



## Cyflenwadau dŵr preifat: Cwmpas ystwyth o'r llenyddiaeth

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## Cyflwyniad

Mae'r adroddiad ystwyth hwn yn nodi canfyddiadau gwaith chwilio a gynhaliwyd gan y Gwasanaeth Tystiolaeth i ddod o hyd i dystiolaeth ynglŷn ag effeithiau iechyd posibl yn sgil defnyddio cyflenwadau dŵr preifat. Mae'n cwmpasu nifer o gwestiynau a ddaeth i'r amlwg wrth inni archwilio'r dystiolaeth a thrafod y pwnc gyda'r rhanddeiliaid. Ar y cychwyn, aethom ati i chwilio am adolygiadau systematig a oedd yn cynnwys astudiaethau sylfaenol a ddeilliai o Gymru, y DU neu wledydd Ewropeaidd / Awstralaidd / Gogledd Americanaidd eraill, yn ymwneud ag effeithiau iechyd yn sgil defnyddio cyflenwadau dŵr preifat, yn cynnwys adolygiadau'n ymwneud ag effeithiau microbaidd a chemegol, ac effeithiau posibl o ganlyniad i hinsawdd newidiol, megis llifogydd. Yn absenoldeb adolygiadau systematig, chwiliwyd am astudiaethau sylfaenol. Hefyd, fe wnaethom chwilio am astudiaethau sylfaenol lle archwilir safbwyntiau, canfyddiadau neu brofiadau defnyddwyr cyflenwadau dŵr preifat ynglŷn â'r risgiau iechyd posibl sy'n gysylltiedig â defnyddio cyflenwadau dŵr preifat, a hefyd ynglŷn ag effaith newid hinsawdd ar ansawdd cyflenwadau dŵr preifat.

Bydd y gwaith hwn yn helpu'r rhanddeiliaid i ddeall yr hyn sy'n hysbys ynglŷn â'r risgiau iechyd a'r effeithiau yn sgil defnyddio cyflenwadau dŵr preifat. Bydd yn cynorthwyo i ddatblygu argymhellion ynglŷn â pha waith arall mae angen mynd i'r afael ag ef i wella ein dealltwriaeth o'r pethau hyn, a pha argymhellion y dylid eu cyflwyno i ddiogelu iechyd y cyhoedd yng Nghymru.

Canfyddiadau a chasgliadau'r awduron yw'r rhai a gynhwysir yn yr adroddiad hwn yn hytrach na dehongliad y Gwasanaeth Tystiolaeth. Gwelir bod gwybodaeth sy'n berthnasol i ateb y cwestiynau a bennwyd ar sail yr astudiaethau sylfaenol wedi cael ei thynnu a'i chrynhof yn yr adroddiad hwn. Os oes rhyw wybodaeth benodol o ddiddordeb i chi, byddai'n syniad da i chi ddarllen ffynonellau'r wybodaeth honno'n fanylach. Os byddwch yn defnyddio unrhyw astudiaethau a gynhwyswyd yn yr adroddiad cwmpasu hwn i lywio polisiau, mae'n bwysig ystyried sut gellir cymhwyso'u canfyddiadau at eich cyd-destun chi.

Go brin fod y gwaith chwilio yr aethpwyd i'r afael ag ef ar gyfer yr adroddiad cwmpasu hwn wedi dod o hyd i'r holl dystiolaeth ynglŷn â'r pwnc hwn, oherwydd ni ellir honni bod y gwaith chwilio yn hollgynhwysfawr; yn hytrach, canolbwyntiwyd ar ddod o hyd i adolygiadau systematig trylwyr ac astudiaethau sylfaenol diweddarach sy'n deillio o nifer cyfyngedig o ffynonellau.

## Amcanion

Cynnal adolygiad cwmpasu er mwyn dod o hyd i dystiolaeth gyhoeddus yn ymwneud â'r cwestiynau canlynol:

1a. Beth yw'r risgiau/effeithiau iechyd posibl yn sgil defnyddio cyflenwadau dŵr preifat?

1b. Beth yw safbwyntiau, canfyddiadau a/neu brofiadau defnyddwyr cyflenwadau dŵr preifat ynglŷn â'r risgiau iechyd posibl sy'n gysylltiedig â defnyddio cyflenwadau dŵr preifat?

2a. Pa effeithiau tebygol a allai ddod i ran cyflenwadau dŵr preifat yn sgil hinsawdd newidiol, yn cynnwys risgiau iechyd posibl i'r defnyddwyr?

2b. Beth yw safbwyntiau, canfyddiadau a/neu brofiadau defnyddwyr cyflenwadau dŵr preifat ynglŷn ag effaith newid hinsawdd ar gyflenwadau dŵr preifat a'r risgiau sy'n gysylltiedig â'u defnyddio?

## Negeseuon Allweddol

- Ni ddaethpwyd o hyd i unrhyw dystiolaeth eilaidd gadarn a oedd yn berthnasol i'r risgiau neu'r effeithiau iechyd posibl yn sgil defnyddio cyflenwadau dŵr preifat. Fodd bynnag, ceir adolygiadau systematig cyhoeddus sy'n canolbwyntio ar agweddau eraill ar gyflenwadau dŵr preifat yn y DU.
- Yn niffyg tystiolaeth eilaidd, aethpwyd ati i chwilio am lenyddiaeth sylfaenol. Daethpwyd o hyd i bymtheg o astudiaethau sylfaenol perthnasol. Roedd nifer o'r rhain yn canolbwyntio ar ddeall ansawdd microbiolegol a chemegol cyflenwadau dŵr preifat ac ar fesur i ba raddau y torrir terfynau statudol yn hytrach na chanolbwyntio ar archwilio'r effeithiau iechyd uniongyrchol sy'n deillio o ddefnyddio cyflenwadau dŵr preifat.
- Yn ôl ymchwiliadau amgylcheddol a gynhaliwyd ar ddau achos o gastroenteritis, yfed dŵr o gyflenwadau dŵr preifat oedd y llwybr trosglwyddo mwyaf tebygol. Fodd bynnag, ni fu modd cyfrifo effaith dosymateb y salwch a'r dŵr a yfwyd gan nad oedd data o'r fath ar gael. Felly, nid yw'r cysylltiad rhwng y cyflenwadau dŵr preifat a'r achosion yn glir.
- Awgryma tystiolaeth mai i raddau bach yn unig mae cyflenwadau dŵr preifat yn cydymffurfio â safonau ansawdd dŵr. Fodd bynnag, ni chaiff y terfynau statudol ar gyfer llygryddion eu seilio bob amser ar elfennau tocsicolegol, ac o'r herwydd efallai nad yw torri'r safonau hyn o angenrheidrwydd yn awgrymu risg i iechyd yn achos rhai llygryddion.
- Pur anaml yr aethpwyd ati i ddwyn cymhariaeth rhwng cyflenwadau dŵr cyhoeddus a chyflenwadau dŵr preifat. Fodd bynnag, mewn achosion pan aethpwyd ati i ddwyn cymariaethau o'r fath, roedd cyfradd fethu cyflenwadau dŵr preifat ar gyfer un paramedr cemegol fan leiaf yn uwch na chyfradd fethu cyflenwadau cyhoeddus.
- Mae'r canfyddiadau'n awgrymu bod angen i reoleiddwyr gryfhau'r canllawiau o ran bodloni safonau dŵr yfed ar gyfer darparwyr a defnyddwyr cyflenwadau dŵr preifat, gan ategu'r manteision iechyd hirdymor sy'n gysylltiedig â chydymffurfio â'r safonau hynny.
- Yn achos y nifer fechan o astudiaethau arsylwadol a aeth ati i fonitro a dadansoddi tueddiadau tymhorol yn ymwneud ag ansawdd cyflenwadau dŵr

preifat, dangoswyd brigiadau ysbeidiol o ran dangosyddion ysgarthol a chrynodiad pathogenau yn dilyn cyfnodau o law trwm.

- Er y daethpwyd o hyd i ryw faint o berthynas ystadegol rhwng organebau sy'n arwydd o ysgarthion ar y naill law a phresenoldeb pathogenau ar y llaw arall, efallai na fydd defnyddio'r elfennau hyn i asesu cydymffurfedd rheoleiddiol wastad yn cynnig dull cadarn o fesur risgiau i iechyd y cyhoedd, oherwydd nid yw absenoldeb y dangosydd h.y. sampl sy'n bodloni lefelau cydymffurfedd rheoleiddiol, yn rhwystro pathogenau rhag bod yn bresennol, ac felly gall y dŵr barhau i beri risg i iechyd y cyhoedd.
- Ni ddaethpwyd o hyd i unrhyw astudiaethau yn y DU nac yn Iwerddon lle'r aethpwyd ati i archwilio safbwyntiau a chanfyddiadau defnyddwyr cyflenwadau dŵr preifat.
- Yn achos astudiaethau a gynhaliwyd mewn gwledydd eraill ac eithrio'r DU, yn gyffredinol roedd canfyddiadau defnyddwyr cyflenwadau dŵr preifat yn gadarnhaol ynglŷn ag ansawdd y dŵr, er gwaethaf pryderon ynglŷn â diogelwch yn sgil halogiad dŵr.
- Dim ond termau allweddol yn ymwneud â chyflenwadau dŵr preifat a'r effeithiau iechyd cysylltiedig a ddefnyddiwyd wrth chwilio am lenyddiaeth ar gyfer yr adroddiad ystwyth hwn. O'r herwydd, mae'n debygol na ddaethpwyd o hyd i'r holl waith ymchwil sy'n berthnasol i'r pwnc.

## Canfyddiadau

Ni ddaeth y gwaith chwilio o hyd i unrhyw adolygiadau systematig trylwyr nac unrhyw astudiaethau sylfaenol trefnus yn y DU nac yn Iwerddon lle ymdriniwyd yn uniongyrchol â'r cwestiynau hyn. Awgryma hyn fod angen mynd i'r afael â gwaith ymchwil pellach yn ymwneud â'r pwnc hwn.

Daethpwyd o hyd i bymtheg o astudiaethau epidemiolegol a oedd yn berthnasol i gwmpas yr adroddiad hwn. Roedd y rhain yn cynnwys tair astudiaeth drawstoriadol, tri dadansoddiad cyfres amser, pedwar dadansoddiad eilaidd, tair o astudiaethau cymheiriaid a dau ddadansoddiad grŵp ffocws. Roedd y rhain yn canolbwyntio'n bennaf ar y canlynol:

- 1) adolygu data'n ymwneud ag achosion er mwyn pennu cysylltiad rhwng lledaenu heintiau coluddol a gludir gan ddŵr i gyflenwadau dŵr preifat sydd heb eu trin neu sydd heb eu trin yn dda
- 2) pennu ansawdd cemegol (e.e., nitradau, alwminiwm, arsenig) cyflenwadau dŵr preifat a mesur i ba raddau y torrir terfynau statudol oherwydd halogiad
- 3) pennu achosion yr halogiad trwy fonitro tueddiadau tymhorol a/neu ffactorau risg epidemiolegol, fel agosrwydd at dda byw
- 4) archwilio safbwyntiau a chanfyddiadau'n ymwneud â diogelwch ac ansawdd cyflenwadau dŵr preifat

5) nodi rhwystrau o ran profi cyflenwadau dŵr preifat.

Yn Nhabl 2, cyflwynir data a ddeilliodd o'r astudiaethau, yn cynnwys cynllun yr astudiaethau, eu lleoliad, eu methodoleg, eu canlyniadau, eu cyfyngiadau, ac i ba raddau y gellir cymhwyso'u canfyddiadau at sefyllfaoedd eraill.

### 1a. Beth yw'r risgiau/effeithiau iechyd posibl yn sgil defnyddio cyflenwadau dŵr preifat?

Daethpwyd o hyd i un ar ddeg o astudiaethau a oedd yn ymchwilio i ansawdd microbiolegol a chemegol cyflenwadau dŵr preifat. O blith y rhain, gwelwyd bod dwy astudiaeth a gynhaliwyd yn Lloegr wedi ymchwilio i epidemioleg a ffynonellau achosion o heintiau coluddol a ddeilliodd o *Cryptosporidiwm* a *Campylobacter*. Ar sail yr ymchwiliadau amgylcheddol a gynhaliwyd ar leoliadau'r achosion hyn a'r ardaloedd amgylchynol, daethpwyd i'r casgliad mai yfed dŵr o gyflenwadau dŵr preifat oedd y llwybr trosglwyddo tebygol. (Duke et al. 1996 a Hoek et al. 2008). Ni ddaeth yr astudiaethau cyfredol o hyd i berthynas uniongyrchol rhwng y cyflenwadau dŵr preifat a'r achosion. Daethpwyd i'r casgliad bod cyflenwadau dŵr preifat yn ffynhonnell drosglwyddo bosibl; seiliwyd y casgliad hwnnw ar epidemioleg ddisgrifiadol ac arsylwadau amgylcheddol yn hytrach nag ar dystiolaeth a ddeilliodd o brofi samplau dŵr.

Mewn astudiaeth a gynhaliwyd gan Riserbo et al. (2012) mewn dwy ardal wledig yn Lloegr (East Anglia a Swydd Henffordd), daethpwyd o hyd i risg uwch o glefydau coluddol heintus ymhlith pobl a ddefnyddiai gyflenwadau dŵr preifat a oedd wedi'u halogi ag *Enterococci* o gymharu â phobl a ddefnyddiai gyflenwadau dŵr preifat a oedd yn cydymffurfio â'r safonau cyfredol. Er na ddaethpwyd o hyd i gysylltiad cyffredinol rhwng y risg o ddal clefyd ar y naill law a phresenoldeb bacteria dangosol ar y llaw arall, datgelodd gwaith dadansoddi is-grwpiau yn ôl oedran fod risg gymharol y clefyd ymhlith plant dan 10 oed a yfai gyflenwadau halogedig yn uwch o ran digwyddedd (mynychder) [4.8 (95%CI: 1.5, 15.3)] ac o ran cyffredinrwydd [8.9 (95%CI: 2.8, 27.5)]. Mae'r gwahanol amcangyfrifon risg cymharol ar gyfer cyfraddau mynychder a chyffredinrwydd yn arwydd o salwch hirach fesul cyfnod ymhlith plant, ond methwyd â rhoi arwyddocâd i hyd oherwydd ni fu modd i'r awduron gynnal gwaith dadansoddi pellach ar yr effaith a gâi hyd y salwch ar ganfyddiadau'r astudiaeth gan fod y sampl yn rhy fach.

Yn achos pedair astudiaeth a aeth ati i ddadansoddi ansawdd microbiolegol cyflenwadau dŵr preifat, daethpwyd ar draws halogi sylweddol. Cofnododd un astudiaeth gyfradd fynychder o 58.4% ar gyfer halogiad *E. coli* mewn dŵr daear a oedd yn deillio o gyflenwadau dŵr preifat yn Iwerddon ar gyfer samplau a ddadansoddwyd rhwng 2011-2012 (O'Dwyer et al. 2014). Yn yr un modd, wrth ddadansoddi samplau dŵr yfed a gymerwyd o saith cyflenwad dŵr preifat masnachol (sef sefydliadau a ddefnyddiai gyflenwadau dŵr preifat at ddibenion masnachol; roedd chwech o'r cyflenwadau dŵr preifat hyn wedi'u trin) ledled y DU (dau yng Nghymru) ac Iwerddon, daethpwyd o hyd i'r parasitiaid protosoaid *Cryptosporidiwm* a *Giardia* yn yr holl gyflenwadau a samplwyd, a gwelwyd enghreifftiau mynych o fethu â chyrraedd safonau dangosyddion ysgarthol (Kay et al. 2007). Ymhellach, yn achos dwy astudiaeth o'r Alban a Lloegr lle'r aethpwyd ati i ddadansoddi ansawdd cyflenwadau dŵr preifat mewn eiddo masnachol ac

anfasnachol er mwyn chwilio am bresenoldeb coliformau (cyfansymiol ac ysgarthol), nitradau neu *E. coli*, gwelwyd bod llawer o'r samplau wedi methu â chyrraedd safonau dŵr yfed ar gyfer y microbau hyn (Reid et al, 2003 a Rutter et al. 2000). Gwelwyd bod oddeutu 50% o'r samplau yn astudiaeth Reid et al. (2003) a 21% o'r samplau o blith 33% o gyflenwadau dŵr preifat yn astudiaeth Rutter et al, (2000) wedi methu â chyrraedd y rheoliadau ar gyfer coliformau a/neu nitradau, ac *E. coli*.

Aeth dwy astudiaeth ati i ddadansoddi ansawdd cemegol cyffredinol dŵr yfed o gyflenwadau dŵr preifat, a darganfuwyd mai i raddau bach yn unig y cydymffurfir â safonau ansawdd dŵr (Ander et al. 2016 a Harrison et al. 2000). Yn astudiaeth Ander et al. (2016), samplwyd dŵr yfed mewn 497 eiddo a ddefnyddiai gyflenwadau dŵr preifat ledled Cernyw a dadansoddwyd y samplau ar sail 25 o baramedrau cemegol; ond yn astudiaeth Harrison et al. (2000), casglwyd data ar gyfer samplau mewn 1297 o gyflenwadau dŵr preifat ledled Rhanbarth Gorllewin Canolbarth Lloegr. Y paramedrau a syrthiai'n fwyaf mynych oddi allan i'r Gwerth Crynodiad Rhagnodedig (PCV) yn y ddwy astudiaeth oedd pH, metelau (yn cynnwys arsenig, alwminiwm, manganis a haearn), a Nitradau. Wrth ddehongli'r canlyniadau hyn, mae'n bwysig nodi nad yw torri'r safonau hyn o angenrheidrwydd yn awgrymu risg i iechyd, oherwydd ni chaiff yr holl derfynau statudol ar gyfer llygryddion eu seilio ar elfennau tocsicolegol, a hefyd mae'r terfynau statudol wedi newid dros amser<sup>1</sup>.

Er mwyn archwilio'r risgiau iechyd posibl, darganfu astudiaeth fiomonitoro ddilynol yn ymwneud ag is-set o sampl Anser et al. (2016) gydberthynas rhwng crynodiadau arsenig mewn dŵr yfed a chrynodiadau arsenig mewn ewinedd traed a gwallt – sef rhywbeth sy'n awgrymu cysylltiad estynedig ag arsenig a phryder iechyd posibl (Middleton et al. 2016). Er bod yr astudiaeth hon wedi ailadrodd dulliau o fonitro dŵr yfed a matricesau biolegol, fel ewinedd traed a gwallt, er mwyn asesu amrywiadau o ran hirhoedledd ac amser mewn perthynas â chrynodiadau arsenig mewn cyflenwadau dŵr preifat, darganfu'r awduron nad yw'r astudiaeth hon yn esbonio'r amrywio mawr mewn perthynas â biofarcwyr ewinedd traed a gwallt. Gan y gallai cysylltiad â phridd a llwch gynnig esboniadau hynod ddichonol mewn rhanbarth y gwyddys fod ganddo lefel uwch o arsenig yn yr amgylchedd, mae angen ymchwilio ymhellach i arwyddocâd llwybrau eraill, a dylid canolbwyntio ar hyn mewn gwaith ymchwil yn y dyfodol.

Mewn asesiad risg meintiol yn ymwneud â risg Giardia a Chyptosporidiwm mewn cyflenwadau dŵr preifat bach iawn, a gynhaliwyd gan Hunter et al. (2011), defnyddiwyd data presennol sy'n deillio o astudiaeth Kay et al. (2007) a data goruchwyllo cenedlaethol yn ymwneud ag *E. coli* mewn cyflenwadau dŵr preifat yn Lloegr a Ffrainc, er mwyn amcangyfrif y risgiau blynyddol posibl o du heintio â phathogenau. Mae'r gwaith dadansoddi'n awgrymu bod pobl sy'n yfed dŵr tap heb ei ferwi o gyflenwadau dŵr preifat bach iawn yn wynebu risg fawr o gael eu heintio â Chyptosporidiwm a Giardia. Mae'r model yn amcangyfrif risg uchel iawn o gael haint – mae'r risg flynyddol ganolrifol mewn perthynas â Chyptosporidiwm oddeutu 25% yn Lloegr a 28% yn Ffrainc, ac mae'r risg gyfatebol mewn perthynas â Giardia yn 0.4%

<sup>1</sup> DEFRA. *The Private Water Supplies Regulations 2009*. (Cyf. Dŵr, Lloegr. Offeryn Statudol Rhif 3101), 2009.  
Sefydliad Iechyd y Byd, *Arsenic in drinking-water – Background document for development of WHO Guidelines for Drinking-water Quality*, Sefydliad Iechyd y Byd, WHO/SDE/WSH/03.04/75/Rev/1, 2011.  
Sefydliad Iechyd y Byd. *Guidelines for drinking-water quality (4ydd argraffiad)*. Genefa: Sefydliad Iechyd y Byd, 2011.



ar gyfer Lloegr ac yn 0.5% ar gyfer Ffrainc. Mae'n werth nodi na chynhwysodd y model effeithiau tymhorol wrth gyfrifo'r risgiau. Ymhellach, defnyddiwyd data gan Kay et al. (2007) yn ymwneud â Chryptosporidiwm a Giardia mewn cyflenwadau dŵr preifat masnachol mawr er mwyn esgor ar hafaliadau atchweliad lle disgrifir y berthynas rhwng crynodiadau o'r pathogenau hyn ac *E. coli* mewn cyflenwadau dŵr preifat. O ganlyniad, tybiodd yr awduron fod y berthynas rhwng *E. coli* a chyfanswm y pathogenau yn y systemau bach yn debyg i'r hyn a geir mewn cyflenwadau dŵr preifat masnachol mawr.

Mae'n ymddangos bod angen samplu cyflenwadau dŵr preifat yn rheolaidd, oherwydd awgryma'r astudiaethau nad aethpwyd ati i ddadansoddi'r driniaeth ar ôl cynnal profion ymhlith aelwydydd a gafodd driniaeth ar gyfer diogelwch bacteriolegol a/neu ar gyfer tynnu metelau penodol (Duke et al. 1996, Harrison et al. 2000, Rutter et al. 2000, Kay et al. 2007 ac Ander et al. 2016).

### **1b. Beth yw safbwyntiau, canfyddiadau a/neu brofiadau defnyddwyr cyflenwadau dŵr preifat ynglŷn â'r risgiau iechyd posibl sy'n gysylltiedig â defnyddio cyflenwadau dŵr preifat?**

Daethpwyd o hyd i dair o astudiaethau cyfyngedig eu methodoleg (dwy astudiaeth ansoddol ac un astudiaeth drawstoriadol) a oedd yn ymdrin â'r cwestiwn hwn. Ar y cyfan, roedd safbwyntiau'r cyfranogwyr ynglŷn ag ansawdd eu cyflenwadau dŵr preifat yn gadarnhaol, er eu bod yn pryderu y gallai'r dŵr gael ei halogi yn sgil gweithgareddau amaethyddol gerllaw (VanDerGeest, et al. 2020 a Jones et al. 2005). Cynhaliwyd y ddwy astudiaeth ansoddol mewn lleoliadau gwledig, ac roedd yna gryn wahaniaethau demograffig a diwylliannol rhwng y bobl a gymerodd ran yn yr astudiaethau; cymunedau Latino amaethyddol gwledig a oedd yn cynnwys cymysgedd o siaradwyr Sbaeneg a Saesneg yn Unol Daleithiau America o gymharu â chyfranogwyr uniaith Saesneg Gwyn a gâi eu gwasanaethu gan gyflenwadau dŵr preifat yn Ninas Hamilton yng Nghanada. Felly, mae angen ystyried ymhellach y modd y gellir cymhwyso'r astudiaethau hyn at gyd-destun Cymru.

Aeth yr astudiaethau ati i archwilio rhwystrau o ran profi cyflenwadau dŵr preifat. Gwelwyd bod anghyfleustra'r broses brofi, canlyniadau derbyniol yn y gorffennol, hunanfodlonrwydd a diffyg gwybodaeth y preswylwyr, gwybodaeth y gellir gweithredu ar ei sail, a chymorth technegol yn rhwystrau allweddol. Mae'r ddwy astudiaeth yn disgrifio pryderon ynglŷn â halogiad bacterol a chemegol sy'n deillio o ffynonellau amaethyddol, dympio llygryddion yn anghyfreithlon a diffyg system fonitro swyddogol ar gyfer dŵr yfed o gyflenwadau dŵr preifat. Dim ond y rhai a gymerodd ran mewn un astudiaeth (VanDerGeest et al., 2020) a nododd y gallai profiad o atgyweirio'r cartref gynorthwyo i oruchwylio cyflenwadau dŵr preifat trwy helpu i feithrin hunaneffeithiolrwydd.

Ymhellach, aeth astudiaeth drawstoriadol ati i gasglu barn ynglŷn â'r risg sy'n gysylltiedig ag *E. coli* O157. Defnyddiwyd dwy ardal ar gyfer yr astudiaeth achos – sef ardal ym mynyddoedd y Grampian (yr Alban) ac ardal yng Ngogledd Cymru, er mwyn cynnig gwrthgyferbyniad o ran mynychder *E. coli* O157 rhwng ardal wledig ac ardal drefol (Strachan et al. 2011). Yn achos pobl a oedd yn byw mewn ardaloedd lle'r oedd y clefyd yn digwydd yn fynych, roeddynt yn fwy tueddol o ddweud eu bod yn

ymwybodol iawn o *E. coli*; fodd bynnag, ni ddaeth yr astudiaeth hon o hyd i gysylltiad rhwng tebygolrwydd ymddangosiadol o salwch personol yn sgil *E. coli* a lefelau cymharol o fynychder y clefyd. Felly, tynnir sylw at ddiffyg cysylltiad rhwng gwybodaeth a risg ymddangosiadol – h.y., efallai fod unigolion yn ymwybodol o'r ffactorau sy'n pennu eu cysylltiad â'r clefyd, ond efallai y byddant yn dal i roi amcangyfrif rhy uchel neu isel o'u tebygolrwydd personol o ddod i gysylltiad â'r clefyd trwy ffactorau seicolegol eraill (e.e. lefel ofn, rheolaeth, cynefindra ac ati).

Fel y nodir yn nhabl 2, daethpwyd o hyd i nifer o ddiffygion wrth gynnal gwerthusiad beirniadol o'r astudiaethau hyn. Defnyddiodd yr astudiaethau fesurau hunanadrodd a mesurau gwrthrychol i gasglu'r data. Fodd bynnag, roedd dilysrwydd rhai o'r offer yn aneglur, ac felly mae risg 'tuedd hunanadrodd' yn bodoli. Recriwtiwyd y cyfranogwyr yn wirfoddol, ni chyfrifwyd maint y sampl yn yr astudiaeth drawstoriadol ac ni lwyddwyd i gasglu digon o ddata yn yr astudiaethau ansoddol. Felly, ni ellir gwarantu bod y sampl yn gynrychiadol, yn ychwanegol at y risgiau o ran y 'tuedd hunanadrodd' a'r 'tuedd dim ymateb'. Ymhellach, nid ystyriwyd atgyrchedd ac ni thrafodwyd cydberthnasau pŵer yn yr astudiaethau ansoddol. Cynigiwyd cymelliadau i'r cyfranogwyr, ond nid archwiliwyd unrhyw oblygiadau posibl. Yn y cyddestunau hyn, mae'r ffaith na thrafododd yr ymchwilyr eu proses atgyrchol yn arbennig o broblemus. Mae angen ystyried y ffactorau hyn i gyd wrth lunio casgliadau a gyflwynir yn yr adran hon.

Mae hi'n hanfodol deall canfyddiadau, anghenion a phryderon defnyddwyr cyflenwadau dŵr preifat wrth ddatblygu cynlluniau strategol effeithiol ar gyfer iechyd y cyhoedd, a hefyd wrth lunio rhaglenni addysg a pholisïau dŵr yfed. Ceir prinder gwaith ymchwil sy'n uniongyrchol berthnasol i'r modd mae defnyddwyr cyflenwadau dŵr preifat yng Nghymru yn amgyffred dŵr yfed.

## **2a. Pa effeithiau tebygol a allai ddod i ran cyflenwadau dŵr preifat yn sgil hinsawdd newidiol, yn cynnwys risgiau iechyd posibl i'r defnyddwyr?**

Methodd ein gwaith chwilio â dod o hyd i unrhyw astudiaethau sylfaenol o ansawdd da a oedd yn mynd ati'n uniongyrchol i ddadansoddi effaith newid hinsawdd ar gyflenwadau dŵr preifat. Fodd bynnag, daethpwyd o hyd i bump o astudiaethau epidemiolegol (Kay et al. 2007, O'Dwyer et al. 2014, Reid et al. 2002 a Rutter et al. 2000) yn ymwneud â'r DU ac Iwerddon lle archwiliwyd tueddiadau tymhorol a digwyddiadau tywydd eithafol er mwyn deall patrymau halogi microbiolegol mewn cyflenwadau dŵr preifat anfasnachol a/neu fasnachol.

Defnyddiodd un astudiaeth fodel atchweliad logistaidd i asesu effaith glawiad a nodweddion dyfrhaenau i ragfynegi pa mor debygol yw cyflenwadau dŵr preifat dŵr daear o gael eu halogi ag *E. coli* yn Iwerddon (O'Dwyer et al. 2014). Dangosodd y model fod halogiad *E. coli* yn fwy tebygol o ddigwydd mewn cyfnodau mwy glawog ac mewn ardaloedd lle ceir dyfrhaen creigwely. Gwelwyd hefyd bod deunydd y ddyfrhaen yn bwysig o ran pa mor hawdd yw halogi'r dŵr â microbau. Nododd yr awduron y cyfyngiadau sy'n perthyn i'w model; fe wnaethant ddefnyddio'r model fel offeryn i dynnu sylw at ardaloedd lle mae halogi ag ysgarthion yn fwy tebygol, gan gynnig arwydd bod system dŵr daear yn cael ei llygru a bod angen ei hadfer.



Yn ôl canfyddiadau gwaith dadansoddi *Cryptosporidiwm* a *Giardia* a wnaed ar samplau dyddiol (n= 1178) o ddŵr yfed dros ddau gyfnod o chwe wythnos yn ystod gwanwyn a hydref 2000 mewn saith o gyflenwadau dŵr preifat masnachol ledled y DU ac Iwerddon, cafwyd brigiadau ysbeidiol byrdymor mewn dangosyddion ysgarthol a chrynodiadau pathogenau ar ôl cyfnodau o law trwm (Kay et al. 2007). Dengys yr astudiaeth hon fod cyflenwadau dŵr wyneb yn fwy amrywiol o ran eu hansawdd a bod effeithiau glaw yn fwy tebygol o ddylanwadu arnynt. Ond mae'n bwysig nodi bod chwech o'r cyflenwadau wedi'u trin, ac er bod yna ryw faint o berthynas ystadegol rhwng organebau sy'n arwydd o ysgarthion ar y naill law a phresenoldeb pathogenau ar y llaw arall, ymddengys nad yw defnyddio'r elfennau hyn i asesu cydymffurfedd rheoleiddiol yn cynnig ffordd gadarn o fesur risg i iechyd y cyhoedd, h.y. nid yw'r ffaith bod y dangosydd yn absennol yn golygu nad yw'r pathogenau protosoaid hyn yn bresennol.

Ymhellach, dim ond yn ystod cam 2 yr astudiaeth y daethpwyd o hyd i barasitiaid mewn samplau ar rai safleoedd (h.y., yn yr hydref), sef rhywbeth y gellid ei briodoli i batrymau tymhorol o ran rheoli da byw. Gan fod ymateb y dangosyddion bacterol a'r parasitiaid protosoaid i lawiad yn gallu amrywio cryn dipyn yn eu maint ar gyfer glawiad ar lefel arbennig, mae angen ymchwilio ymhellach i'r hyn sydd wrth wraidd amrywiadau o'r fath.

Mewn dwy astudiaeth a aeth ati i ddadansoddi ansawdd cyflenwadau dŵr preifat mewn eiddo masnachol ac anfasnachol, daethpwyd o hyd i dueddiadau tymhorol mewn perthynas â phresenoldeb coliformau (cyfansymiol ac ysgarthol), nitradau neu *E. coli* (Reid et al. 2003 a Rutter et al. 2000). O ran cyfraddau methu am resymau microbiolegol, roedd y duedd dymhorol yn fwy amlwg yn ystod ail hanner y flwyddyn; ond roedd crynodiadau nitradau yn tueddu i arddangos tuedd i'r gwrthwyneb, gyda mwy o fethiannau i'w gweld yn ystod y gwanwyn, heb unrhyw berthynas amlwg â glawiad (Reit et al. 2003). Roedd y cyfraddau methu ar gyfer coliformau neu nitradau yn debyg i'w gilydd, ac awgryma hyn fod y dŵr daear wedi'i halogi'n uniongyrchol yn y rhan fwyaf o achosion yn hytrach na'i fod wedi'i halogi yn sgil storio neu ffordd gyflenwi. Mae'n drawiadol bod yr awduron wedi cael gafael ar ddata hanesyddol yn ymwneud ag ansawdd microbaidd dŵr yfed a'u bod wedi dwyn cymhariaeth syml rhwng cyfanswm y glawiad cyfartalog tymhorol a'r gyfradd fethu, a ddangosodd berthynas bositif (er isel) yn achos coliformau.

Yn yr un modd, archwiliwyd amrywiadau tymhorol mewn ansawdd dŵr cyflenwadau dŵr preifat yn astudiaeth Rutter et al. (2000), a datgelodd y gwaith dadansoddi fod canran y samplau lle daethpwyd o hyd i *E. coli* ar ei uchaf yn ystod yr haf a'r hydref, ac ar ei hisaf yn ystod y gaeaf. Gan mai dadansoddiad eilaidd oedd hwn, mae'r awduron yn nodi bod anhawster o ran casglu gwybodaeth gefndir, megis dosbarth, ffynhonnell a thriniaeth nifer o gyflenwadau gan awdurdodau lleol, wedi cyfyngu ar yr astudiaeth, gan fod yr awdurdodau lleol yn bryderus ynglŷn â chyfrinachedd.

Ymhellach, mae ymchwiliad i ganfod cysylltiad posibl rhwng digwyddedd (mynychder) cronol achosion gwasgaredig o *Cryptosporidiwm parvum* a *Chryptosporidiwm hominis* yn yr Alban, ac amrywiadau gofodol ac amserol esboniadol (yn cynnwys data cyflenwadau dŵr preifat) rhwng 2005 a 2007, wedi dangos

gwahaniaethau rhwng y ddau fath o *Gyptosporidiwm* yn ystod adegau penodol o'r flwyddyn, pan welwyd y nifer fwyaf o achosion (Pollok et al. 2010). Gwelwyd y cynnydd yn ystod yr un misoedd bob blwyddyn dros gyfnod o ddwy flynedd: cyrhaeddodd achosion o *C. parvum* eu hanterth rhwng mis Mawrth a mis Mehefin, a chyrhaeddodd achosion o *C. hominis* eu hanterth rhwng mis Awst a mis Tachwedd; a nodwyd bod cyflenwadau dŵr preifat yn newidyn pwysig, gyda'r adroddiadau'n llawer mwy tebygol o ddigwydd oherwydd *C. parvum*, sef y rhywogaeth filheintiol.

Ys dywed yr awduron, dylid ystyried nifer o ffactorau wrth ddehongli'r canlyniadau hyn, yn cynnwys hynodrwydd yr effeithiau ymylol<sup>2</sup> a rôl da byw. Ymhellach, dim ond pellteroedd llinell syth a ystyriwyd yn y modelau gofodol a ddefnyddiwyd yn Pollock et al. (2010). Gallai hyn esgor ar effeithiau sylweddol mewn ardaloedd arfordirol neu fynyddig lle gallai nodweddion daearyddol greu ffiniau biolegol.

Yn gyffredinol, mae'r astudiaethau yn yr adran hon yn awgrymu y dylid pennu cyfnodau pan fo'r risg halogi ar ei mwyaf ac y dylid samplu cyflenwadau dŵr preifat mewn modd a dargedir er mwyn gwneud y gorau o'r adnoddau cyfyngedig sydd ar gael i fonitro cyflenwadau dŵr preifat.

## **2b. Beth yw safbwyntiau, canfyddiadau a/neu brofiadau defnyddwyr cyflenwadau dŵr preifat ynglŷn ag effaith newid hinsawdd ar gyflenwadau dŵr preifat a'r risgiau sy'n gysylltiedig â'u defnyddio?**

Methodd ein gwaith chwilio â dod o hyd i unrhyw astudiaethau sylfaenol o ansawdd a oedd yn ymdrin yn uniongyrchol â'r cwestiwn hwn.

### **Astudiaethau ychwanegol a allai fod o ddiddordeb**

Daeth ein gwaith chwilio o hyd i lawer o waith ymchwil sydd, yn bennaf, ar ffurf adolygiadau naratif neu astudiaethau sylfaenol nad oeddynt yn bodloni ein meini prawf ac y peidiwyd â'u cynnwys yn dilyn trafodaethau gyda'r rhanddeiliaid. Fodd bynnag, efallai y bydd y cyfeiriadau canlynol o ddiddordeb i'r rhanddeiliaid. Pe bai'r rhain yn cael eu defnyddio ar gyfer mentrau polisi ac ymarfer, byddai angen asesu eu hansawdd.

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<sup>2</sup> "Edge effect occurs when the study area is defined by a border which does not actually prevent travel across the border" Fortney et al. 2000. Yn fwy manwl, daw i'r amlwg pan fo ffiniau ardal yr astudiaeth yn effeithio ar fesur gofodol penodol ac yn arwain at ystumio amcangyfrifon. Fortner J et al. 2000. 'Comparing alternative methods of measuring geographic access to health services'. *Health Services and Outcomes Research Methodology*. 1:173-84.

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## Ystyriaethau

- Er ein bod wedi chwilio'n eang am adolygiadau systematig trylwyr, gan chwilio wedyn am astudiaethau sylfaenol, nid yw'r gwaith chwilio'n hollgynhwysfawr. Felly, mae'n bosibl y gellir dod o hyd i adolygiadau systematig ac astudiaethau sylfaenol eraill sy'n ymdrin â'r cwestiynau ymchwil trwy chwilio cronfeydd data ychwanegol (yn cynnwys llenyddiaeth lwyd).
- Mae'n bwysig nodi y gallai rhai astudiaethau a gynhwyswyd yn yr adroddiad fod wedi defnyddio safonau ansawdd dŵr cyfoes, ond bod y safonau hynny wedi dyddio erbyn hyn.
- Cynhwyswyd cwestiynau 1b a 2b ar gais y rhanddeiliaid ar ôl sgrinio'r teitlau a'r crynodebau. Felly, mae'n bosibl bod rhai astudiaethau perthnasol wedi'u hepgor. Er gwaethaf y cyfyngiad hwn, cytunwyd na ddylid ail-wneud y gwaith chwilio oherwydd cyfyngiadau amser. Ar ôl trafod gyda'r rhanddeiliaid, cynhwyswyd astudiaethau a oedd yn ymwneud â gwledydd y tu allan i'r DU ar

gyfer C1b a C2b, ond byddem yn argymhell y dylid gwerthuso i ba raddau y gellir eu cymhwyso at gyd-destun Cymru.

## Opsiynau ar gyfer gwaith pellach

Mae'n debygol iawn na ddaeth ein gwaith chwilio o hyd i'r holl dystiolaeth (eilaidd a sylfaenol) sy'n berthnasol i'r pwnc hwn, oherwydd dim ond termau allweddol yn ymwneud â chyflenwadau dŵr preifat a gynhwyswyd yn ein strategaeth chwilio, ac efallai nad yw nifer o astudiaethau perthnasol wastad yn cyfeirio at y term ei hun. Fodd bynnag, ar sail prinder yr astudiaethau sylfaenol cyhoeddedig a nodir yn yr adroddiad hwn, cyfyngedig yw cwmpas y Gwasanaeth Tystiolaeth o ran mynd i'r afael â rhagor o waith yn ymwneud â'r pwnc hwn.

## Dulliau

Mae Atodiad A (atodiad technegol) yn rhoi amlinelliad o'r rhesymeg gyffredinol a'r dulliau a ddefnyddiwyd i ddatblygu adolygiadau cwmpasu ystwyth. Mae'r fethodoleg ganlynol yn amlinellu'r dull a ddefnyddiwyd ar gyfer yr adroddiad cwmpasu ystwyth hwn.

Gan fod hwn yn bwnc eang, cyfyngwyd y cwmpas ystwyth hwn i gynnwys adolygiadau a gynhyrchwyd gan ddefnyddio dulliau penodol ac atgynhyrchadwy o chwilio systematig, gwerthuso beirniadol o ansawdd a chyfosod y llenyddiaeth sylfaenol ynghylch y pwnc yn unig. Mae hon yn ffordd dderbyniol o asesu'r rhan fwyaf o'r sylfaen dystiolaeth yn gyflym, ac er nad yw'n bwriadu nodi pob cyhoeddiad ar bwnc, byddai'n caniatáu ar gyfer cynhyrchu trosolwg. Cafodd astudiaethau sylfaenol eu heithrio gan y byddai cynnwys ffynonellau dystiolaeth sylfaenol ac eilaidd ar bwnc mor eang wedi gwneud yr adroddiad hwn yn anhydrin o fewn amserlen yr ymchwil hwn.

### Ffynonellau data:

Chwiliwyd 20 o ffynonellau dystiolaeth dibynadwy sy'n cadw at egwyddorion adolygu systematig cadarn<sup>3</sup>, chwiliwyd Google Scholar, Epistemonikos a Medline am dystiolaeth adolygu systematig gyhoeddedig, gan ddefnyddio termau chwilio a strategaethau a ddyluniwyd yn benodol ar gyfer pob ffynhonnell ddata. Chwiliwyd Google Scholar a Medline am astudiaethau cynradd cyhoeddedig gan ddefnyddio cyfuniad o'r termau canlynol fel y disgrifir yn Atodiad B:

- Private water supply/ies
- Private well supply/ies
- Borehole
- Well water
- Groundwater
- Climate change
- Rainfall
- Storm
- Drought
- Health risk/ impact
- Views/ perceptions/ beliefs
- Barriers/ factors

Mae rhestr lawn o'r adnoddau a chwiliwyd wedi'i chynnwys yn atodiad B (atodiad chwilio). Yn ogystal, ymgynghorwyd ag arbenigwyr pwnc i nodi astudiaethau perthnasol.

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<sup>3</sup> Yn dilyn egwyddorion adolygu systematig craidd: strategaeth chwilio gynhwysfawr a datganedig, dewis ffynonellau yn seiliedig ar feini prawf gwrthrychol, asesiad o risg o duedd ffynonellau gwreiddiol a/neu yn fethodoleg a ddatblygwyd gan gorff arbenigol e.e. NICE. Am restr lawn o'r ffynonellau a chwiliwyd, cyfeiriwch at adran Ffynonellau a chwiliwyd yn yr adroddiad.

**Dethol astudiaethau:** Aseswyd adolygiadau a gynhyrchwyd gan ddefnyddio methodoleg systematig (gan gynnwys gwerthuso beirniadol) h.y. adolygiadau systematig, adolygiadau cwmpasu, adolygiadau cyflym ac ati, i'w cynnwys. Sgriniodd un adolygydd yr erthyglau yn annibynnol o ran perthnasedd ar lefel y teitl, y crynodeb a'r testun llawn o'u cymharu â'r meini prawf ar gyfer cynnwys astudiaethau a amlinellir yn nhabl 1.

**Echdynnu data:** Lle'r oedd hi'n bosibl, tynnwyd data oedd yn adrodd nodweddion perthnasol o'r adolygiadau a gynhwyswyd i mewn i dabl echdynnu data (tabl X). Gwiriodd ail adolygydd y data a echdynnwyd. Cafodd anghytundebau ar unrhyw adeg eu datrys trwy drafod gyda thrydydd adolygydd.

**Asesiad ansawdd:** Cafodd yr astudiaethau sylfaenol a gynhwyswyd eu gwerthuso'n feirniadol ar sail eu hansawdd. Aeth un adolygydd ati i werthuso'r holl astudiaethau a gynhwyswyd trwy ddefnyddio rhestr wirio'r Uned Arbenigol ar gyfer Tystiolaeth Adolygu (SURE). Aeth ail adolygydd ati i wirio cysondeb ar gyfer oddeutu 20% o'r papurau a gynhwyswyd, ac fe'u trafodwyd i gadarnhau dibynadwyedd rhyng-raddwyr. Nodwyd unrhyw bryderon ynglŷn ag ansawdd methodolegol yr astudiaethau o dan 'sylwadau'r adolygwr' yn y tabl data. Dim ond astudiaethau yr ystyriwyd eu bod o ansawdd digon da a gynhwyswyd yn y cwmpas ystwyth hwn.

**Tabl 1a. Meini Prawf Cynnwys am C1a.**

| Beth yw risgiau/effeithiau iechyd posibl o ddefnyddio gyflenwadau dŵr preifat? |                                                                                     |                                              |
|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------|
|                                                                                | Cynnwys                                                                             | Eithrio                                      |
| Poblogaeth                                                                     | Oedolion a phlant sy'n defnyddio/sy'n agored i gyflenwadau dŵr preifat              |                                              |
| Amlygiad                                                                       | Cyflenwadau dŵr preifat                                                             |                                              |
| Canlyniadau                                                                    | Risgiau/effeithiau iechyd                                                           | Unrhyw canlyniadau eraill                    |
| Dyluniad astudiaeth                                                            | Llenyddiaeth gynradd gyhoeddusig o unrhyw ddyluniad                                 | Adolygiadau (unrhyw fath), llenyddiaeth lwyd |
| Math o ymchwil                                                                 | Unrhyw ddyluniad ymchwil: dulliau meintiol neu gymysg gyda data meintiol perthnasol |                                              |
| Gwlad                                                                          | DU, Iwerddon                                                                        | Pob gwlad arall                              |
| Ystyriaethau Eraill yr Astudiaeth: Saesneg yn unig                             |                                                                                     |                                              |

**Tabl 1b. Meini Prawf Cynnwys am C1b.**

| Beth yw safbwyntiau, canfyddiadau a/neu brofiadau defnyddwyr PWS ynghylch y risgiau iechyd posibl sy'n gysylltiedig â defnyddio gyflenwadau dŵr preifat? |                                                                        |         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|---------|
|                                                                                                                                                          | Cynnwys                                                                | Eithrio |
| Sampl                                                                                                                                                    | Oedolion a phlant sy'n defnyddio/sy'n agored i gyflenwadau dŵr preifat |         |
| Ffenomen o ddiddordeb                                                                                                                                    | Risgiau iechyd sy'n gysylltiedig â defnyddio cyflenwad dŵr preifat     |         |



|                                                    |                                                     |                                              |
|----------------------------------------------------|-----------------------------------------------------|----------------------------------------------|
| Dyluniad                                           | Llenyddiaeth gynradd gyhoeddedig o unrhyw ddyluniad | Adolygiadau (unrhyw fath), llenyddiaeth lwyd |
| Gwerthusiad                                        | Safbwyntiau, canfyddiadau, profiadau                | Unrhyw ganlyniadau eraill                    |
| Math o ymchwil                                     | Dulliau ansoddol/neu gymysg gyda data perthnasol    |                                              |
| Gwlad                                              | DU, Iwerddon, UDA a Canada                          | Pob gwlad arall                              |
| Ystyriaethau Eraill yr Astudiaeth: Saesneg yn unig |                                                     |                                              |

Tabl 2a. Meini Prawf Cynnwys am C2a.

Beth yw effeithiau tebygol newid hinsawdd ar gyflenwadau dŵr preifat gan gynnwys y risgiau iechyd posibl i ddefnyddwyr?

|                                                    |                                                                                     |                                             |
|----------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------|
| Poblogaeth                                         | Oedolion a phlant sy'n defnyddio/sy'n agored i gyflenwadau dŵr preifat              |                                             |
| Amlygiad                                           | Newid hinsawdd                                                                      |                                             |
| Canlyniadau                                        | Ansawdd cyflenwad dŵr preifat a risgiau/effeithiau iechyd ar ei ddefnyddwyr         |                                             |
| Dyluniad astudiaeth                                | Astudiaethau gynradd                                                                | Adolygiadau (unrhyw fath), dogfennau polisi |
| Math o ymchwil                                     | Unrhyw ddyluniad ymchwil: dulliau meintiol neu gymysg gyda data meintiol perthnasol |                                             |
| Gwlad                                              | DU, Iwerddon                                                                        | Pob gwlad arall                             |
| Ystyriaethau Eraill yr Astudiaeth: Saesneg yn unig |                                                                                     |                                             |

Tabl 2b. Meini Prawf Cynnwys am C2b.

Beth yw safbwyntiau, canfyddiadau a/neu brofiadau defnyddwyr gyflenwadau dŵr preifat ynghylch effaith newid hinsawdd ar PWS a'r risgiau sy'n gysylltiedig â'u defnydd?

|                                                    |                                                                                                                |                                              |
|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------------------------------------------|
|                                                    | Cynnwys                                                                                                        | Eithrio                                      |
| Sampl                                              | Oedolion a phlant sy'n defnyddio/sy'n agored i gyflenwadau dŵr preifat                                         |                                              |
| Ffenomen o ddiddordeb                              | Newid hinsawdd a'i effaith ar ansawdd gyflenwadau dŵr preifat<br>Risgiau / effeithiau iechyd ar ei ddefnyddwyr |                                              |
| Dyluniad                                           | Llenyddiaeth gynradd gyhoeddedig o unrhyw ddyluniad                                                            | Adolygiadau (unrhyw fath), llenyddiaeth lwyd |
| Gwerthusiad                                        | Safbwyntiau, canfyddiadau, profiadau                                                                           | Unrhyw ganlyniadau eraill                    |
| Math o ymchwil                                     | Dulliau ansoddol/neu gymysg gyda data perthnasol                                                               |                                              |
| Gwlad                                              | DU, Iwerddon, UDA a Canada                                                                                     | Pob gwlad arall                              |
| Ystyriaethau Eraill yr Astudiaeth: Saesneg yn unig |                                                                                                                |                                              |

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## Atodiad A: Dogfen dechnegol

MAE ADOLYGIADAU CWMPASU ystwyth yn drosolygon systematig a chyflym o'r dystiolaeth ar bwnc sy'n cael eu gyrru gan y rhanddeiliaid. Maent yn darparu trosolwg tryloyw a dibynadwy o'r dirwedd dystiolaeth ac maent yn ddefnyddiol er mwyn:

- sefydlu pa lenyddiaeth sy'n bodoli
- helpu i fireinio cwestiwn eang
- nodi bylchau yn y dystiolaeth
- llywio gwaith pellach gan y rhanddeiliaid.

Mae'r adolygiadau cwmpasau'n defnyddio proses o hyd at dri cham, gan ddibynnu ar ba dystiolaeth sydd ar gael ar gyfer y pwnc. Mae symud ymlaen o'r naill gam i'r llall yn cael ei drafod a'i gytuno gyda'r rhanddeiliaid.

1. Y cam cyntaf yw tynnu ar dystiolaeth adolygiadau systematig bresennol sydd wedi'u nodi mewn ffynonellau dibynadwy<sup>4</sup> (ffynonellau tystiolaeth eilaidd sy'n defnyddio methodolegau cadarn) lle mae hyn yn bodoli. Nid yw'r Gwasanaeth Tystiolaeth yn cynnal gwerthusiad beirniadol o'r adolygiadau hyn.
2. Os nad oes fawr ddim tystiolaeth, os o gwbl, wedi'i nodi ar hyn o bryd, cynhelir chwiliad syml iawn yn Medline gan ddefnyddio allweddeiriau yn unig i ganfod budd cynnal chwiliadau pellach mewn ystod ehangach o gronfeydd data. Bydd crynodeb o ganlyniadau'r chwiliad (h.y., nifer, cynllun yr astudiaeth, perthnasedd ac ati) yn cael ei ddarparu yn y cwmpas ystwyth i helpu i hysbysu rhanddeiliaid.
3. Lle nad oes fawr ddim tystiolaeth eilaidd y gellir ymddiried ynddi yn bodoli, os o gwbl, ac os yw'r chwiliad Medline a gynhaliwyd yng nghanam 2 yn nodi ei fod o fudd, gellir ymestyn y cwmpas, ar gais y rhanddeiliad, i gynnwys chwiliad am adolygiadau systematig neu lenyddiaeth sylfaenol yn Google Scholar, Scopus neu Medline, fel y bo'n briodol. Yn y cam hwn ac unrhyw gam dilynol, byddai angen asesu ansawdd y dystiolaeth a nodwyd.
4. Nid yw astudiaethau sylfaenol yn cael eu cynnwys fel arfer, oni bai bod ychydig neu ddim adolygiadau systematig yn cael eu nodi yng nghanam rhagarweiniol cam 1, neu fod rhanddeiliaid yn gofyn am hynny yn dilyn gwaith cynharach y maent wedi'i wneud.

## Ystyriaethau

- Nid yw'r cwmpas yn ceisio nodi'r holl dystiolaeth ar bwnc penodol.
- Ni fydd pob canlyniad a nodir yn y llenyddiaeth o reidrwydd yn cael ei
- gynnwys yn yr adroddiad cwmpasu hwn am nifer o resymau, gan gynnwys:
  - Mae'r canlyniadau a gynhwysir yn y cwmpas wedi'u cyfyngu i'r rhai sy'n

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<sup>4</sup> Darperir y ffynonellau ar restr y Gwasanaeth Tystiolaeth o'r adnoddau tystiolaeth eilaidd y gellir ymddiried ynddynt yn Atodiad B, tabl 1

- berthnasol i gwestiwn gwreiddiol y rhanddeiliaid.
- Mae'n bosibl nad yw canlyniadau wedi'u hadrodd yn y ffynonellau eilaidd, er y gallen nhw fodoli yn y llenyddiaeth sylfaenol. Gan hynny, fydd y canlyniadau hyn ddim yn cael eu cynnwys yn yr adroddiad cwmpasu.
- Nid yw canfyddiadau mewn adolygiadau sydd wedi'u cynnwys yn cael eu hasesu i weld a oes modd eu cyffredinoli yn y cyd-destun Cymreig. [Byddai hynny'n broses gymhleth gan fod tystiolaeth eilaidd yn debygol o gynnwys astudiaethau o nifer o wledydd.] Byddai angen i'r rhanddeiliaid ystyried hyn os ydyn nhw'n defnyddio tystiolaeth eilaidd i lywio polisi ac arferion. Gellid gofyn am waith ychwanegol os oes ei angen.
- Mae'r cwmpas yn crynhoi canfyddiadau a chasgliadau awduron y ffynonellau. Os oes elfen benodol o'r adroddiad o ddiddordeb arbennig, mae'n ddoeth darllen y ffynhonnell/ffynonellau y mae'n tarddu ohonyn nhw yn fanylach, gan y bydd hyn yn rhoi mwy o gyd-destun. Gellir gwneud gwaith pellach ar feysydd penodol os oes ei angen.
- Darperir hyperddolenni i'r dystiolaeth sydd wedi'i chynnwys yn y tabl crynhoi data. Mewn llawer o achosion, mae'r dystiolaeth honno ar gael am ddim. Os nad yw, gall gwasanaeth Gwybodaeth a Llyfrgell eich Ymddiriedolaeth helpu. [Gwasanaeth Llyfrgell GIG Cymru](#)

## Dulliau

Mae pob adolygiad cwmpasu ystwyth yn dilyn methodoleg a strwythur eang, gydag amrywiadau bach yn unig yn ôl y cwestiwn a'r sylfaen dystiolaeth a nodwyd. Trwy drafod gyda'r rhanddeiliaid, datblygir cwestiwn ymchwil a meini prawf cynnwys/hepgor gan ddefnyddio fformat PICO/PECO (poblogaeth, ymyriad/amlygiad, cymharydd, canlyniad). **Sylwch: gofynnir i'r rhanddeiliaid nodi tystiolaeth/gwybodaeth y maen nhw eisoes wedi'u nodi.**

Fel y nodwyd uchod, mae'r fethodoleg a ddefnyddir wedi'i chynllunio i ddarparu gwybodaeth gyflym i'r rhanddeiliaid. Yn y cam cyntaf, mae cyfyngu'r chwiliad i ffynonellau o'r rhestr adnoddau tystiolaeth eilaidd yr ymddiriedir ynddynt yn lleihau'r amser a gymerir o ran cwmpas y chwiliad a thrwy hepgor yr angen am werthusiad beirniadol.

Mae'r strategaeth chwilio a ddatblygwyd wedi'i seilio ar y meini prawf cynnwys ac yn defnyddio geiriau allweddol. Mae'r cwmpas wedi'i gyfyngu i gynnwys tystiolaeth Saesneg yn unig a gellir gosod terfynau o ran y dyddiad cyhoeddi pan fydd canlyniadau'r chwiliad yn rhy fawr i'w rheoli mewn cyfnod byr, neu pan fo'r rhanddeiliad yn gofyn i waith gael ei gwblhau o fewn amserlen benodol. Yn ychwanegol, gall y gwledydd a gynhwysir gael eu cyfyngu yng nghanam tri, yn enwedig lle mae cyffredinoli i gyddestun Cymru yn bryder arbennig.

Cedwir yr holl ganlyniadau chwilio a sgrinio ar gyfer adolygiadau systematig perthnasol mewn llyfrgell EndNote neu mewn system addas ar gyfer rheoli cyfeiriadau. Mae'r penderfyniad i gynnwys deunyddiau ar lefel y teitl a'r crynodeb yn

cael ei bwyso a'i fesur gan ddau adolygydd sy'n sgrinio'n annibynnol y 10% i 20% cyntaf o'r adolygiadau systematig ar gyfer perthnasedd, gyda'r gweddill yn cael eu sgrinio gan un adolygydd. Mae penderfyniadau sgrinio'r testun llawn yn cael eu gwneud gan ddau adolygydd. Mae data ar nodweddion yr astudiaethau a'r canfyddiadau sy'n berthnasol i'r cwestiwn yn cael eu tynnu gan un adolygydd a'u gwirio gan ail adolygydd. Wedyn mae'r dystiolaeth yn cael ei chrynhofio ar ffurf naratif i ateb cwestiynau'r rhanddeiliaid. Mae adroddiad yn cael ei gyflwyno ar fylchau yn y dystiolaeth yn y llenyddiaeth eilaidd.

Os na nodir unrhyw dystiolaeth, neu nodir tystiolaeth gyfyngedig, o'r rhestr o ffynonellau eilaidd y gellir ymddiried ynddynt, cynhelir chwiliad byr yn Medline gan ddefnyddio chwiliadau gydag allweddeiriau sylfaenol i ganfod budd cynnal chwiliadau pellach mewn ystod ehangach o gronfeydd data. Bydd crynodeb o'r canlyniadau chwilio (h.y. nifer, cynllun yr astudiaeth, perthnasedd ac ati) yn cael ei ddarparu yn y cwmpas ystwyth.

## Canfyddiadau

Mae'r adroddiad cwmpasu ystwyth yn cynnwys crynodeb naratif a thabl data. Mae'r crynodeb naratif yn drosolwg bras o'r dystiolaeth a nodwyd, gyda ffocws penodol ar elfennau a amlygwyd fel rhai pwysig gan y rhanddeiliaid. Mae'r tablau data yn cynnwys y cyfeiriad (gyda hyperddolen), gwybodaeth am nodweddion a chanfyddiadau'r astudiaeth. Bydd yr wybodaeth yn y tablau data yn amrywio yn ôl y cwestiwn, y mathau o astudiaethau sydd wedi'u cynnwys a gofynion y rhanddeiliaid. Mae'r tabl hefyd yn cynnwys adran sylwadau sy'n amlygu unrhyw elfennau o ddiddordeb arbennig i'r rhanddeiliaid ynghyd ag unrhyw gyfyngiadau y dylid eu hystyried.

Mae'r adroddiad yn cloi gydag adran 'opsiynau ar gyfer gwaith pellach'. Mae'r awgrymiadau hyn wedi'u seilio ar y dystiolaeth a nodwyd ac yn rhoi sail resymegol benodol lle argymhellir gwaith pellach i adolygu'r dystiolaeth. Bydd yr wybodaeth hon yn cael ei llywio gan y chwiliad byr ychwanegol a gynhaliwyd yn Medline i helpu i asesu faint o wybodaeth ychwanegol sydd, a manteision tebygol cynnal gwaith ychwanegol. Bydd y canfyddiadau hyn yn cael eu darparu i rhanddeiliaid er mwyn sicrhau eu bod yn gallu gwneud penderfyniad gwybodus ynghylch beth i'w wneud nesaf.



## Atodiad B: Atodiad Chwiliadau

| Tabl 1: Yr adnoddau a chwiliwyd                                                                                                                                                                                                                                                                                                                                                                                        |                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| <p>Cochrane database of systematic reviews - <a href="https://www.cochranelibrary.com/cdsr/reviews">https://www.cochranelibrary.com/cdsr/reviews</a></p> <p><i>Systematic reviews on health care interventions, diagnostics and public health interventions.</i></p>                                                                                                                                                   | Dyddiad y chwyliad:<br>Mai 2023 |
| <p>NICE – <a href="https://www.nice.org.uk/guidance">https://www.nice.org.uk/guidance</a></p> <p><i>Guidelines of health care and public health topics. Note: you should be looking for systematic evidence reviews that may underpin guidance on your topic, not the guidance itself. Not all recommendations are based on evidence reviews.</i></p>                                                                  | Dyddiad y chwyliad:<br>Mai 2023 |
| <p><a href="https://journals.lww.com/jbisrir/pages/advancedsearch.aspx">Joanna Briggs Institute - https://journals.lww.com/jbisrir/pages/advancedsearch.aspx</a></p> <p><i>This organisation's journal, JBI Evidence Synthesis includes systematic and scoping reviews of both quantitative and qualitative evidence on healthcare and public health topics.</i></p>                                                   | Dyddiad y chwyliad:<br>Mai 2023 |
| <p>Prospero – <a href="https://www.crd.york.ac.uk/prospero/">https://www.crd.york.ac.uk/prospero/</a></p>                                                                                                                                                                                                                                                                                                              | Dyddiad y chwyliad:<br>Mai 2023 |
| <p><a href="#">National Institute for Health Research (NIHR) Public Health Research –</a><br/><i>Some reports in this journal are systematic reviews of interventions to improve public health.</i></p>                                                                                                                                                                                                                | Dyddiad y chwyliad:<br>Mai 2023 |
| <p><a href="#">The Evidence for Policy and Practice Information and Co-ordinating Centre (EPPI-Centre) – http://eppi.ioe.ac.uk/cms/</a></p>                                                                                                                                                                                                                                                                            | Dyddiad y chwyliad:<br>Mai 2023 |
| <p><a href="https://www.campbellcollaboration.org/better-evidence.html">Campbell Collaboration systematic reviews - https://www.campbellcollaboration.org/better-evidence.html</a><br/><i>Systematic reviews of the effects of social interventions in Crime &amp; Justice, Education, International Development, and Social Welfare.</i></p>                                                                          | Dyddiad y chwyliad:<br>Mai 2023 |
| <p><a href="https://whatworkswellbeing.org/about-us/">What Works Centre for Wellbeing – https://whatworkswellbeing.org/about-us/</a></p> <p><i>Systematic reviews of the impacts of policies and projects on wellbeing.</i></p>                                                                                                                                                                                        | Dyddiad y chwyliad:<br>Mai 2023 |
| <p><a href="https://www.eif.org.uk/about">Early Intervention Foundation (EIF) – https://www.eif.org.uk/about</a><br/><i>Systematic reviews about early interventions for tackling the root causes of social problems for children and young people.</i></p>                                                                                                                                                            | Dyddiad y chwyliad:<br>Mai 2023 |
| <p><a href="https://healthtechnology.wales/">Health Technology Wales – https://healthtechnology.wales/</a><br/><i>Reports and guidance on use of medical devices, surgical procedures, psychological therapies, tele-monitoring or rehabilitation.</i></p>                                                                                                                                                             | Dyddiad y chwyliad:<br>Mai 2023 |
| <p><a href="https://www.hiqa.ie/areas-we-work/health-technology-assessment">Health Technology Assessments (Ireland) – https://www.hiqa.ie/areas-we-work/health-technology-assessment</a><br/><i>Health technology assessments on the clinical and cost-effectiveness of drugs, equipment, diagnostic techniques and public health activities.</i></p>                                                                  | Dyddiad y chwyliad:<br>Mai 2023 |
| <p><a href="https://www.journalslibrary.nihr.ac.uk/hta/about-the-hta-journal.htm">National Institute for Health Research Health (NIHR) Technology Assessment (HTA) Journal – https://www.journalslibrary.nihr.ac.uk/hta/about-the-hta-journal.htm</a><br/><i>Some reports in this journal are systematic reviews of interventions to, prevent and treat disease and improve rehabilitation and long-term care.</i></p> | Dyddiad y chwyliad:<br>Mai 2023 |
| <p><a href="#">Agency for Healthcare Research and Quality (AHRQ)</a><br/>Search Evidence-Based Reports   Agency for Healthcare Research and Quality (ahrq.gov)</p>                                                                                                                                                                                                                                                     | Dyddiad y chwyliad:<br>Mai 2023 |

|                                                                                                                                                                                                                                                                                                                                                                                                         |                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| <i>Effectiveness and comparative effectiveness reviews of health care interventions.</i>                                                                                                                                                                                                                                                                                                                |                                 |
| <a href="https://www.sign.ac.uk/our-guidelines/">Scottish Intercollegiate Guidelines Network (SIGN) clinical guidelines – https://www.sign.ac.uk/our-guidelines/</a><br><i>Clinical practice guidelines. Note: you should be looking for systematic evidence reviews that may underpin guidance on your topic, not the guidance itself. Not all guidance is based on evidence reviews</i>               | Dyddiad y chwyliad:<br>Mai 2023 |
| <a href="#">The Collaboration for Environmental Evidence (CEE)</a><br><i>CEE seeks to promote and deliver evidence syntheses (systematic reviews and maps) on issues of greatest concern to environmental policy and practice, as a public service.</i>                                                                                                                                                 | Dyddiad y chwyliad:<br>Mai 2023 |
| <a href="https://scholar.google.com/">Google Scholar – https://scholar.google.com/</a><br><i>"private water supply" AND "health" AND "systematic review"</i>                                                                                                                                                                                                                                            | Dyddiad y chwyliad:<br>Mai 2023 |
| <a href="https://www.epistemonikos.org/">Epistemonikos - https://www.epistemonikos.org/</a><br>abstract:(private) AND abstract:(groundwater OR well OR "ground water")<br>AND abstract:(water)<br><i>Search using keywords and select "systematic reviews" in the filter By Category menu in the results</i>                                                                                            | Dyddiad y chwyliad:<br>Mai 2023 |
| <a href="https://www.scopus.com/search/form.uri?display=basic#basic">Medline – https://www.scopus.com/search/form.uri?display=basic#basic</a><br>Private adj2 water AND health<br>Private adj2 well AND health<br>AND systematic review<br>Also, searched for borehole, groundwater, rain, rainfall, storm, drought and flood* and climate change<br><i>Suitable for clinical/health related topics</i> | Dyddiad y chwyliad:<br>Mai 2023 |

## Atodiad C: Echdynnu data

| Tabl 2: Echdynnu data o'r astudiaethau cynradd sydd wedi'u cynnwys (yn nhrefn yr wyddor)                                                                                                                                                       |                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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| Cyfeiriad                                                                                                                                                                                                                                      | Nod/Cwestiwn                                                                                                                                                                                                                       | Crynodeb                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Sylwadau                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Ander EL, Watts MJ, Smedley PL, et al. (2016). Variability in the chemistry of private drinking water supplies and the impact of domestic treatment systems on water quality. <i>Environmental Geochemistry and Health</i> . 38, pp.1313–1332. | To help quantify human exposure to chemicals in private drinking water supplies in the UK and identify any potential public health risks, as part of Public Health England's (PHE) Environmental Public Health Tracking programme. | <p><b>Study design:</b> Cross-sectional survey.</p> <p><b>Location:</b> Cornwall, England.</p> <p><b>Method:</b> Tap water samples from 497 properties using PWS were collected across two phases: spring 2011 and 2013. Sampling design, sampling, data analysis and data reporting were undertaken by the British Geological Survey (BGS). Chemical variability was measured for 25 parameters as determined by PCV set by (DEFRA 2009)<sup>5</sup> and WHO guidelines (Smedley et al. 2014)<sup>6</sup>.</p> <p><b>Result:</b> Sources of drinking water included: Boreholes 82% (n = 406), traditional large-diameter wells 12% (n = 62), spring capture 3% (n = 14) and unidentified source 3% (n = 15). Treatment could be recorded for 487 of the 497 (98 %) drinking water samples. Of these, 21% (n = 102) were untreated, and 47 % (n = 229) had no disinfection system in place using UV or, rarely, chlorination (n = 5). 65 % samples exceeded one or more chemical standards. The highest exceedances for health-based standards were nitrate (11 %), and arsenic (5 %). Other exceedance included pH (47 %), manganese (12 %), nitrates (11%), aluminium (7 %), iron (3 %) and nickel (3 %).</p> <p>Significant reductions in concentrations of aluminium, cadmium, copper, lead and/or nickel were found where</p> | <p><b>Generalisability:</b> The samples were collected from an area of metalliferous and arsenic mineralisation (Cornwall). Therefore, the reported findings could be generalisable to Wales; however, the contextual environment of the PWS in England needs consideration.</p> <p><b>Methodological rigour:</b> This is a cross-sectional study and is therefore, susceptible to biases inherent to its study design.</p> <p>Randomised sampling was used to minimise sampling bias; however snowballing was also employed and therefore representativeness of the sample is not guaranteed.</p> <p>Water sample collection methods followed standard protocols used at BGS and the volunteer recruitment and appointment booking system was operated by PHE.</p> <p>Though self-reporting of treatment systems was used, criterion was used to assess the effects of pH adjustments on wider chemical properties.</p> |

<sup>5</sup> DEFRA. (2009). *The Private Water Supplies Regulations 2009*. (Vol. Water, England. Statutory Instrument No. 3101).

<sup>6</sup> Smedley, P. L., Cooper, D. M., & Lapworth, D. J. (2014b). Molybdenum distributions and variability in drinking water from England and Wales. *Environmental Monitoring and Assessment*, 186(10), 6403–6416.

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|                                                                                                                                                                                     |                                                                                                                                                                                                                            | <p>households were successfully treating low-pH groundwaters, arsenic and nickel where treatment was installed for iron and/or manganese removal, and arsenic where treatment specifically to decrease tap water arsenic concentrations was installed. However, 31 % of samples where pH treatment was reported had pH &lt; 6.5 (the minimum value in the drinking water regulations), suggesting widespread problems with system maintenance.</p> <p><b>Conclusion:</b> The degree of drinking water standard exceedances warrants further work to understand environmental controls and the location of high concentrations. The residents were more willing to accept drinking water with high metal (iron and manganese) concentrations than international guidelines assume. The findings point to the need for regulators to reinforce the guidance on drinking water quality standards to PWS users, and the benefits to long-term health of complying with these, even in areas where treated mains water is widely available.</p> | <p>Chemical analyses were undertaken in accredited BGS Inorganic Geochemistry laboratories and recognised water quality guideline values were used.</p> <p>This study was a one-off survey conducted at two separate intervals: study authors assumed that variation within the dataset during the survey is substantially greater than variation in time.</p>                                                                                                                                                                                                                                                                                                                                                             |
| Duke et al. (1996). A mixed outbreak of cryptosporidium and campylobacter infection associated with a private water supply. <i>Epidemiology and Infection</i> , 116(3), pp.303–308. | To describe an outbreak of gastroenteritis in which both campylobacter and cryptosporidium were isolated from the faeces of infected individuals, and where contaminated water was implicated as the vehicle of infection. | <p><b>Study design:</b> cross-sectional study</p> <p><b>Location:</b> Northumberland</p> <p><b>Method:</b> On the 20 May 1993, following request from a general practitioner, the Department of Public Health Medicine in Northumberland investigated an outbreak of gastroenteritis amongst residents of a mediaeval building, including 45 students and 9 tutors. The case definition was restricted to anyone resident in the accommodation wing who had developed symptoms of diarrhoea and/or vomiting in the week beginning 15 May 1993. The student residence was visited, and food histories were taken from symptomatic individuals. Stool specimens were collected and cultured for salmonella, shigella and campylobacter, and examined for cryptosporidium cysts. Water samples from the building were collected and examined for E coli, campylobacter, and cryptosporidium cysts. Following</p>                                                                                                                              | <p><b>Generalisability:</b> The reported findings could be generalisable to Wales; however, the outbreak took place in 1993 in a mediaeval building in England and therefore contextual environment of the outbreak needs consideration.</p> <p><b>Methodological rigour:</b> This is a cross-sectional study and is therefore, susceptible to biases inherent to its study design.</p> <p>The researchers provide results of an epidemic curve showing the number of cases per day and daily rainfall showing a possible association between rainfall, number of cases and the protective influence of sterilising water.</p> <p>Study utilised various methods to collect data including validated and self-reported</p> |

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|                                                                                                                                                                                                      |                                                                                                                                          | <p>indications of water-borne transmission, detailed inspections of water supply were undertaken.</p> <p><b>Results:</b> This outbreak was attributed to water borne infection involving a PWS. In total, 200 residents were served by the PWS and the overall, attack rate of 22%. Analysis of stool specimens (n=20) identified 11 pathogens including <i>Campylobacter</i> and <i>cryptosporidium</i>. Water sampling identified high <i>E. coli</i> counts and further sampling suggested contamination in or near storage chambers. Investigations revealed the carcasses in a collection chamber connected with the water supply, and these, or run-off of slurry from surrounding fields, were the presumed source of contamination. Variation in the level of contamination were due to poor maintenance of UV treatment and untreated outlets.</p> <p><b>Conclusion:</b> This outbreak highlights some of the difficulties associated with PWS including difficulty to achieve, maintain and enforce water quality standards in PWS because of their varied history and nature. Issues relating to the maintenance and monitoring of private water supplies are discussed. Problems with such supplies include old piping, proximity of livestock, inadequate knowledge of the layout and limited resources for monitoring and maintenance.</p> | <p>measures. Therefore, self-reporting bias is possible.</p> <p>Participant characteristics were not reported. Therefore, representativeness of the sample is not guaranteed in addition to risk of self-selection and non-response biases.</p> <p>Only a small number of faecal samples could be collected and analysed (n=20) and might affect reliability of the results.</p> <p>Authors did not report sponsorship/possible conflicts of interest, and therefore their potential impact is unclear.</p> <p>They also failed to identify limitations of own work, reflecting a lack of transparency as well as inability to demonstrate a comprehensive and holistic understanding of the research process and topic.</p> |
| <p>Harrison et al. (2000). Chemical Contamination of Private Drinking Water Supplies in the West Midlands, United Kingdom. <i>Journal of Toxicology: Clinical Toxicology</i>, 38(2), pp.137–144.</p> | <p>To collate data on chemical contamination of private drinking water supplies in the 13 health districts in the West Midlands, UK.</p> | <p><b>Study design:</b> secondary analysis</p> <p><b>Location:</b> West Midlands, England</p> <p><b>Method:</b> The most recent year's data on the number of PWS, the number of supplies sampled, and the number and type of failures for chemical parameters were obtained from District and Local Authorities in the West Midlands Region.</p> <p><b>Result:</b> Data covered 12-month periods during 1995–1996. Of the 6013 private supplies identified, samples from 1297 had been tested for chemical parameters</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p><b>Generalisability:</b> The samples were collected from West Midlands region. Therefore, the reported findings could be generalisable to Wales; however, the contextual environment of the PWS in England needs consideration.</p> <p><b>Methodological rigour:</b> In the absence of a specific tool to assess quality of secondary analyses, we have used a generic tool for observational studies. However, we do</p>                                                                                                                                                                                                                                                                                                 |

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|                                                                                       |                                                                                            | <p>during the period of the study. A total of 420 individual failures for chemical parameters were reported in 386 water supplies. The majority of breaches of UK and EU standards were due to increased concentrations of nitrate (270, 65% of failures), metals (81, 19%), nitrite (14, 3%), pesticides (6, 1%), and others (49, 12%).</p> <p><b>Conclusion:</b> Over a quarter of the supplies tested during the period of the study were in breach of UK and EU legislation. Of the reported failures, the high concentrations of nitrate and nitrite, lead, copper and sulfate are of concern to health and remedial action is warranted. Regular sampling of private drinking water supplies remains necessary to prevent risk to health from a wide variety of toxic contaminants.</p> <p><b>Note:</b> Since the publication of this study, the standards have been revised therefore, some findings may not fall within the current the guidelines.</p> | <p>understand that this tool may not be the most ideal.</p> <p>This is a secondary analysis of data and is therefore, susceptible to biases inherent to its study design.</p> <p>Although it uses data that were collected and analysed following standard protocols, it is limited by the biases and limitations of the methods used by the sources.</p> <p>Participant characteristics were not reported. Therefore, representativeness of the sample is not guaranteed in addition to risk of self-selection and non-response biases.</p> <p>It is unclear whether the survey utilised to collect the data were validated. Therefore, self-reporting bias is possible.</p> <p>Results for only a small number of PWS were available and therefore, representativeness of the sample is not guaranteed.</p> <p>Authors did not report sponsorship/possible conflicts of interest, and therefore their potential impact is unclear.</p> <p>They also failed to identify limitations of own work, reflecting a lack of transparency as well as inability to demonstrate a comprehensive and holistic understanding of the research process and topic.</p> |
| Hoek et al (2008)<br>Outbreak of <i>Cryptosporidium parvum</i> among children after a | To investigate the outbreak of <i>Cryptosporidium parvum</i> among children after a school | <p><b>Study design:</b> cohort study</p> <p><b>Location:</b> outdoor adventure farm in Cornwall, England.</p> <p><b>Method:</b> A cohort study was implemented to investigate possible sources of infection during the farm visit</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <p><b>Generalisability:</b> The reported findings could be generalisable to Wales; however contextual environment of the outbreak needs consideration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

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| <p>school excursion to an adventure farm, South West England. <i>Journal of Water and Health</i>, 6(3), pp.333-338.</p>                                     | <p>excursion to an adventure farm, South-West England</p>                                                                                                           | <p>following an outbreak among 35 people, (27 students and 8 teachers), who participated in a school excursion to an outdoor adventure farm in South West England, from 22 to 26 May 2006. Four stool samples were sent in from those who participated in school trip 2 and who had symptoms of illness. A standardized postal questionnaire was sent out to record symptoms, medical care, food and water consumption, and participation in the various activities organized during school trip 2. Only laboratory confirmed cases were included. Environmental investigation was undertaken to identify potential sources of infection and possible transmission routes.</p> <p><b>Result:</b> Only 17 respondents matched the case definition and the attack rate was 85% with 100% attack rate in students and 50% in teachers. Single variable analysis of the completed questionnaires indicates several possible associations with illness. The most likely transmission route was contact with faecally contaminated surface water following heavy rainfall, or consumption of water from the private well. Disinfection of the water reservoir was by chlorination, to which cryptosporidium is resistant.</p> <p><b>Conclusion:</b> This study highlights the fact that epidemiological investigations of outbreaks as a result of environmental exposures are complex but important to inform the public and health professionals of the risks posed by PWS and outdoor activities. This is particularly so after heavy rainfall, as this may result in an increased effluent from faecally contaminated land, causing a wide variety of pathogens to wash into surface water and potentially, private wells. This pose risks for public health.</p> | <p><b>Methodological rigour:</b> This is a retrospective cohort study and is therefore, susceptible to biases inherent to its study design.</p> <p>Study utilised various methods to collect data including validated and self-reported measures. Therefore, self-reporting bias is possible.</p> <p>To mitigate for bias, an objective measure of outcome was used.</p> <p>All participants of school trip 2 with eligible data were included so minimising risk of selection bias.</p> <p>Response rate for the questionnaires was moderate (74%).</p> <p>Authors did not report sponsorship/possible conflicts of interest, and therefore their potential impact is unclear.</p> |
| <p>Hunter et al. (2011). Quantitative microbial risk assessment of cryptosporidiosis and giardiasis from very small private water supplies. <i>Risk</i></p> | <p>To analyse regulatory sampling data from PWS to develop a quantitative microbial risk assessments (QMRA) model, which estimates the potential annual risk of</p> | <p><b>Study design:</b> development of risk assessment model utilising secondary data from observational studies</p> <p><b>Location:</b> England and France</p> <p><b>Method:</b> This risk assessment utilised a Bayesian belief network approach with Monte Carlo simulation. <i>E. coli</i> concentrations in PWSs were estimated using national</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p><b>Generalisability:</b> The reported findings could be generalisable to Wales; however, the contextual environment of the PWS in England and France needs consideration.</p> <p><b>Methodological rigour:</b> In the absence of a specific tool to assess quality of a risk assessment model, we have used a generic</p>                                                                                                                                                                                                                                                                                                                                                        |



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| <p><i>Analysis: An International Journal</i>, 31(2), 228-236.</p> | <p>infection with <i>Cryptosporidium</i> and <i>Giardia</i>.</p> | <p>surveillance data from England and France. The English dataset comprised of 34,904 separate microbiological samples collected from 11,233 PWSs submitted to Public Health Laboratory Service from 1995 to 2003. Whilst the French dataset comprised of 150,775 samples were extracted from 2,665 water supply systems serving less than 50 people, extracted from SISE-EAUX (the French Ministry of Health water quality database). For <i>Cryptosporidium</i> and <i>Giardia</i>, the data used were from the study of Kay et al. 2007. Drinking water consumption as well as the dose-response curves were obtained from the published literature. The estimated pathogen concentration, the risk of infection per day and annualised risks for one or more infections per year were calculated. And tornado graphs were derived to determine the impact of variation in the input variables.</p> <p><b>Result:</b> The final regression model found that <i>E. coli</i> concentrations are significantly associated with concentrations of both <i>Giardia</i> and <i>Cryptosporidium</i>. This study found the risks of both <i>Cryptosporidium</i> and <i>Giardia</i> in very small water supplies to be very similar between France and England. The estimated risk of infection was very high with the median annual risk being of the order of 25–28% for <i>Cryptosporidium</i> and 0.4% to 0.7% for <i>Giardia</i>, though, in the poorer quality supplies the risk could be much higher. For both pathogens, the main driver of variance in the estimated daily risk of infection is the uncertainty in the pathogen—<i>E. coli</i> regression constant. For <i>Giardia</i>, the second strongest driver is <i>E. coli</i> concentration while for <i>Cryptosporidium</i> the amount of unboiled tap water consumed is most relevant. For <i>Cryptosporidium</i>, the indicator <i>E. coli</i> concentration is relegated to third place, reflecting the weaker association between <i>Cryptosporidium</i> and <i>E. coli</i> in the regression model.</p> <p><b>Conclusion:</b> The analyses presented here indicate a major risk of <i>Cryptosporidium</i> and <i>Giardia</i> infection in people consuming unboiled tap water from very small drinking</p> | <p>tool for observational studies. However, we do understand that this tool may not be the most ideal.</p> <p>This is a secondary analysis of data and is therefore, susceptible to biases inherent to its study design.</p> <p>Although it uses data that were collected and analysed following standard protocols, it is limited by the biases and limitations of the methods used by the sources.</p> <p>Participant characteristics were not reported. Therefore, representativeness of the sample is not guaranteed in addition to risk of self-selection and non-response biases.</p> <p>In addition to other limitations identified by the authors, they note that due to lack of sufficient information on the effects of seasonality on the variation of water consumption behaviour and pathogen concentration in drinking water, this model assumes that risk does not vary seasonally.</p> |
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|                                                                                                                                              |                                                                                                                                                                              | water supplies. For those consuming water from supplies that averaged around the median risk, some 26% would expect at least one <i>Cryptosporidium</i> infection and 0.4% at least one <i>Giardia</i> infection in a year. Even among consumers whose supplies average around the lowest 5% daily risk, 3.5% would expect at least one <i>Cryptosporidium</i> and 0.05% at least one <i>Giardia</i> infection per year.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Jones et al. (2005). Public perception of drinking water from private water supplies: focus group analyses. <i>BMC Public Health</i> , 5(1). | To explore the drinking water perceptions and self-described behaviours and needs of participants served by private water systems in the City of Hamilton, Ontario (Canada). | <p><b>Study design:</b> Focus groups</p> <p><b>Location:</b> City of Hamilton, Canada</p> <p><b>Method:</b> In September 2003, three focus group discussions were conducted; with English-speaking, Caucasian adult residents of the City who received their household water from PWS; two with men and women aged 36–65 years, and one with men and women 20–35 years of age. To identify residences with PWS, residential addresses were linked to digitized maps of the distribution areas served by the City's water treatment utilities within a Geographic Information System. Recruitment criteria used by a professional marketing firm for telephone screening and enrolment of participants was used and the focus groups were stratified with age. A trained facilitator moderated the discussions and an assistant recorded notes on the discussions. Systematic procedures were used to help ensure reliability and validity of data collection and content analysis was used for analyses.</p> <p><b>Result:</b> Overall, participants had positive perceptions of their private water supplies, particularly in the older age group. Concerns included bacterial and chemical contamination from agricultural sources. Testing of water from private supplies was minimal and was done less frequently than recommended by the provincial government. Barriers to water testing included the inconvenience of the testing process, acceptable test results in the past, resident complacency and lack of knowledge. The younger participants greatly emphasized</p> | <p><b>Generalisability:</b> The reported findings could be partially generalisable to Wales; however contextual environment of the PWS in rural settings of Canada needs consideration. Additionally, study included only English-speaking Caucasian adults.</p> <p><b>Methodological rigour:</b> This is a qualitative study using focus groups to collect data and content analysis; and is therefore, susceptible to limitations inherent to its study design.</p> <p>Full demographic and socio-economic characteristics of participants were not reported, thereby applicability might be limited.</p> <p>Setting of the focus group and potential power relationships were not explored, therefore, how these might have impacted the participant responses, cannot be ascertained.</p> <p>Data saturation was not achieved.</p> <p>Participants were incentivised for their participation. However, it is unclear what it was and how it might have motivated their participation.</p> <p>Authors did not include a reflexive statement of potential impact on</p> |

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|                                                                                                                                                                                     |                                                                                                                                                                                                                  | <p>their need for more information on private water supplies. Participants from all groups wanted more information on water testing, and various media for information dissemination were discussed.</p> <p><b>Conclusion:</b> While most participants were confident in the safety of their private water supply, the factual basis for these opinions is uncertain. Improved dissemination of information pertaining to private water supplies in this population is needed. Observed differences in the concerns expressed by users of different water systems and age groups may suggest the need for targeted public education strategies. These focus groups provided significant insight into the public perception of private water supplies and the need for public health outreach activities; however, to obtain a more representative understanding of the perceptions in this population, it is important that a larger scale investigation be performed.</p>                             | <p>participant responses. This was important as only one author analysed the data.</p> <p>Additionally, the quotations given had no tags so it unclear if these were representative of the data and selected fairly.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <p>Kay et al. (2007). The microbiological quality of seven large commercial private water supplies in the United Kingdom. <i>Journal of Water and Health</i>, 5(4), pp.523–538.</p> | <p>This paper reports on intensive monitoring at seven commercial private water supplies (six of which were treated) spread throughout the UK serving hotels, holiday parks and food production enterprises.</p> | <p><b>Study design:</b> Time series analysis</p> <p><b>Location:</b> England, Scotland, and Wales and one in Northern Ireland</p> <p><b>Method:</b> Seven private water supply sites were selected across the UK; two in each of England, Scotland, and Wales and one in Northern Ireland. Daily sampling of 'potable' water, both at the consumer tap and using large volume filtration for Giardia and Cryptosporidium spp. was conducted over two six-week periods in the spring and autumn of 2000; allowing for the effects of short-term episodic peaks in faecal indicator and pathogen concentration to be quantified. Samples were analysed for coliforms, Escherichia coli, enterococci, presumptive Clostridium perfringens and Campylobacter. Additional samples were taken for E. coli O157:H7.</p> <p><b>Result:</b> A total of 1178 samples were analysed, mostly for bacteria and protozoan parasites. Each site was sampled on approximately 40 consecutive days over each of the</p> | <p><b>Generalisability:</b> The reported findings might be generalisable to Wales as two of the included seven PWS were from Wales whilst the rest were from other parts of the UK and therefore, contextualising these would need further consideration.</p> <p><b>Methodological rigour:</b> This is a time series analyses and is therefore, susceptible to biases inherent to its study design.</p> <p>It is unclear why the seven PWS were specifically chosen for the study, however as these were spread across UK, applicability is highly likely.</p> <p>Sample collection and analyses were conducted following standard protocol and using objective measures.</p> <p>Daily rainfall (mm) data were obtained for the UK Meteorological Office.</p> |

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|                                                                                                                                                                                                                        |                                                                                                                                                                                      | <p>two phases. All the supplies experienced intermittent pathogen presence and only one, a chlorinated deep borehole supply, fully complied with UK water quality regulations during both periods of sampling. Poor microbiological water quality typically followed periods of heavy rainfall. This suggests that the design and installation of such systems should be undertaken only after the likely range of raw water quality has been characterised, which requires a thorough understanding of the effects of flow and seasonality on raw water quality. There is no reason to suspect that the monitored sites are uncharacteristic of other commercial supplies and the results reinforce public health concerns related to domestic supplies. Furthermore, the pattern of contamination is highly episodic, commonly lasting only a few days. Thus, the relatively infrequent regulatory monitoring of such supplies would be unlikely to identify the poor water quality episodes and does not provide the data necessary for public health protection.</p> <p><b>Conclusion:</b> The results of this study suggest that a risk assessment system similar to the WHO 'Water Safety Planning' approach might offer a more appropriate regulatory paradigm for private water supplies.</p> | <p>Current standards for the coliforms, <i>Escherichia coli</i>, enterococci, <i>Clostridium perfringens</i> and <i>Campylobacter</i> were used to determine failure rates.</p> <p>Authors failed to identify limitations of own work, reflecting a lack of transparency as well as inability to demonstrate a comprehensive and holistic understanding of the research process and topic.</p>                                                                                                                                                          |
| <p>Middleton et al. (2016). Prolonged exposure to arsenic in UK private water supplies: toenail, hair and drinking water concentrations. <i>Environmental Science: Processes &amp; Impacts</i>, 18(5), pp.562–574.</p> | <p>The study aimed to assess exposure to inorganic Arsenic (As) via drinking water consumption in a population served by PWS in Cornwall, UK, using hair and toenail biomarkers.</p> | <p><b>Study design:</b> cohort study</p> <p><b>Location:</b> Cornwall, England</p> <p><b>Method:</b> The sampling frame consisted of 476 households using a PWS that had provided drinking water samples for Ander et al. 2016- henceforth referred to as initial sampling (drinking water only). Information letters were sent and following telephone contact, 127 households were recruited to provide a follow-up drinking water sample in November 2013. Biomonitoring was conducted at time of follow-up. Sample collection packs were mailed to participants. Nail samples were self-collected by participants whereas hair samples were collected by researchers using an amended version of the COPHES</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <p><b>Generalisability:</b> The samples were collected from an area of metalliferous and arsenic mineralisation (Cornwall). Therefore, the reported findings could be generalisable to Wales; however, the contextual environment of the PWS in England needs consideration.</p> <p><b>Methodological rigour:</b> This is a prospective cohort study and is therefore, susceptible to biases inherent to its study design.</p> <p>Recruitment was voluntary and sample size were not calculated. Therefore, representativeness of the sample is not</p> |

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|  |  | <p>project protocol. Additionally, an exposure/food frequency questionnaire was administered as well as data for drinking water related analysis and biomonitoring analysis along with information on the consumption of select dietary items that have been reported to contain As in relatively high concentrations. Amended versions of previously reported protocols were used to chemically analyse the samples and steps were taken to ensure quality control.</p> <p><b>Result:</b> Strong positive Pearson correlations (<math>r_p = 0.95</math>) indicated stability of water As concentrations over the time period investigated (up to 31 months). Significant positive correlations were observed between drinking water and toenail (<math>r_p = 0.53</math>; <math>p &lt; 0.001</math>; 95% C.I: 0.43, 0.63) and drinking water and hair (<math>r_p = 0.38</math>; <math>p &lt; 0.001</math>; 95% C.I: 0.20, 0.53) As concentrations. Significantly higher As concentrations were measured in hair samples from males and smokers and As concentrations in toenails were negatively associated with age. A positive association between seafood consumption and toenail As and a negative association between home-grown vegetable consumption and hair As was observed for volunteers exposed to <math>&lt;1 \text{ As } \mu\text{g L}^{-1}</math> in drinking water.</p> <p><b>Conclusion:</b> The temporal stability of As concentrations in PWS suggests that, for this particular region, measurements of As taken in the present are strong predictors of past levels of exposure dating back at least 31 months. Both toenail and hair biomarkers were susceptible to the influence of covariables on As concentrations. Although useful in assessing prolonged exposures to As from drinking water, other factors, such as diet, predominate where As concentrations in drinking water are low. A large degree of variation in toenail and hair biomarkers was still unaccounted for in this study, with exposure to soil and dust highly possible explanations in a region of well-documented elevated environmental As. Investigation into the significance of</p> | <p>guaranteed (26% of original sample) in addition to risk of self-selection and non-response biases.</p> <p>Study utilised objective methods to collect/analyse data, however adaptations were made. Additionally, it is unclear whether the questionnaires used to collect self-report data were validated. Therefore, self-reporting bias is possible.</p> <p>Authors did not report sponsorship/possible conflicts of interest, and therefore their potential impact is unclear.</p> <p>They also failed to identify limitations of own work, reflecting a lack of transparency as well as inability to demonstrate a comprehensive and holistic understanding of the research process and topic.</p> <p>As this study used data collected as part of another cross-sectional study Ander et al. as baseline, the limitations of the original study (reported earlier) need also be considered.</p> |
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|                                                                                                                                                                                                    |                                                                                                                                                                                    | other exposure routes will be the focus of future research.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| O'Dwyer et al. (2014). Microbiological assessment of private groundwater-derived potable water supplies in the Mid-West Region of Ireland. <i>Journal of Water and Health</i> , 12(2), pp.310–317. | To assess the microbiological contamination of groundwater as a function of both aquifer type and rainfall events in Ireland, using geographic information system (GIS) technology | <p><b>Study design:</b> time series analyses</p> <p><b>Location:</b> Mid-West Region of Ireland</p> <p><b>Method:</b> Private water wells (n = 125) were each sampled following standard protocol three times between 12 September 2011 and 12 November 2012 from all over the research area. Two factors, aquifer type and rainfall (mm), were chosen as independent variables that can affect the vulnerability of a groundwater body. Using a GIS, the relative hydrogeological and climatological features unique to each sampling location were derived. Utilising this information, a logistic regression model was used to predict the probability of contamination of PWSs with E. coli. The model contained two independent variables: rainfall (mm; <math>p &lt; 0.001</math>) and aquifer characteristics (<math>p = 0.001</math>).</p> <p><b>Result:</b> The full model, containing both predictors, was statistically significant at <math>p &lt; 0.001</math>, indicating that the model distinguished between the independent variables' relationship to the incidence of contamination. The results showed that 58.4% of wells (n = 73) were positive for E. coli at least once and hence failed to meet the legislative microbiological standards of the Drinking Water Directive 98/83/EC. Of the 125 PWSs analysed, 41.6% (n = 52) were found to contain none of the indicator bacterium E. coli. Of the 73 samples, 83.6% (n = 61) tested positive for E. coli at every sample event.</p> <p>The model identified rainfall as the strongest predictor of reporting contamination, with odds ratio of 1.173. This indicated that contamination was 1.173 times more likely with an increase in rainfall, controlling for aquifer in the model. The model indicated that contamination was 6.58 times more likely to be present in a karstified bedrock aquifer, controlling for rainfall in the model. In this model,</p> | <p><b>Generalisability:</b> The reported findings could be generalisable to Wales; however, the contextual environment of the PWS in Ireland needs consideration.</p> <p><b>Methodological rigour:</b> This is a prospective time series analyses and is therefore, susceptible to biases inherent to its study design.</p> <p>Recruitment was voluntary, sample size was not calculated, and participant characteristics were not reported. Therefore, representativeness of the sample is not guaranteed in addition to risk of self-selection and non-response biases.</p> <p>Aquifer classification system developed by Geological Survey of Ireland and rainfall data from Irish Meteorological Office were obtained.</p> <p>Microbiological sampling and analysis followed US EPA approved kit and protocol.</p> <p>Authors did not report sponsorship/possible conflicts of interest, and therefore their potential impact is unclear.</p> |

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|                                                                                                                                                                    |                                                                                                                                                                                                                                          | <p>rainfall (mm) demonstrates a higher odds ratio of 1.148. This suggests that in relation to bedrock aquifers containing either karstic or fissured flow regimes, the probability of contamination with <i>E. coli</i> is 1.15 times higher with an increase in rainfall.</p> <p><b>Conclusion:</b> Contamination was above the national statistic of microbiological contamination in groundwater of 34% of routine sample. The occurrence of microbiological contamination was related to hydrogeological and climatological variables using LR. The LR model proved to be a potentially effective tool for the prediction of bacterial contamination in PWSs in Ireland and in similar regions, from a geological and meteorological perspective. This research suggests that households utilising a well water supply in areas where the underlying aquifer is overtly permeable, as in karst aquifer systems, are statistically more vulnerable to microbiological contamination and therefore appropriate guidance and source protection are recommended. Furthermore, it has been shown that precipitation also has a significant impact on the extent of faecal contamination with the likelihood of contamination increasing with successive rainfall episodes.</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Pollock et al. (2009). Spatial and Temporal Epidemiology of Sporadic Human Cryptosporidiosis in Scotland. <i>Zoonoses and Public Health</i> , 57(7-8), pp.487–492. | To identify possible associations between the cumulative incidence of sporadic <i>C.parvum</i> and <i>C.hominis</i> cases in Scotland at postcode sector level and a no. of explanatory spatial and temporal variables from 2005 to 2007 | <p><b>Study design:</b> Time series analysis</p> <p><b>Location:</b> Scotland</p> <p><b>Method:</b> Only Sporadic cases of <i>C. hominis</i> or <i>C. parvum</i> infection in Scotland reported to UK Cryptosporidium Reference Laboratory from June 2005 to June 2007 were included in this study. Data were retrieved at postcode sector resolution on human population from 2001 census and on livestock population from DEFRA 2000 agricultural census. PWS data were provided by local authorities. For analyses, using area-based data, cases and human and livestock populations were assumed to be evenly distributed within a postcode sector. And for analyses</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <p><b>Generalisability:</b> The reported findings could be generalisable to Wales; however, the contextual environment of the PWS in Scotland needs consideration.</p> <p><b>Methodological rigour:</b> This is a time series analyses and is therefore, susceptible to biases inherent to its study design.</p> <p>Only included laboratory confirmed cases for which spatial and temporal reference data were available.</p> <p>Data on human population and livestock population were obtained from appropriate census data. Participation in the</p> |



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|  |  | <p>using point patterns, cases occurring within a postcode sector were spatially referenced to the postcode centroid.</p> <p><b>Result:</b> Of the 560 identified cases, 276 cases were <i>C. hominis</i> (49%) and 284 cases were <i>C. parvum</i> (51%). The highest incidence of both <i>C. parvum</i> and <i>C. hominis</i> was in children aged 0–4 years, with <i>C. parvum</i> predominating, although this was not statistically significant.</p> <p>There were differences between the two <i>Cryptosporidium</i> species in the time of year, at which the peak of number of cases occurs. <i>C. parvum</i> case numbers peaked in April and May, and <i>C. hominis</i> case numbers increased bi-modally in August and October. These increases in case reports were observed in the same months each year over the 2 years of data analysed in this study. The differences between months were significant (<math>\chi^2 = 185</math>, P-value = 0.00).</p> <p><i>C. parvum</i> was more common in areas with lower human population densities, with a higher ratio of the number of farms to human inhabitants and with a higher ratio of the number of PWS to human inhabitants. It caused disease in humans in rural areas and in areas with high ruminant livestock density, whereas <i>C. hominis</i> was more common in the more densely human populated areas of Scotland.</p> <p><b>Conclusion:</b> In postcode sectors where there was a lower human population density and a higher ratio of the number of farms to humans, there was an increased rate of <i>C. parvum</i> infection. These factors could both be considered as indicators of rurality. The higher ratio of PWS to human population was also a risk for increased cases of <i>C. parvum</i>. Drinking water contaminated with <i>Cryptosporidium</i> oocysts is a recognized risk factor for human illness, and inadequately treated PWS may pose a threat to public health in Scotland, particularly in more rural areas. Implementation of education programmes could reduce the risk of disease transmission.</p> | <p>questionnaires used to collect these data is voluntary. Additionally, sample size was not calculated. Therefore, representativeness of the sample is not guaranteed in addition to risk of self-selection and non-response biases.</p> |
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| <p>Reid et al., (2003). The quality of drinking water from private water supplies in Aberdeenshire, UK. <i>Water Research</i>, 37(2), pp.245–254.</p> | <p>To investigate the quality of drinking water from private water supplies in Aberdeenshire – data for Central and South Divisions from 1992 to 1998, and North Divisions from 1996 to 1998</p> | <p><b>Study design:</b> secondary analysis of time series data with a sub-study of time series analysis of primary data</p> <p><b>Location:</b> Aberdeenshire, Scotland</p> <p><b>Method:</b> The quality of private water supplies within Aberdeenshire sampled between 1992 and 1998 was analysed with respect to the presence of total coliforms (TC), faecal coliforms (FC), and nitrate. Water quality data for Central and South Divisions were available from 1992 to 1998 and those for North Division, from 1996 to 1998 from individual PWS registers from North, South and Central Divisions. Additionally, Category one F PWS were contacted and respondents were randomly selected and tested on three separate occasions within a year. Historic data for microbiological drinking water quality prior to 1994 and post 1994 were obtained and analysed using appropriate methods. Statutory limits by PWS (Scotland) regulations 1992 were used to determine failure rates.</p> <p><b>Result:</b> Samples from Category two supplies had a higher failure rate (55%) than samples from Category one supplies (B35%) for coliforms. A total of 1100 samples were analysed for nitrate. The failure rate was smaller than for coliforms and generally greater for samples from Category one compared to category two supplies. The average nitrate concentration for samples from Category one E and F supplies was 32 mg l<sup>-1</sup> with half the samples having a concentration &gt;25 mg l<sup>-1</sup>. The comparatively high average nitrate concentration is a consequence of the majority of PWS (91%) being located within a predominantly agricultural land-use area and is also typical of many surface waters in the region where increasing annual trends have been apparent.</p> | <p><b>Generalisability:</b> The reported findings could be generalisable to Wales; however, the contextual environment of the PWS in Scotland needs consideration.</p> <p><b>Methodological rigour:</b> In the absence of a specific tool to assess quality of secondary analyses, we have used a generic tool for observational studies. However, we do understand that this tool may not be the most ideal.</p> <p>This is study utilised primary and secondary analyses of time series data and is therefore, susceptible to biases inherent to its study design.</p> <p>Study utilised previously collected data on water quality by the respective divisions as well as collection of water samples for further analysis for the sub-study. Although these were done following appropriate standards and water quality regulations, the reliability is limited by the biases inherent to the methods used by the sources.</p> <p>Though random sampling was employed for the collection of primary data for the sub-study, recruitment was originally voluntary. Additionally, sample size calculation was not reported. Therefore, representativeness of the sample is not guaranteed in addition to risk of self-selection and non-response biases.</p> <p>Water sample collection methods and analyses followed standard protocols and appropriate were used to ascertain failure rates.</p> |
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| Risebro et al. (2012). Contaminated small drinking water supplies and risk of infectious intestinal disease: A prospective cohort study. <i>PLoS One</i> , 7(8), e42762. | To investigate whether an elevated risk of infectious intestinal disease (IID) exists in individuals who consume water from contaminated small supplies compared with those who drink from small supplies that comply with current standards and also whether this effect is modified by age. | <p><b>Study design:</b> Cohort study</p> <p><b>Location:</b> East Anglia (Norfolk and Suffolk) and Herefordshire</p> <p><b>Method:</b> A prospective cohort study of 611 individuals served by a private supply in England was conducted. In Norfolk and Suffolk, recruitment occurred between January and December 2008 and follow-up completed in March 2009. In Herefordshire, recruitment occurred between October 2008 and September 2009 and follow-up completed in January 2010. Individual and household level data was collected via structured interviewer- and self-administered questionnaire. Water supplies received sanitary inspection and examination for indicator bacteria and participants maintained a daily record of IID. Regression modelling with generalised estimating equations that included interaction terms between age and indicators of faecal pollution was performed.</p> <p><b>Result:</b> Crude IID prevalence was 9.3 days with symptoms/1000 person days (95%CI: 8.4, 10.1) and incidence was 3.2 episodes/1000 person days (95%CI, 2.7, 3.7) or 1.2 episodes per person year. Although there was no overall association between IID risk and indicator presence, there was strong interaction between age and indicator presence. In children under ten, relative risk (RR) of IID in those drinking from enterococci contaminated supplies was 4.8 (95%CI: 1.5, 15.3) for incidence and 8.9 (95%CI: 2.8, 27.5) for prevalence. In those aged 10 to 59, IID risk was lower but not statistically significant.</p> <p><b>Conclusions:</b> Contaminated small water supplies pose a substantial risk of IID to young children who live in homes reliant on these supplies. By contrast older children and</p> | <p><b>Generalisability:</b> The reported findings could be generalisable to Wales; however contextual environment of the PWS in England needs consideration.</p> <p><b>Methodological rigour:</b> This is a prospective cohort study and is therefore, susceptible to biases inherent to its study design.</p> <p>Recruitment was voluntary and sample size was calculated and achieved despite low response and recruitment rate. However, representativeness of the sample is not guaranteed (11.4% of original sample) in addition to risk of self-selection and non-response biases.</p> <p>Study utilised objective methods for collecting data on exposure and self-report methods for outcome data. Therefore, self-reporting bias is possible.</p> |

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|                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                            | adults do not appear to be at increased risk. Health care professionals with responsibility for children living in homes provided by very small water supplies should make parents aware of the risk.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Rutter et al. (2000). A survey of the microbiological quality of private water supplies in England. <i>Epidemiology and Infection</i> , 124(3), pp.417–425. | To collect results from regulatory microbiological testing carried out at Public Health Laboratories to provide a national picture of the water quality from private supplies. Furthermore, this information was combined with background information on class, source, treatment and geographical location of supply to examine how these factors affected water quality. | <p><b>Study design:</b> secondary analysis of data</p> <p><b>Location:</b> Bristol, Manchester, Newcastle, Norwich, Nottingham, Poole, Preston, Reading and Surrey (England)</p> <p><b>Method:</b> PWS were sampled by local authority in accordance with standard protocols. Sampling was carried out for 'regulatory or routine', 'follow-up', in response to previously positive samples, or 'other' reasons, which included sampling in response to complaints. Water samples were examined for total coliforms and E. coli at Public Health Laboratories according to published standards. Results from the laboratory examination of samples from PWS, carried out between January 1996 and December 1997 were collected. Information was collected for coliform and E. coli contamination of PWS but detailed analysis of the results was only carried out for E. coli.</p> <p><b>Result:</b> A total of 6551 samples from 2911 supplies was examined, over a 2-year period, of which 1342 (21%) samples, and 949 (33%) supplies on at least one occasion, failed current regulations for Escherichia coli. Total coliforms, including E. coli, were detected in 1751 (27%) samples from 1215 (42%) supplies. The percentage of samples positive for E. coli was highest in summer and autumn, and lowest in winter. Samples taken from larger supplies and from boreholes were less frequently contaminated than those from other sources. Chlorination, filtration or UV light treatment improved the bacteriological quality of supplies, but still resulted in a low level of compliance with the regulations.</p> | <p><b>Generalisability:</b> The reported findings could be generalisable to Wales; however, the contextual environment of the PWS in England needs consideration.</p> <p><b>Methodological rigour:</b> In the absence of a specific tool to assess quality of secondary analyses, we have used a generic tool for observational studies. However, we do understand that this tool may not be the most ideal.</p> <p>This is a secondary analysis of data and is therefore, susceptible to biases inherent to its study design.</p> <p>Although it uses data that were collected and analysed following standard protocols, it is limited by the biases and limitations of the methods used by the sources.</p> <p>Sample size was not calculated. Therefore, representativeness of the study sample is not guaranteed.</p> <p>Authors did not report sponsorship/possible conflicts of interest, and therefore their potential impact is unclear.</p> |

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|                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                  | <p><b>Conclusion:</b> It is clear from this study that the general microbiological quality of PWS is poor in comparison with the public water supply. A risk-based assessment of the likelihood of faecal contamination might also improve water quality and aid health protection, as the current regulatory monitoring frequencies for the smaller supplies are clearly insufficient to ensure safe drinking water. In the short term, practical measures are also needed to improve the quality of PWS. Such measures should include informing and educating the owners and consumers of PWS of the risks. There is also the need for further studies to assess the contribution of private water supplies to the incidence of intestinal infectious diseases in England and Wales. In particular, studies which show the degree to which PWS are contaminated with pathogens and epidemiological investigations to estimate the prevalence of disease in users of PWS.</p>                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <p>Strachan et al. (2011). The relationship between lay and technical views of Escherichia coli O157 risk. <i>Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences</i>, 366(1573), pp.1999–2009.</p> <p>Only data relevant to this agile scope has been extracted here. For further information, please refer to the full report.</p> | <p>To understand the lay (accessible primarily through social science methodologies) and technical (via risk assessment and epidemiological techniques) views of the risk associated with the Escherichia coli O157 pathogen using two case study areas in the Grampian region of Scotland, and North Wales.</p> | <p><b>Study design:</b> cross-sectional study</p> <p><b>Location:</b> Grampian region of Scotland, and North Wales</p> <p><b>Method:</b> Study areas were mapped and selected to offer a rural -urban contrast in E. coli O157 disease incidence. Human case data were obtained for North Wales for 1999–2007, totalling 250 postcoded cases; and for the Grampian region of northeast Scotland for the years 1997–2008, totalling 667 postcoded cases. The information from the National Public Health Service of Wales, Communicable Disease Surveillance Center, Cardiff, and from Foresterhill Hospital, Aberdeen on date of birth, postal district and date of reporting of each individual case was used in this study.</p> <p>A telephone-based exposure assessment questionnaire based on a sub-sample (n= 580) of the Grampian population stratified by age, population density and socio-economic status was carried out during the period September 2008 to June 2009. Awareness of, and attitudes towards, E. coli O157 risk in three equally</p> | <p><b>Generalisability:</b> The reported findings might be generalisable to Wales as one of the studied regions was within Wales; however data from Scotland were also analysed and therefore, contextualising these would need further consideration.</p> <p><b>Methodological rigour:</b> This is a cross-sectional study and is therefore, susceptible to biases inherent to its study design.</p> <p>Data for disease incidence mapping was obtained from National Public Health Service of Wales and Foresterhill Hospital in Aberdeen.</p> <p>Disease incidence calculation included both laboratory confirmed cases as well as those with links to a confirmed case within an outbreak.</p> |

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|  |  | <p>represented groups from Grampian and North Wales: farmers, rural visitors and non-farming rural residents in the two study areas, (n= 900), was assessed using a paper-based, self-complete questionnaire. A multivariate linear regression model was developed to link together proxy risk factors, for each of the three primary transmission pathways: foodborne, waterborne, and environmental. And Quantitative microbiological risk assessment (QMRA) for the pathways were developed.</p> <p><b>Result:</b> Epidemiological risk factors of contact with farm animals, visiting farms or farm fields and having a PWS were associated with postcode districts of higher than average disease incidence in the human population. Estimates of risk factors using spatial epidemiology indicated that environmental and food sources were responsible for a higher proportion of cases than water from PWS. The relative importance of each exposure pathway was modelled, and results show that in Grampian, PWS use presented a 24.6% likelihood of transmission (95% CI 19.9 – 29.4) compared to main supply use at 3.5% likelihood (95% CI 1.7 – 5.3). In North Wales, the likelihood for PWS was 18.6 (95% CI 14.1–23.2) whereas main supply use had a likelihood of 8.0 (95% CI 5–10.9).</p> <p>The proportion of the population expressing a high knowledge of E. coli O157 was greatest in high-incidence disease districts compared with low incidence areas (17% vs 7%). However, no statistically significant difference was found between high- and low-incidence postcode districts in terms of the proportion of the population expressing a high likelihood of personal risk of infection (10% vs 14%), giving a counterintuitive difference between the technical (epidemiological and QMRA) and the lay assessment of E. coli O157 risk.</p> | <p>Recruitment was voluntary, sample size was not calculated, stratification was not explained, and participant characteristics were not reported. Therefore, representativeness of the sample is not guaranteed in addition to risk of self-selection and non-response biases.</p> <p>It is unclear whether the self-reported questionnaires utilised to collect data were validated. Therefore, self-reporting bias is possible.</p> |
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|                                                                                                                                                                 |                                                                                                                                                                                   | <p><b>Conclusion:</b> Overall, the lay and technical views of the relative importance of different infection pathways showed a strong degree of consistency, although this was not the case between perceived personal likelihood of risk and living in an area of high risk. Integrative research incorporating both lay and technical views of risk is required in order that informed decisions can be made to handle or treat the risk by the groups concerned (e.g., the public, policy makers/risk managers, etc.).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <p>VanDerGeest et al. (2020). Private well stewardship within a rural, agricultural Latino community: a qualitative study. <i>BMC Public Health</i>, 20(1).</p> | <p>To examine the key factors impacting private well water testing behaviour among well water users residing in predominantly Latino communities in rural, agricultural areas</p> | <p><b>Study design:</b> Focus groups</p> <p><b>Location:</b> The Lower Yakima Valley (LYV) in Central Washington, USA</p> <p><b>Method:</b> Four focus groups were conducted with private well users; 2 in Spanish and 2 in English. Latinos and non-Latinos (n=37) were recruited from a rural, agricultural community with a large Latino population and elevated nitrate concentrations in groundwater. A semi-structured interview guide was developed to capture factors impacting testing as guided by the Risk, Attitudes, Norms, Ability, and Self-Regulation (RANAS)</p> <p>Model and inductive thematic analysis was conducted by two coders to identify common themes.</p> <p><b>Result:</b> Themes emerged around the factors impacting well stewardship, including well water testing, treatment, and maintenance, and were not specific to nitrate contamination. Private well users reported many of the same factors reported in other communities, with the exception of home repair experience and challenges around landlords and neighbours on shared wells, which have not been reported previously. In addition to landlords and neighbours, lack of actionable information, economic limitations, and lack of technical support emerged as factors that made well stewardship burdensome for individuals. The majority of participants</p> | <p><b>Generalisability:</b> The reported findings could be partially generalisable to Wales; however contextual environment of the PWS in rural settings of USA needs consideration. Additionally, study included Spanish and English-speaking Latino and non-Latino adults.</p> <p><b>Methodological rigour:</b> This is a qualitative study using focus groups to collect data and thematic analysis; and is therefore, susceptible to limitations inherent to its study design.</p> <p>Full demographic and socio-economic characteristics of participants are reported, therefore applicability to Wales context can be determined.</p> <p>Authors note that saturation on the universal themes across all focus groups was reached but not on the differences between language groups.</p> <p>Participants were incentivised for their participation. However, authors did not discuss its potential impact on participants' motivation.</p> <p>Authors did not include a reflexive statement and potential power relationships were not explored, therefore,</p> |



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|  |  | <p>reported using bottled water, including many who used point-of-use or point-of-entry water treatment systems.</p> <p><b>Conclusion:</b> The burden of well stewardship in rural, agricultural Latino communities may suggest the need for interventions at the community, county, or state levels and not at the individual level alone. Additionally, the role of landlords, neighbours on shared wells, and home repair experience in well stewardship represent important areas of exploration for researchers and public health practitioners.</p> | <p>how these might have impacted the participant responses, cannot be ascertained.</p> <p>Authors identified some limitations of own work, reflecting a lack of transparency as well as inability to demonstrate a comprehensive and holistic understanding of the research process and topic.</p> |
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ISBN: 978-1-83766-290-6