras[tw]OR Hungary[tw] OR India[tw] OR Maldives[tw] OR Indonesia[tw] OR Iran[tw] OR Iraq[tw] OR Isle of Man[tw] OR Jamaica[tw] ORJordan[tw] OR Kazakhstan[tw] OR Kazakh[tw] OR Kenya[tw] OR Kiribati[tw] OR Korea[tw] OR Kosovo[tw] OR Kyrgyzstan[tw] ORKirghizia[tw] OR Kyrgyz Republic[tw] OR Kirghiz[tw] OR Kirgizstan[tw] OR "Lao PDR"[tw] OR Laos[tw] OR Latvia[tw] ORLebanon[tw] OR Lesotho[tw] OR Basutoland[tw] OR Liberia[tw] OR Libya[tw] OR Lithuania[tw] OR Macedonia[tw] OR Madagascar[tw]OR Malagasy Republic[tw] OR Malaysia[tw] OR Malaya[tw] OR Malay[tw] OR Sabah[tw] OR Sarawak[tw] OR Malawi[tw] OR Nyasaland[tw]OR Mali[tw] OR Malta[tw] OR Marshall Islands[tw] OR Mauritania[tw] OR Mauritius[tw] OR Mexico[tw] OR Micronesia[tw] OR MiddleEast[tw] OR Moldova[tw] OR Moldovia[tw] OR Moldovian[tw] OR Mongolia[tw] OR Montenegro[tw] OR Morocco[tw] OR Ifni[tw] ORMozambique[tw] OR Myanmar[tw] OR Myanma[tw] OR Burma[tw] OR Namibia[tw] OR Nepal[tw] OR Netherlands Antilles[tw] OR NewCaledonia[tw] OR Nicaragua[tw] OR Niger[tw] OR Nigeria[tw] OR Northern Mariana Islands[tw] OR Oman[tw] OR Muscat[tw] ORPakistan[tw] OR Palau[tw] OR Palestine[tw] OR Panama[tw] OR Paraguay[tw] OR Peru[tw] OR Philippines[tw] OR Philipines[tw] ORPhillipines[tw] OR Phillippines[tw] OR Poland[tw] OR Portugal[tw] OR Puerto Rico[tw] OR Romania[tw] OR Rumania[tw] ORRoumania[tw] OR Russia[tw] OR Russian[tw] OR Rwanda[tw] OR Ruanda[tw] OR Saint Kitts[tw] OR St Kitts[tw] OR Nevis[tw] OR SaintLucia[tw] OR St Lucia[tw] OR Saint Vincent[tw] OR St Vincent[tw] OR Grenadines[tw] OR Samoa[tw] OR Samoan Islands[tw] OR SaoTome[tw] OR Saudi Arabia[tw] OR Senegal[tw] OR Serbia[tw] OR Montenegro[tw] OR Seychelles[tw] OR Sierra Leone[tw] ORSlovenia[tw] OR Sri Lanka[tw] OR Ceylon[tw] OR Solomon Islands[tw] OR Somalia[tw] OR Sudan[tw] OR Suriname[tw] OR Surinam[tw]OR Swaziland[tw] OR Syria[tw] OR Tajikistan[tw] OR Tadzhikistan[tw] OR Tadjikistan[tw] OR Tadzhik[tw] OR Tanzania[tw] ORThailand[tw] OR Togo[tw] OR Togolese Republic[tw] OR Tonga[tw] OR Trinidad[tw] OR Tobago[tw] OR Tunisia[tw] OR Turkey[tw] ORTurkmenistan[tw] OR Turkmen[tw] OR Uganda[tw] OR Ukraine[tw] OR Uruguay[tw] OR USSR[tw] OR Soviet Union[tw] OR Union of SovietSocialist Republics[tw] OR Uzbekistan[tw] OR Uzbek[All Fields] OR Vanuatu[tw] OR New Hebrides[tw] OR Venezuela[tw] ORVietnam[tw] OR Viet Nam[tw] OR West Bank[tw] OR Yemen[tw] OR Yugoslavia[tw] OR Zambia[tw] OR Zimbabwe[tw] OR Rhodesia[tw]) |

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| Table 2. EMBASE search strategy. |
| CMD terms | (uterine cervix cancer OR uterine cervix tumor OR papillomavirus infection OR 'noncommunicable disease'/exp OR 'noncommunicable disease' OR 'hypertension'/exp OR hypertension OR 'diabetes'/exp OR diabetes OR 'hyperlipidemia'/exp OR hyperlipidemia OR 'dyslipidemia'/exp OR dyslipidemia OR 'non-communicable disease'/exp OR 'non-communicable disease' OR 'chronic disease'/exp OR 'chronic disease' OR 'obesity'/exp OR obesity OR 'depression'/exp OR depression OR 'cancer'/exp OR cancer OR cardiovascular)  |
| HIV/AIDS terms | (HIV OR 'human immunodeficiency virus’) |
| Health service delivery terms | (program\* OR screen\* OR assess\* OR adherence\* OR treatment\* OR compliance\* OR retention\* OR PAP\* OR VIA OR ‘visual inspection with acetic acid’ OR ‘primary care’ OR ‘primary health care’) |
| Cost terms | (cost\* OR 'cost-effective\*' OR 'cost analysis'/exp OR 'cost analysis' OR 'economic analysis') |
| Filter for LMIC countries, exclusive EMBASE, languages, and publication dates | (NOT ('united states' OR europe) AND [embase]/lim AND [2007-2017]/py AND [english]/lim AND ([young adult]/lim OR [adult]/lim OR [middle aged]/lim OR [aged]/lim OR [very elderly]/lim) |
| Publication Date Limits | 2007-2017 |

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| Table 3. Global Health Database. |
| NCD terms | ("noncommunicable disease" OR hypertension OR diabetes OR hyperlipidemia OR dyslipidemia OR "non-communicable disease" OR "chronic disease" OR obesity OR depression OR cancer OR cardiovascular OR cervical) |
| HIV/AIDS terms | (HIV OR 'human immunodeficiency virus’) |
| Integrated programs | (program\* OR screen\* OR assess\* OR diagnosis\* OR treatment\* OR retention\*) |
| Economic evaluation terms | (Cost\* OR "cost-effective\*" OR "cost analysis" OR "economic analysis") |
| Filter for LMIC countries, languages | NOT ('united states' OR europe OR australia) |
| Publication Date Limits | 2007-2017 |

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| Table 4. Econlit. |
| NCD terms | ("noncommunicable disease" OR hypertension OR diabetes OR hyperlipidemia OR dyslipidemia OR "non-communicable disease" OR "chronic disease" OR obesity OR depression OR cancer OR cardiovascular OR cervical OR “early cancer”) |
| HIV/AIDS terms | (HIV OR 'human immunodeficiency virus’) |
| Integrated Screening programs | (program\* OR screen\* OR assess\* OR diagnosis\* OR treatment\* OR retention\*) |
| Economic evaluation terms | None |
| Filter for LMIC countries, languages | None |
| Publication Date Limits | None |

**Figure 1: Flowchart for the selection of studies on costs of integrated non-communicable diseases and HIV strategies in low-middle income countries**

Full-text articles excluded, with reasons
(n = 10)

* No costing data
* Secondary economic evaluation
* Based solely on modelling
* Comparison of NCD and HIV vertical programs not integrated

Studies included in the review (n= 12)

* 6 noncancerous NCD (4 studies)
* 6 cervical cancer (5 studies)

Records identified through database searching (Jan 1, 2007 – March 1, 2018)
(n = 1,009 )

*Pubmed = 363 Global Health = 291*

*Embase = 237 Econlit = 18*

Records identified through grey literature, collegue requests

 (n = 4)

Records excluded
(n = 874)

Records screened (abstracts reviewed)
(n = 896)

Full-text articles assessed for eligibility
(n = 22)

Records after duplicates removed
(n = 896)

**Table S1 Economic Review of Inclusion Papers\***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Manuscript** | **Study Design** | **Data collection** | **Analysis** |  |
| **Author** | **Study** | Research question well-defined, in context of decision-making | Rationale and description for alternatives | Form of economic evaluation stated and justified | Effectiveness of the programme or service was established or assumptions used to establish effectiveness | Inputs clearly defined, including unit costs and resource quantification | Currency and price data recorded, in appropriate units | Costs and consequences valued credibly | Economic prospective described and costs described (capital, operating, etc) | Differential timing described and discount rates provided | Sensitivity analysis and rationale provided | Incremental analysis reported | Attempts to answer study question, generalizability and comparison discussion | Limitations discussed | **Score** |
| Chamie, G | SEARCH | √ | X | √ | X | X | √ | X | ? | X | X | X | √ | X | + |
| Chang, W | SEARCH | √ | X | √ | X | √ | √ | √ | √ | √ | X | X | √ | √ | ++ |
| Kabami, J | SEARCH | √ | X | √ | X | √ | √ | √ | √ | √ | X | X | √ | √ | ++ |
| de Beer, I | Bophelo | √ | X | √ | X | √ | √ | √ | √ | √ | X | X | √ | - | + |
| Hewett, PC | n/a | √ | √ | - | √ | X | √ | X | √ | X | X | √ | √ | √ | + |
| Labhardt, ND | SMART | √ | √ | √ | X | X | √ | X | - | X | X | X | - | X | + |
| Lince-Deroche, N | n/a | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | +++ |
| Obure, CD | Integra | √ | √ | √ | X | √ | √ | √ | √ | √ | X | X | √ | √ | ++ |
| Schnippel, K | Right to Care | √ | X | √ | X | X | √ | √ | √ | √ | X | X | √ | √ | + |
| Vodicka, E | n/a | √ | √ | √ | X | √ | √ | √ | √ | √ | √ | √ | √ | √ | ++ |
| Zimmermann | n/a | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | +++ |
| Golovaty, I | Linkages | √ | X | √ | X | √ | √ | √ | √ | √ | √ | √ | √ | √ | ++ |

*\*Adopted from Drummond checklist.* score was assigned to each study to measure quality of economic analysis as follows: + - 1-8 Drummond checkmarks; ++ - 9-12 Drummond checkmarks; +++ - >12 Drummond checkmarks. Data was extracted separately by two researchers, who then reviewed their results for agreement. Any disagreements were reviewed by a third independent researcher and authors discussed the study to reach a consensus.

- - Reviewers were unable to assign checkmark by Drummond criteria since data was unclear or not published

**Appendix A**

**Interiewer Guide: HIV/NCD Integration Paper**

**Introduction/Purpose of Call:**

Thank you for taking the time to talk with me today. My name is (xxx). I am a (HHS Specialist/Research Epidemiologist) at RTI. We are working on a paper with U Washington, OGAC, and Aga Khan University in Kenya, looking at the economic aspects of integration of HIV and non-communicable diseases. This work is part of a special journal supplement being led by the Fogarty Center at NIH and Pepfar. The research team is examining quantitative information about the costs and cost-effectiveness of HIV/NCD integration. Due to challenges with limited data, we are also including qualitative key informant interviews in our research process. You were selected due to your knowledge of and involvement in PEPFAR-funded and other HIV/AIDS treatment programs. We are very interested in your experience and opinions/insight on this topic.

**Consent Process:**

Today’s interview will take approximately 30-minutes. Your participation in this interview is completely voluntary. Your responses will be kept confidential. We will not use your names or any other potentially identifying information (such as title and organization) in our final report. You are free to skip any questions you prefer not to answer. Shall we continue?

| **Questions** | **Probes** |
| --- | --- |
|  |
| **Background** |  |
| 1. To start, please tell me about your role in your organization.
 | * Title
* Projects
* Responsibilities
 |
| **Overview** |  |
| 1. I will be asking you some questions about your knowledge/experience with programs that integrate HIV and NCD services. But before I do that, I would like to first ask you to share with me your definition of HIV/NCD program integration?
 | * What elements would you expect to see included in a program that integrates HIV and NCD?
* What source of information or experience has most informed your definition?
 |
| **Experience with Integration** |
| 1. Tell me now about your experience with integrating HIV and NCD.
 | * This may include anything from program design, policy frameworks, costing, clinical services, monitoring and evaluation, etc.
* Have you observed programs that have included HIV/NCD integration? Where was/were this/these program(s)?
* What NCDs were integrated? For example, cervical cancer, general prevention on Diabetes, cardiovascular disease?
* Are you currently working on some aspect of HIV/NCD program integration in your work? How long have you been involved with this work?
* How has this work changed or evolved since you first got involved? (E.g. a shift in how or what services are integrated or a scaling up of various elements.)
 |
| **Implementation** |
| 1. We are trying to get a better understanding of how different programs are implementing HIV/NCD integration. I would like to show you a few models of integration approaches and have you tell me which most closely resembles the approach you are currently taking.
 | * How well do you think this model describes your program?
* Notwithstanding the similarities between your program and the model you indicated, do you think there are still important differences?
* Are there other models that should be considered for integration?
 |

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| Importance of Integration |
| 1. From your experiences, what have been the most effective aspects of programs integrating HIV and NCDs?
 | * For example, are there system-level elements that are essential? Does effectiveness rely on money, good governance, the health workforce, privacy, etc.?
* Effective aspects are not limited to service delivery but also can be prevention oriented and outside the health systems

Complete the sentence. Integration works when… |
| 1. What do you see as some of the key challenges facing national health programs trying to integrate HIV and NCDs?
 | * What are/have been some of the barriers to integration?
 |
| 1. How important do think it is [at this time] to try to integrate HIV and NCD service delivery? Why is that?
 | * Are there situations where you think it is more important?
 |
| 1. I would like to talk about the different groups affected by services integrations: patients, health care providers, program funders, national governments?

For [group], what do you see as the main benefits?* What do you see as the challenges or barriers for this group?
* What could be improved for this group?
 | * Can you elaborate on that?
* What can impede integration or get in the way of the benefits?
 |

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| **Cost-Effectiveness:** Now I want to talk with you about cost effectiveness. |
| 1. What are your thoughts on the cost-effectiveness of integrating treatment and care for co-infected patients?
 | * First, can you give me your definition of cost-effectiveness, and how important do you think it is in program delivery?
* For which NCDs, do you think integration with HIV makes the most sense (e.g. diabetes, heart disease, mental health, cancer)?
* What types of services (e.g. health promotion, screenings, treatment of acute or chronic disease, patient retention (such as for mental health) are most likely to be cost-effective?
 |
| 1. Do you think integration can be done efficiently and cost effectively in most settings?
 | * What are the challenges to efficient, cost effective integration?
 |
| 1. Is there specific data that has informed your views?
 | * This could be information you currently have…
* What other information about programs would you like to see to help you answer this question better.
 |
| 1. If your information suggests there are cost savings or efficiencies in integrated care, which cost savings are particularly feasible through integration, and which costs are not affected?
 | * Does integration just add 2 kinds of programs costs, or does it deliver the same care with a portion of the total program costs?
 |
| **Closing Thoughts** |  |
| 1. Do you have any other thoughts you’d like to share to help us develop a broad understanding of cost implications for integration of HIV/NCD services?
 |  |
| 1. Are there additional staff you recommend we speak with to develop a full understanding of this topic? In particular, we are seeking local MOH staff who may be familiar with integration programs.
 |  |

**Thank you for your time**

References

1. Shamseer L MD, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L. **Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P)**. *BMJ* 2015; (2;349(jan02 1)):g7647.

2. Drummond M JT. **Guidelines for authors and peer reviewers of economic submissions to the BMJ. The BMJ Economic Evaluation Working Party.** . *BMJ* 1996; ((7052):275).