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| **Ref** | **Year** | **Institution/**  **Sponsor** | **Clinical Trial register** | **Target** | **CAR Gen.** | **Disease** | **No.**  **treated** | **Conditioning** | **Cell product & dose** | **Clinical**  **outcome** | **Toxicity (>grade 3)** | **Survival** |
| ***B-cell malignancy*** | | | | | | | | | | | | |
| (1) | 2011 | MSKCC | NCT00466531  NCT01044069 | CD19 | 2G: CD28 | B-CLL  B-ALL | 9 | Nil or Cy | 1.2-3x107/Kg (B-CLL)  3x106, 1-3x107/Kg (B-ALL) | 33% SD | 0% CRS  0% ICANS  1 fatality - presumed sepsis | N/A |
| (2) | 2011 | Baylor | N/A | CD19 | 2G: CD28 | B-NHL | 6 | Nil | 2x107/m2  1x108/m2  2x108/m2 | 33% SD | 0% CRS  0% ICANS | SD n=2 for 3 and 10m |
| (3) | 2012 | NCI | NCT00924326 | CD19 | 2G: CD28 | B-NHL  B-CLL | 8 | Flu/Cy | 0.3-3x107/Kg | 13% CR  75% PR | >Grade 3 toxicity in all patients | 1 ongoing CR at 15m |
| (4) | 2014 | MSKCC | NCT01044069 | CD19 | 2G: CD28 | B-ALL | 16 | Cy | 3x106/Kg | 88% CR/CRi | 44% CRS  6% ICANS | 44% in remission post allo HSCT |
| (5) | 2014 | Novartis | NCT01626495  NCT01029366 | CD19 | 2G: 41BB | B-ALL  Children/  young adults | 30 | Flu/Cy | 0.76x106 to 20.6x106/Kg | 90% CR | 27% CRS  0% ICANS | At 6m, EFS 67% |
| (6) | 2015 | UPenn | NCT01029366 | CD19 | 2G: 41BB | B-CLL | 14 | Flu/Cy/others | 0.14x108 to 11x108/Kg | 57% ORR  29% CR  29% PR | 35% CRS  7% ICANS | 100% PFS for CR pts - median duration 40m |
| (7) | 2015 | NCI | NCT00924326  (update of (3)) | CD19 | 2G: CD28 | B-NHL  B-CLL | 15 | Flu/Cy | 1x106/Kg | 53% CR  27% PR | Seen in 13, including sepsis, CRS and ICANS | At 7m,  all CRs ongoing |
| (8) | 2015 | NCI | NCT01593696 | CD19 | 2G: CD28 | B-ALL  Children/  young adults | 20 | Flu/Cy | 1-3 x106/Kg | 70% ORR  60% CR | 30% CRS  5% ICANS | 51.6% OS  med 10m follow-up |
| (9) | 2016 | Baylor | NCT00881920 | k light chain | 2G: CD28 | B-NHL  B-CLL | 9 | Cy unless lymphopenic | 1.7x107 to 1.9x108/m2 | 2 CR and 1 PR | 0% CRS  0% ICANS | 1 durable CR at 3y |
| (10) | 2016 | Chinese PLA General Hospital | NCT01735604 | CD20 | 2G: 41BB | B-NHL | 11 | Cytoreductive chemotherapy, including Cy | 0.41x107 to 1.46x107/Kg | 82% ORR  55% CR | 0% CRS  0% ICANS | Med PFS >6m |
| (11) | 2016 | UPenn | NCT01747486 | CD19 | 2G: 41BB | B-CLL | 41 | Flu/Cy | 5x107  5x108 cells | 24% CR at higher dose | 20% CRS | Med follow-up 26m - 12% CR |
| (12) | 2016 | UPenn | NCT01626495 | CD19 | 2G: 41BB | B-ALL  (children) | 59 | Flu/Cy | 1x107 to 1x108/Kg | 93% CR | 27% CRS | Med follow-up 12m - 57% CR  79% OS |
| (13) | 2016 | City of Hope | NCT01318317 | CD19 | 1G | B-NHL | 8 | Administered post auto HSCT | 25 to 200x106 (CD8+ CM) | 38% CR 25% PR | 0% CRS  0% ICANS | 50% PFS at 1y |
| (13) | 2016 | City of Hope | NCT01815749 | CD19 | 2G: CD28 | B-NHL | 8 | Administered post auto HSCT | 50 to 800x106 (CD4+ and CD8+ CM) | 75% CR  25% PR | 0% CRS  0% ICANS | 75% PFS  at 1y |
| (14) | 2016 | FHCRC | NCT01865617 | CD19 | 2G: 41BB | B-ALL | 30 | Cy ± Flu | 2x105/Kg  2x106/Kg  2x107/Kg  1:1 CD4:CD8 | 23% CRS  50% ICANS | 93% ORR  86% CR | 10% CR 400d post CAR-T |
| (15) | 2016 | FHCRC | NCT01865617 | CD19 | 2G: 41BB | B-NHL | 32 | Cy ± Flu | 2x105/Kg  2x106/Kg  2x107/Kg  1:1 CD4:CD8 | 13% CRS  28% ICANS | Cy/Flu: 72% ORR, 50% CR  Cy: 50% ORR  8% CR | Med OS - No Flu 6.3m; Cy/Flu 25m  Med PFS -  No Flu 1.5m; Cy/Flu 5.8m |
| (16) | 2016 | MDACC | NCT00968760 | CD19 | 2G: CD28 | B-ALL  B-NHL | 7 | Auto HSCT | 107 to 5x109/m2  Sleeping beauty | 0% CRS  0% ICANS | 86% CR | 83.3% PFS at 30m |
| (17) | 2017 | UPenn | NCT02640209 | CD19 | 2G: 41BB | B-CLL | 10 | Flu/Cy | N/A | 89% CR (marrow) | 10% CRS | Med follow-up 6m |
| (18) | 2017 | UPenn | NCT02030834 | CD19 | 2G: 41BB | DLBCL  FL | 28 | Flu/Cy | 5x108/Kg | 64% ORR  43% CR (DLBCL)  71% CR (FL) | 18% CRS  11% ICANS | Med  follow-up  28.6m  86% (DLBCL)-89% (FL) sustained  remission |
| (19) | 2017 | FHCRC | NCT02028455 | CD19 | 2G: 41BB | B-ALL  (paediatric/  young adults | 43 | Various, including Flu/Cy | 0.5-10x106  0.5-5x106/Kg | CR 93% | 93% CRS  49% ICANS | 51% EFS and  69% OS at 12m |
| (20) | 2017 | FHCRC | NCT01865617 | CD19 | 2G: 41BB | B-CLL | 24 treated  19 evaluable for efficacy | Flu/Cy | 2x105/Kg  2x106/Kg  2x107/Kg  1:1 CD4:CD8 | 71% ORR | 83% CRS  33% ICANS | Med OS  6.6m |
| (21) | 2017 | Zhejiang University/ Innovative Cellular Therapeutics | ChiCTR-OCC-15007008 | CD19 | 2G: 41BB | B-ALL | 15 | Flu/Cy | 1.1 x106 to 9.8x106/Kg | 80% CR | 40% CRS  33% ICANS | OS 65.5% and  DFS 37.8% at 150d |
| (22) | 2017 | NCI | NCT00924326 | CD19 | 2G: CD28 | DLBCL | 22 | Flu/Cy | 1x106 to  6x106/Kg | 73% ORR  55% CR  18% PR | 0% CRS  55% ICANS | Duration of response 7-24m  CRs ongoing |
| (23) | 2017 | Hebei Yanda Lu Daopei Hospital / Shanghai Pulmonary Hospital | ChiCTR-IIh-16008711 | CD19 | 2G: 41BB | B-ALL | 51 | Flu/Cy | 0.05-14x105 /Kg  1x105/Kg | 90% CR/CRi | 16% CRS  4% ICANS | 23/27 bridged to allo HSCT remained in CR at med follow up of 206d |
| (24) | 2018 | MSKCC | NCT0144069 | CD19 | 2G: CD28 | B-ALL | 53 | Flu/Cy | 1x106 to  3x106/Kg | 83% CR | 26% CRS  43% ICANS | Med EFS 6.1m Med OS 12.9m |
| (25) | 2018 | NCI/ Stanford | NCT02315612 | CD22 | 2G: 41BB | B-ALL  children/  young adults | 21  (17 prior CD19 CAR-T) | Flu/Cy | 3x105  to 3x106/Kg | 73% CR | 0% CRS  28% ICANS (?grade) | Med response duration 6m |
| (26) | 2018 | Uppsala University | NCT02132624 | CD19 | 3G: CD28/  41BB | CD19+ leukaemia or lymphoma | 15 | Flu/Cy | 2x107  to 2x108  cells/m2 | 36% CR (B-NHL)  50% CR (B-ALL) | 20% CRS  13% ICANS | Med response duration 5m |
| (27) | 2018 | Sheba Medical Center | NCT02772198 | CD19 | 2G: CD28 | B-ALL | 20 | Flu/Cy | 1x106/Kg | 90% CR | 20% CRS (grade 2-3)  30% ICANS (grade 2-4) | 73% EFS and  90% OS at 1y |
| (28) | 2018 | Third Military Medical University | NCT02349698 | CD19 | 2G: CD28  2G: 41BB | B-ALL | 10  (5-CD28)  (5-41BB) | Flu/Cy | 1x106  to 1x107/Kg | CD28: 60% CR  41BB: 60% CR | 0% CRS  0% ICANS | Med PFS 6 m |
| (29) | 2018 | Xuzhou Medical University | N/A | CD19 | 2G: 41BB | B-ALL | 14 | Flu/Cy | 1x106/Kg | 92.9% CR/CRi | 29% CRS  7% ICANS (?grade) | At 180d  OS 65.8%  DFS 71.4% |
| (30, 31) | 2018 | Novartis | NCT02435849  (ELIANA) | CD19 | 2G: 41BB  (Kymriah; Tisagen-lecleucel) | B-ALL  (paediatric/  young adults | 79 | Flu/Cy in 76/79 | 0·2–5 × 10⁶  0·1–2·5x10⁸/Kg | 60% CR  21% CRi | 48% CRS  13% ICANS | 66% DFS at 18m  Med OS not reached |
| (32) | 2018 | Third Military Medical University | NCT02685670 | CD19 | 2G: CD28  2G: 41BB | B-ALL (6) and B-CLL (1) | 7 | Flu/Cy | 1x106/Kg  2G CAR T-cells mixed 1:1 | 71% CR | 0% CRS  0% ICANS | Med OS 12m  Med PFS 5m |
| (33) | 2018 | Novartis-UPenn | NCT02445248  (JULIET) | CD19 | 2G: 41BB  (Kymriah; Tisagen-lecleucel) | DLBCL | 93 | Flu/Cy | Med dose 3x108 | 52% ORR  40% CR  12% PR | 22% CRS  12% ICANS | DFS 65% at 12m |
| (34) | 2018 | MSKCC | NCT01416974 | CD19 | 2G: CD28 | B-CLL | 8 | Cy | 3x106 to  3x107/Kg | 25% CR  13% PR | 0% CRS  0% ICANS | Med PFS 13.6m  Med OS not reached |
| (35) | 2018 | Stanford University | NCT03233854 | CD19 & CD22 | 2G: 41BB  Bispecific CAR | B-ALL  DLBCL | 6 | Flu/Cy | 1x106/Kg  3x106/Kg  1x107/Kg | 33% CR | 33% CRS  0% ICANS | N/A |
| (36) | 2018 | Eureka Therapeutics | NCT02658929  (ARTEMIS) | CD19 | 2G: 41BB | B-NHL | 21 | Flu/Cy | 1x106/Kg  3x106/Kg  6x106/Kg | 52% ORR  29% CR | 0% CRS  0% ICANS | 24% CR at 6m |
| (37) | 2019 | Kite/ Gilead | NCT02348216  (ZUMA-1) | CD19 | 2G: CD28  (Yescarta; Axicabta-gene Ciloleucel) | B-NHL | 108 treated  101 evaluable for efficacy | Flu/Cy | 2x106/Kg | 83% ORR  58% CR | 11% CRS  32% ICANS | Med duration of response 11.1m  Med PFS 5.9m |
| (38) | 2019 | MSKCC | NCT01840566 | CD19 | 2G: CD28 | B-NHL | 15 | Auto HSCT | 5x106/Kg  1x107/Kg | 53% CR | 40% CRS  67% ICANS | 30% PFS at  2y |
| (39) | 2019 | FHCRC | NCT01865617 | CD19 | 2G: 41BB | B-ALL | 57 treated  53 evaluable for efficacy | Flu/Cy | 2x106/Kg  1:1 CD4:CD8 | 85% CR | N/A | Med follow-up  30.9m  EFS 61%  OS 72% |
| (40) | 2019 | FHCRC | NCT01865617 | CD19 | 2G: 41BB | B-NHL | 65 treated  47 evaluable  For efficacy | Flu/Cy | 2x106/Kg  1:1 CD4:CD8 | 51% ORR  40% CR | N/A | Med PFS 20m in CR patients |
| (41) | 2019 | UCL | NCT02443831  (CARPALL) | CD19 | 2G: 41BB  AUTO1 | B-ALL  Burkitt NHL  (paediatric/  young adults) | 14 | Flu/Cy | 1x10⁶ cells/Kg | 86% CR | 0% CRS  7% ICANS | OS 84% at 6m  OS 63% at 12m |
| (42) | 2019 | Shanghai Institute of Hematology | NCT03355859 | CD19 | 2G: 41BB | B-NHL | 10 treated  9 evaluable for efficacy | Flu/Cy | 2x x107, 5 x107  and 1 x108 cells | 67% CR  33% PR | 0% CRS  11% ICANS | 56% still in CR at 6m |
| (43) | 2019 | FHCRC | NCT01865617 | CD19 | 2G: 41BB | B-NHL:  FL (38%)/  tFL(62%) | 21 | Flu/Cy | 2x106 cells/Kg  1:1 CD4:CD8 | 88% CR (FL)  46% CR (tFL) | 0% CRS  0% ICANS | All FL CR patients still in CR at 24m; Med PFS 10.2m in tFL group |
| (44) | 2019 | MSKCC | NCT01860937 | CD19 | 2G: CD28 | B-ALL  (paediatric/  young adults) | 25 treated  24 evaluable | High or low dose Cy | 1x106/Kg  3x106/Kg | CR/CRi 75% | 16% CRS  28% ICANS | Most consolidated by allo HSCT. 44% alive at time of publication |
| (45) | 2019 | The Second Hospital of Hebei Medical University | NCT02963038 | CD19 | 2G: 41BB | B-ALL | 10 | Flu/Cy | Average dose 0.71x106/Kg | 80% CR | 40% CRS  30% ICANS  (all grades) | Med OS 10.3m  Med EFS 4m |
| (46) | 2019 | MGH | N/A | CD19 | 2G: 41BB | CNS Lymphoma | 8 | Flu/Cy | 0.6x108  to 6x108/Kg | 25% CR  25% PR | 0% CRS  0% ICANS | 38% ongoing response at >180d |
| (47) | 2019 | Peking Univ Cancer Hospital; Norris Comp Cancer Center | NCT02842138 | CD19 | 2G: 41BB | B-NHL | 25 | Flu/Cy | 3x106  to 3.6x108 | 28% CR (55% at highest dose level); 32% PR | 0% CRS  0% ICANS | Med response >181d for 6 patients show achieved CR at highest dose level |
| (48) | 2019 | Huazhong University of Science and Technology | NCT02965092  and  NCT03366350 | CD19 | 2G: 41BB | B-ALL | 58 | Flu/Cy | 0.89x106  to 4.01x106/Kg | 87.9% CR | 38% CRS  15% ICANS | Consolidation by allo HSCT in 21 patients.  Med OS 16.1m |
| (49) | 2019 | Tianjin Medical University | ChiCTR-ONN-16009862 and ChiCTR1800019288 | CD19 | 2G: 41BB | B-NHL | 11 | Flu/Cy and nivolumab | 8x106 /Kg | 82% ORR  45% CR | 0% CRS  0% ICANS | Med PFS 6m  27% ongoing CR |
| (50) | 2019 | Peking Univ Cancer Hospital | NCT03528421 | CD19 | 2G: CD28  2G: 41BB | B-NHL | 9  (CD28 3; 4-1BB 6) | Flu/Cy | 0.75-5x105/Kg | 78% CR | 1/3 grade 5 CRS (CD28)  1/3 grade 3 ICANS (CD28) | 67% response ongoing at 3m |
| (51) | 2019 | MSKCC | NCT004466531 | CD19 | 2G: CD28 | B-CLL  B-NHL | 20 treated  12 CLL patients evaluable | Nil or Cy | 0.4-3x107/Kg | 25% CR | 10% CRS  10% ICANS | Med follow-up at 53m, all CR stable |
| (52) | 2019 | Multicentre China | ChiCTR-OIC-17013523 | CD22 | 2G: 41BB | B-ALL | 34 treated  30 evaluable | Flu/Cy | ≤1 × 106/kg to  ≤4 × 106 per kg | 80% CR/CRi | 3% CRS  0% ICANS | 1-year LFS  71.6% (11 bridged to allo HSCT) |
| (53) | 2019 | Multicentre China | N/A | CD19 | 4G: CD28 +CD27 | B-ALL | 25 | Flu/Cy | Med dose  7.133 × 105/kg | 92% ORR  80% CR | 0% CRS  0% ICANS | Med OS 267 |
| (54) | 2019 | Autolus | NCT03289455  (Amelia) | CD19 & CD22 | 2 x 2G: OX40  (CD19)  4-1BB  (CD22)  (AUTO3) | B-ALL  (paediatric/  young adults) | 10 treated  7 evaluable | Flu/Cy | 1,3 or 5x106 /Kg | 100% CR/CRi | 0% CRS  0% ICANS | Med follow-up 8m  57% CR/CRi |
| (55) | 2020 | NCI | NCT00924326  (update of (3) and (7)) | CD19 | 2G: CD28 | B-NHL  B-CLL | 43 | Flu/Cy | 1-30x106 /Kg | 81% ORR  58% CR | N/A | Med follow up 42m  Med EFS 55m |
| (56) | 2020 | Medical College of Wisconsin | NCT03019055 | CD19 & CD20 | 2G: 41BB  Bispecific CAR | B-NHL 19  B-CLL 3 | 22 | Flu/Cy | 2.5x105  to 2.5x106/Kg | 82% ORR  64% CR | 5% CRS  14% ICANS | Med OS 20.3m |
| (57) | 2020 | NCI | NCT02659943 | CD19 | 2G: CD28 | B-NHL | 20 | Flu/Cy | 0.66 × 106, 2 × 106 or 6 × 106 cells/Kg  (some received 2 doses) | 70% OR  55% CR | 10% CRS  5% ICANS | 40% ongoing CRs ranging from 17-35m |
| (58) | 2020 | Kite/ Gilead | NCT02601313 (ZUMA-2) | 2 | 2G: CD28  (Tecartus; Brexucab-tagene autoleucel) | Mantle cell  lymphoma | 68 treated  60 evaluable for efficacy | Flu/Cy | 2x106 cells/Kg | 67% CR  27% PR | 15% CRS  31% ICANS | At 12m PFS 61% and OS 81% |
| (59) | 2020 | Lu Daopei Hospital | NCT03173417 | 1/2 | 2G: CD28  2G: 41BB | B-ALL  65% children  35% adult | CD28 21  4-1BB 89 | Flu/Cy | 1-10x105/Kg | 93% CR | 16% CRS  14% ICANS (grade 2-3) | 58% DFS and  64% OS at 1y |
| (60) | 2020 | Autolus | NCT03287817  (Alexander) | CD19 & CD22 | 2 x 2G: OX40  (CD19)  4-1BB  (CD22)  (AUTO3) | DLBCL | 19 treated  18 evaluable for efficacy | Flu/Cy & Pembro | 50,150 or 450x106 cells | dose > 50 x 106  64% ORR  55% CR | 0% CRS  5% ICANS | All CRs ongoing at 1-12m |
| (61) | 2020 | Chinese PLA General Hospital | NCT03185494 | CD19 & CD22 | 2G: 41BB  Bispecific CAR | B-ALL | 6 | Flu/Cy | 1.7x106  To 3x106/Kg | 100% CR | 0% CRS  0% ICANS | DFS  3-11m |
| (62) | 2020 | UPenn | NCT02030847 and NCT01029366 | CD19 | 2G: 41BB | B-ALL  (adult) | 35 | Flu/Cy | 5×107 cells (9)  5×108 cells (26) (single dose or fractionated) | 33% CR low dose  90% CR high dose | 3 CRS deaths in high single dose group;  High dose fractionated safest and most effective with 5% CRS | High dose fractionated 2y OS 73%  EFS 49.5% |
| (63) | 2020 | Multicentre China | ChiCTR- OOC-16007779. | CD19 | 4G: CD28 +CD27 | B-NHL | 21 | Flu/Cy | 8.9x105/Kg | 67% OR  43% CR  24% PR | 0% CRS  5% ICANS | Med OS 23.8m |
| (64) | 2020 | FHCRC | NCT01865617 | CD19 | 2G: 41BB  (outcome of second infusion) | B-ALL 14  B-CLL 9  B-NHL 21 | 44 | Flu/Cy | 2 doses  CART1&2 ALL  2x105 to 2x106/Kg  CART1&2 CLL/NHL  2x106 to 2x107/Kg | B-ALL 21% CR  B-CLL 22% CR  B-NHL 19% CR | 9% CRS  11% ICANS | Med duration response  B-CLL, B-NHL, B-ALL was 33,6 and 4m respectively |
| (65) | 2020 | JW Therapeutics  Shanghai Ming Ju Biotechnol. Company | NCT04089215 | CD19 | 2G: 41BB  Relmacab-tagene autoleucel | B-NHL | 59 treated  58 evaluable for efficacy | Flu/Cy | 100x106  150x106 | 76% ORR  52% CR | 5.1% CRS  5.1% ICANS | ORR 60.3% at 3m |
| (66) | 2020 | Multicentre China | ChiCTR-OIB-17013670 | CD19 & CD22 | 2G: 41BB  Sequential CAR T-cell infusions | B-ALL (paediatric) | 20 | Flu/Cy | Median dose for both CAR T-cells 10x105/Kg | 100% CR | 5% CRS  5% ICANS | DFS and OS 79.5% and 92.3% respectively at 1y (no HSCT consolidation) |
| (67) | 2020 | Second Hospital of Anhui Medical University | NCT02735291 | CD19 | 2G: 41BB | B-ALL  (paediatric/  adult) | 51 treated  47 evaluable for efficacy | Flu/Cy /others | 1–5×106/Kg | 80.9% CR/ CRi | 23.4% CRS  6.4% ICANS | OS and DFS  53% and 45%  respectively at 1y |
| (68) | 2020 | Sheba Medical Center | NCT00287131 | CD19 | 2G: CD28 | B-ALL  B-NHL | 90 | Flu/Cy | 1×106/Kg | ALL: 84.4% CR (67% MRD neg);  NHL: 62% ORR and 31% CR | N/A | N/A |
| (69) | 2020 | Lyon Sud Hospital | N/A | CD19 | 2G: CD28  (Yescarta; Axicabta-gene Ciloleucel)  2G: 4-1BB  (Kymriah; Tisagen-lecleucel) | B-DLBCL | 61  Kymriah 33  Yescarta 28 | Flu/Cy (98%) Bendamustine (2%) | As per EMA approval | At 3m  Yescarta: 40% CR  8% PR  Kymriah  39% CR  3% PR | 8% CRS  10% ICANS | At med follow-up 5.7m    med PFS 3m; med OS 11.8m |
| (70) | 2020 | Multicentre China | NCT03097770 | CD19 & CD20 | 2G: 41BB  Bispecific CAR | B-NHL | 28 | Flu/Cy | 0.5-6×106/Kg | 79% ORR  71% CR | 14% CRS  0% ICANS | PFS 64% at 12m |
| (71) | 2020 | Tongji Medical College | ChiCTR-OPN-16008526 | CD19 & CD22 | 3G: CD28 & 41BB sequential CAR T-cell infusions | B-ALL 51  B-NHL 38 | 89 | Flu/Cy | B-ALL 2.6×106/Kg CAR19 & 2.7×106/Kg CAR22  B-NHL  5.1×106/Kg CAR19 &  5.3×106/Kg CAR22 | B-ALL  96% CR  B-NHL 50% CR | 23.52% CRS  0% ICANS | B-ALL  med OS and PFS 31 and 13.6m respectively  B-NHL  med OS and PFS  18 and 9.9m respectively |
| (72) | 2020 | US Lymphoma CAR T Consortium | Axicabtagene Ciloleucel as standard of care | CD19 | 2G: CD28 | LBCL | 275 | Flu/Cy | As per FDA approval | 82% ORR  64% CR | 7% CRS  31% ICANS | at med follow-up 12.9m  med OS not reached  med PFS 8.3m |
| (73) | 2020 | Xuzhou Medical University | NCT03207178 | CD19 & CD20 | 2G: 41BB co-infusion of CAR T-cells | DLBCL | 21 | Flu/Cy (19) or ifosfamide (2) | CD19 CAR T-cell dose 0.2-4x106/Kg  CD20 CAR T-cell dose 0.1-4.0x106/Kg | 81% ORR  52.4% CR | 28.5% CRS  9.5% ICANS | med PFS 5.0m  med OS 8.1m |
| (74) | 2020 | Juno | NCT02631044  (TRANSCEND NHL-001) | CD19 | 2G: 4-1BB (Lisocabt-agene ma- raleucel) | B-NHL | 269 treated,  256 evaluable for efficacy | Flu/Cy | 50x106  100x106  150x106 cells  1:1 CD4:CD8 | 73% ORR  53% CR  20% PR  13% SD | 2% CRS  10% ICANS | 44% PFS and 58% OS at 1y  med OS 21.1m |
| (75) | 2020 | Kite/ Gilead | NCT03105336  (ZUMA-5) | CD19 | 2G: CD28  (Yescarta; Axicabta-gene Ciloleucel) | Indolent NHL  (FL & MZL) | 146 treated (124 FL; 22MZL)  104 evaluable for efficacy | Flu/Cy | 2x106/Kg | 92% ORR  76% CR | 7% CRS  19% ICANS | Med follow up 17.5m  92% ORR  76% CR |
| (76) | 2020 | First Affiliated Hospital of Zhengzhou University | N/A (Abstract only available) | CD19 | 2G: 41BB | B-NHL | 14 | N/A (Abstract only available) | N/A (Abstract only available) | 77% ORR  43% CR | 28.6% CRS | N/A (Abstract only available) |
| (77, 78) | 2020 | Kite/ Gilead | NCT02926833  (ZUMA-6) | CD19 | 2G: CD28 | DLBCL | 28 | Flu/Cy + atezolizumab | 2x106/Kg | 75% ORR  46% CR | 4% CRS  29% ICANS | Med follow up 10.2m, 46% ongoing responders |
| (79) | 2020 | Autolus | NCT04404660  (ALLCAR) | CD19 | 2G: 41BB  AUTO1 | B-ALL | 20 treated  19 evaluable for efficacy | Flu/Cy | 410 x 106 cells as split dose d1 and 10 | 84% CR | 0% CRS  15% ICANS | EFS at 6m 69% EFS at 12m 52% |
| (80) | 2020 | Kite/ Gilead | NCT03761056  (ZUMA-12) | CD19 | 2G: CD28  (Yescarta; Axicabta-gene Ciloleucel) | High risk  LBCL | 31  12 evaluable for efficacy  15 evaluable for safety | Flu/Cy | 2x106/Kg | 92% ORR  75% CR | 20% CRS  27% ICANS | 75% CRs persisted at data cut-off |
| ***Other haematological malignancies*** | | | | | | | | | | | | |
| (9) | 2016 | Baylor | NCT00881920 | k light chain | 2G: CD28 | MM | 7 | Cy unless lymphopenic | 1.7x107 to 1.9x108/m2 | 4 SD | 0% CRS  0% ICANS | SD for 117m and 24m |
| (81) | 2016 | NIH | NCT02215967 | BCMA | 2G: CD28 | MM | 12 | Flu/Cy | 0.3x106  to 9x106 /Kg | 8% CR  8% PR (both at highest dose level)  67% SD | 33% CRS  8% ICANS (?grades) | 8% ongoing response at 26w |
| (82) | 2017 | Chinese PLA General Hospital | NCT02259556 | CD30 | 2G: 41BB | HD | 18 | Flu/Cy or two others | 1x107 to  3x107/Kg | 39% PR | 0% CRS  0% ICANS | med PFS  6 mo |
| (83) | 2017 | Baylor | NCT01316146 | CD30 | 2G: CD28 | HD/ALCL | 9 | Nil | 2x107/m2  1x108/m2  2x108/m2 | 33% CR | 0% CRS  0% ICANS | 2 CRs for 9 & 30 months |
| (84) | 2018 | Juno | NCT03430011  (EVOLVE) | BCMA | 2G: 41BB | MM | 13 treated  8 evaluable for efficacy | Flu/Cy | 50x106  150x106 cells | 100% ORR  38% CR | 0% CRS  12% ICANS | At data cut, no patients had progressed |
| (85) | 2018 | MSKCC | NCT03070327 | BCMA | 2G: 41BB | MM | 11 | Cy or Flu/Cy | 72-818x106 cells | 64% ORR | 20% CRS  0% ICANS | med duration response 106d |
| (86) | 2018 | UPenn | NCT02135406 | CD19 | 2G: 41BB | MM | 10 | High dose melphalan and auto HSCT | 1×107 to 5×107 | 80% ORR | 0% CRS  0% ICANS | med PFS 200d |
| (87) | 2018 | Celyad Oncology | NCT03018405  (Think study) | NKG2D ligands | 1G plus endog. DAP10  (CYAD-01) | AML  MDS  MM | 16 treated  13 evaluable for efficacy | Nil | 3x108  1x109  3x109  (multiple infusions) | 46% ORR (3 CRi/h in AML cohort) | 42% CRS  0% ICANS | One AML CR patient bridged to allo HSCT and in CR for >1y |
| (88) | 2018 | The Second Affiliated Hospital of Henan University of Traditional Chinese Medicine | NCT03093168 | BCMA | 2G: 41BB | MM | 17 treated  14 evaluable for efficacy | Flu/Cy | 9x106 /Kg | 79% ORR  50% CR | 7% CRS  7% ICANS | Two responses sustained at 15m |
| (89) | 2018 | FHCRC | NCT03338972 | BCMA | 2G: 41BB | MM | 7 | Flu/Cy | 5 to 15×107 cells  1:1 CD4:CD8 | 100% ORR | 0% CRS  0% ICANS | All surviving at a median of 16w follow up |
| (90) | 2018 | Huazhong University of Science and Technology | ChiCTR-OPC-16009113 | BCMA | 2G: CD28 | MM | 28 | Flu/Cy | 5.4-25×106/Kg | 93% ORR  If BCMA >50%  CR 73%  If BCMA  <50% CR & VGPR 33% | 14% CRS | Med PFS 296d and 64d  based on BCMA expression >50% and <50% respectively |
| (91) | 2018 | Jiangsu Institute of Hematology | NCT03455972 | CD19 & BCMA | 3G: CD28 + OX40  Sequential CAR T-cell infusions | MM | 9 | Cy/Bu and auto HSCT | 1x106/Kg CD19  1x106/Kg BCMA | 100% ORR 33% CR | 0% CRS  0% ICANS | Not available as pts had further treatments |
| (92) | 2019 | Celgene/ Bluebird Bio | NCT02658929 | BCMA | 2G: 41BB  (BB2121; idecabta-gene  vicleucel) | MM | 33 | Flu/Cy | 50x106 to  800x106 cells | 85% ORR  45% CR | 6% CRS  3% ICANS | Med PFS 11.8m |
| (93) | 2019 | Xuzhou Medical University | ChiCTR-OIC-17011272 | CD19 & BCMA | Both 2G: 41BB and infused on the same day | MM | 21 | Flu/Cy | 1x106 /Kg CD19 +  1x106 /Kg BCMA | 95% ORR  57% CR | 4% CRS  0% ICANS | Med PFS for responders 243d |
| (94) | 2019 | Celyad Oncology | NCT02203825 | NKG2D ligands | 1G plus endog. DAP10  (CYAD-01 | AML  MM | 7 AML  5 MM | Nil | 1x106  to 3x107 cells | No responses | 0% CRS  0% ICANS | Med OS 4.7m |
| (95) | 2019 | Celyad Oncology | NCT03466320  (Deplethink) | NKG2D ligands | 1G plus endog. DAP10  (CYAD-01) | AML  MDS | 9 | Flu/Cy | 1x108  3x108  1x109 cells | 0% ORR first 2 dose levels | 22% CRS  11% ICANS | 33% did not progress after 1m |
| (96) | 2019 | Tongji Medical College | ChiCTR1800018143 | BCMA& CD38 | 2G: 41BB  Bispecific CAR | MM | 16 | Flu/Cy | 0.5-4×106/Kg | 85% ORR  50% sCR  12.5% VGPR  25% PR | 25% CRS  0% ICANS | Med duration of PFS not reached  75% PFS at 9m |
| (97) | 2019 | UPenn | NCT02546167 | BCMA | 2G: 41BB | MM | 25 | Cy  (cohorts 2&3) | 1×108 to 5×108  1×107 to 5×107  1×108 to 5×108 cells | 48% ORR  8% CR | 32% CRS  12% ICANS | Med duration of response 124.5d |
| (98) | 2019 | Tongji Medical College | ChiCTR1800018137 | BCMA | 2G: 41BB | MM | 9 | Flu/Cy | 1×106 to 6×106/Kg x 3 doses | 100% ORR  44% CR | 0% CRS  1 DLT at highest dose level | N/A |
| (99-101) | 2019 | Nanjing Legend Biotech Co | NCT03090659 | BCMA | 2G: 41BB  LCAR-B38M; JNJ-68284528; Ciltacabta-gene  autoleucel) | MM | 57 | Cy or Flu/Cy | 0.2 to 1.5 × 106/Kg | 88% ORR  82% CR  6% PR | 41% CRS (1 fatal)  0% ICANS | Med OS not reached  Med PFS 12m |
| (102) | 2019 | The First Affiliated Hospital of Soochow University | NCT03196414 | CD19 & BCMA | 3G: CD28 + OX40  Sequential infusions | MM | 28 | Flu/Cy | CART-19 1×107/kg  CART-BCMA 2-6.8×107/kg | 92.6% ORR  40.7%CR | 32% CRS  3% ICANS | Med PFS 8m  Med OS 16m |
| (103) | 2019 | FHCRC | NCT03502577 | BCMA | 2G: 41BB | MM | 7 treated  6 analysed for efficacy | Flu/Cy + JSMD194  (g-secretase inhibitor) | 5x107 cells  1:1 CD4:CD8 | 100%ORR | 16% CRS (fatal)  70% ICANS | No relapses at median follow-up 5 months |
| (104) | 2019 | Multicentre China | NCT03716856  NCT03302403  NCT03380039 | BCMA | 2G: 41BB | MM | 24 | Flu/Cy | 0.5-1.8x108 cells | 87.5% ORR  79.2% CR | 33% CRS  12.5% ICANS | 54% ongoing CR at med follow-up of 383d |
| (105) | 2019 | UCL | NCT03287804 | BCMA & TACI | 3G: CD28 + OX40 dual antigen targeted CAR  (AUTO2) | MM | 12 | Flu/Cy | 15 to 900x106 cells | 43% ORR  28% PR | 0% CRS  0% ICANS | N/A |
| (106) | 2019 | NCI | NCT03602612 | BCMA | 2G: 41BB | MM | 12 | Flu/Cy | 0.75x106/Kg  1.5x106Kg  3x106/Kg | 83% ORR  41% CR & VGPR | 8% CRS  8% ICANS | Best duration of response 2-37w |
| (107) | 2019 | Bluebird Bio | NCT03274219 | BCMA | 2G: 41BB  (bb21217; includes the PI3K inhibitor bb007\* during culture) | MM | 22 treated  18 analysed | Flu/Cy | 150, 450, 800, 1200x106 cells | 83% ORR | 5% CRS  9% ICANS | 50% ongoing response at >2m follow-up  (including 2 pts at 15&18m) |
| (108) | 2020 | Poseida Therapeutics | NCT03288493 | BCMA | 2G: 41BB | MM | 43 treated | Flu/Cy | 0.75-15× 106 cells/Kg  Piggy/Bac transposon | 57% ORR | 3% CRS  0% ICANS | Median OS not reached |
| (109, 110) | 2020 | Celyad  Oncology | NCT04167696  (CYCLE-1) | NKG2D ligands | 1G plus endog. DAP10  (CYAD-02; includes shRNA targeting MICA/B) | AML  MDS | 9  treated  7 evaluable for efficacy | Flu/Cy | 1x108  3x108  1x109 cells | 14% CR | 14% CRS  0% ICANS | Ongoing responses  at 4 & 6m |
| (111) | 2020 | CARsgen Therapeutics | NCT03975907  (Lummicar-1) | BCMA | 2G: 41BB | MM | 14 treated  12 evaluable for efficacy | Flu/Cy | 1.0-1.5×108  CAR+ T-cells | 100% ORR  42% CR | 0% CRS  0% ICANS | N/A |
| (112) | 2020 | CARsgen Therapeutics | NCT03915184  (Lummicar-2) | BCMA | 2G: 41BB | MM | 14 treated  10 evaluable for efficacy | Flu/Cy | 0.5–1.8×108 | 100% ORR  40% CR | 0% CRS  0% ICANS | N/A |
| (113) | 2020 | Celgene | NCT03361748  (KarMMa) | BCMA | 2G: 41BB  (BB2121; idecabta-gene vicleucel) | MM | 128 | Flu/Cy | 150×106 to 450×106 CAR+ T-cells | 73% ORR  31% CR | 5.5% CRS (1 fatal)  3% ICANS | Med PFS 8.6m  Med duration of response 10.6m  Med OS 19.4m |
| (114, 115) | 2020 | Janssen Research & Dvpt | NCT03548207  CARTITUDE-1 | BCMA | 2G: 41BB  (JNJ-68284528; LCAR-B38M; Ciltacabta-gene  autoleucel) | MM | 97 | Flu/Cy | Target dose 0.75 x106/Kg (range 0.5-1.0x106/Kg) | 94.8% ORR  55.7% sCR | 4.1% CRS (1 fatal)  10.3% ICANS (1 fatal) | 87.4% PFS at 6m  93.8% OS at 6m  Med duration of response not reached (med follow up 8.8m) |
| ***Solid Tumours*** | | | | | | | | | | | | |
| (116-118) | 1998  2002 | Cell Genesys | N/A | TAG-72 | 1G | Colorectal cancer | 16 | Nil | Up to 1010 cells by IV (10) or intrahepatic artery infusion (6) | No responses | Hyperbilirubin-aemia n=2 | N/A |
| (117) | 2002 | N/A | N/A | CEA | 1G | Colorectal cancer and breast cancer | 7 | Nil | Up to 1011 cells + IL-2 (n=2) | Two “minor responses” | Tolerance “adequate” | N/A |
| (119) | 2006 | NCI | N/A | FR-a | 1G | Ovarian cancer | 14 | Nil | 3-216x109 in 1-2 doses + IL-2 (n=8) | No responses | Toxicity attributed to IL-2 | N/A |
| (120) | 2007 | Children’s Hospital Seattle | N/A | L1-CAM | 1G | Neurobl-astoma | 6 | Nil | 1-11x108/m2 in 1-2 doses + IL-2 in some cases | Cannot assess owing to additional therapies | 0% CRS  0% ICANS | Died of disease d162-1670 |
| (121-123) | 2006-2013 | Erasmus University Medical Center | N/A | CAIX | 1G | Renal cell carcinoma | 12 | Nil | 0.2-2.1x109 cells | No responses | 33% hepatotoxicity due to on-target off-tumour toxicity | Med OS 9.5m (12.5m in 4 patients who received a CAIX blocking antibody prior to CAR T-cells) |
| (124, 125) | 2008  2011 | Baylor | NCT00085930 | GD2 | 1G | Neurobl-astoma | 19  Treated  11 evaluable for efficacy | Nil | 2-20x107 cells | 27% CR  9% PR | 0% CRS  0% ICANS | Two CR durable for >60m and >21m |
| (126) | 2013 | MSKCC | NCT01140373 | PSMA | 2G: CD28 | Prostate cancer | 7 | Cy | 1 to 3 x107/kg | 29% SD | Pyrexia up to 39°C | SD for 6 and 16m |
| (127) | 2015 | Baylor | NCT00902044 | HER2 | 2G: CD28 | Sarcoma | 19 | Nil | 1x104 to 1x108cells/m2 | 24% SD for 12w to 14m | 0% CRS 0 % ICANS | Med OS 10.3m |
| (128) | 2015 | Roger Williams Medical Center | NCT01373047 | CEA | 2G: CD28 | CEA+ metastatic liver disease | 6 | Nil | 1x108  to 1x1010 cells by 3 sequential intrahepatic artery infusions + IL-2 in 3 cases | 17% SD | 0% CRS 0 % ICANS | Med OS 15w |
| (129) | 2016 | Chinese PLA General Hospital | NCT01869166 | EGFR | 2G: 41BB | Non-small cell lung cancer | 11 | Nil, Cy alone or Cy with additional cytotoxic drugs | Median dose 0.97x107/kg | 18% PR  45% SD | 0% CRS 0% ICANS | Responses lasted 2-8m |
| (130) | 2017 | Chinese PLA General Hospital | NCT01869166 | EGFR | 2G: 41BB | Biliary tract cancer | 19 treated  17 analysed for efficacy | Cy/ nab-paclitaxel | Median 2.65 x106/kg x 1-3 cycles | 6% CR  59% SD | 15% CRS (grade 3 acute fever/ chill)  0% ICANS | Med PFS 4m |
| (131) | 2017 | The Christie NHS | NCT01212887 | CEA | 1G | CEA+ malignancy | 14 | Fludarabine alone or Flu/Cy + IL-2 | Up to5x1010 cells | No responses  50% SD | On-target off-tumour pulmonary toxicity | No long term sustained  responses |
| (132) | 2017 | Third Military Medical University | NCT02349724 | CEA | 2G: CD28 | Colorectal cancer | 10 | Cy | 1 x105 to 1 x108/kg | 70% SD | 0% CRS 0 % ICANS | 20% SD at 30w follow up |
| (133) | 2017 | UPenn | NCT01837602 | MET | 2G: 41BB | Breast cancer | 6 | Nil | 3x107  3x108 cells  mRNA transfected CAR T-cells administered directly to tumour | No responses | 0% CRS  0% ICANS | 1SD at med follow up 10m |
| (134) | 2017 | Baylor | NCT01822652 | GD2 | 3G: CD28/  OX40 | Neurobl-astoma | 11 | Nil or Flu/Cy  Final cohort received Flu/Cy+PD-1 inhibitor | 1-17x107/m2 | 45% SD | 0% CRS  0% ICANS | Med OS 506d |
| (135) | 2017 | UPenn | NCT02209376 | EGFR  vIII | 2G: 41BB | GBM | 10 | Nil | 1x108  to 5x108 CAR+ cells | 90% SD  (Antigen loss noted in 5/7 tumours) | 0% CRS  ICANS not easily assessed due to tumour location | Med OS 8m |
| (136) | 2017 | Baylor | NCT01109095 | HER2 | 2G: CD28 | GBM  Adults/  children | 17 | Nil | 1x106  to 1x108 /m2  virus-specific T-cells (CMV, EBV, adenovirus) | 6% PR  41% SD | 0% CRS 0% ICANS | Med OS 11.1m |
| (137) | 2018 | Chinese PLA General Hospital | NCT01935843 | HER2 | 2G: 41BB | Biliary tract and pancreatic cancer | 11 | Cy/ nab-paclitaxel | Median dose  2.1x106/Kg x 1-2 cycles | 9% PR  45% SD | 0% CRS  0% ICANS | Med PFS 4.8m |
| (138) | 2018 | UPenn | NCT01897415 | Meso-thelin | 2G: 41BB | Pancreatic cancer | 6 | Nil | mRNA transfected CAR T-cells x 9 infusions of 1-3x108/m2  cells over 3 weeks | 33% SD  Reduction in FDG uptake seen by PET in one patient | 0% CRS  0% ICANS | PFS 3.8 and 5.4m in 2 patients |
| (139) | 2018 | King’s College London | NCT01818323 | ErbB family | 2G: CD28 | Squamous cell carcinoma of head and neck | 13 | Nil | 1x107 to  1x109 CAR+cells by intra-tumoural injection | 69% SD | 0% CRS  0% ICANS | N/A |
| (140) | 2019 | UPenn | NCT02159716 | Meso-thelin | 2G: 41BB | Malignant pleural mesothel-ioma  Ovarian cancer  Pancreatic cancer | 15 | Nil or Cy | 1-3x107or  1-3x108/m2 cells | 73% SD | 0% CRS  0% ICANS | Med PFS 2.1m |
| (141) | 2019 | Bellicum Pharma-ceuticals | NCT02744287 | PSCA | 1G + rimiducid-inducible MyD88/  CD40 co-activation switch  (BPX-601) | PSCA-expressing cancers | 15 | Nil, Cy or Flu/Cy | 1.25x106  1.25x106 +rimiducid  2.25x106 +rimiducid | 53% SD | 0% CRS  0% ICANS | N/A |
| (142, 143) | 2019 | Baylor | NCT00902044 | HER2 | 2G: CD28 | Sarcomas  (paediatric) | 10 | Fludarabine alone or Flu/Cy | 1x108/m2  Up to 3 infusions post LD followed, in some cases, by further infusions without LD | 20% CR | 0% CRS  0% ICANS | Two survivors at 32 and 33m |
| (144, 145) | 2019 | UPenn | NCT03089203 | PSMA | 2G: 41BB  + TGF-b dominant negative receptor | Prostate | 10 | Nil or Flu/Cy (cohort 3) | 1-3x107/m2  1-3x108/m2  1-3x108/m2 cells | Med 33.2%  PSA decline | 40% CRS  DLT cohort 3 | N/A |
| (146) | 2019 | Changhai Hospital | NCT03159819 | Claudin 18.2 | 2G: CD28 | Gastric or pancreatic cancer | 12  11 evaluable for efficacy | Flu/Cy alone or with nab-paclitaxel | 0.5-55x108 CAR+ cells administered over 1-5 cycles | 9% CR  27% PR  45% SD | 0% CRS  0% ICANS | Med PFS 130d |
| (147) | 2019 | MSKCC | NCT02414269 | Meso-thelin | 2G: CD28 | Pleural cancers | 20  14 in cohort 3 evaluable for efficacy | Nil (3)  Cy (3)  Cy + anti-PD-1 (14) | 3x105-1x107/Kg | 14% CR  36% PR  29% SD | 0% CRS  0% ICANS | N/A |
| (148) | 2019 | NCI | NCT01454596 | EGFR  vIII | 3G: CD28 & 41BB | GBM | 18 | Flu/Cy + IL-2 | 6.3 x106 to 2.6x1010 CAR+ cells | No responders | 1 fatal pulmonary event event at highest dose level (?CRS)  1 grade 3 neurological event | Med PFS 1.3m  Med OS 6.9m |
| (149) | 2019 | Beijing Sanbo Brain Hospital | NCT02937844 | PD-L1/2 | PD1-CD28 switch receptor | GBM | 14 | Cy | Up to 1x109 cells over three IV infusions. One patient received IV & intracavitary cells | Transient response | 0% CRS  0% ICANS | Med OS 4.4 months |
| (150) | 2020 | Roger Williams  Medical Centre | NCT02416466  (HITM-SIR) | CEA | 2G: CD28 | CEA+ metastatic liver disease | 6 | Selective intra-arterial radiation with SIR spheres | 1x1010 cells by 3 sequential intrahepatic artery infusions & IL-2 | 16% SD prior to SIR sphere administration | 0% CRS 0 % ICANS | Med OS 8m |
| (151) | 2020 | RenJi Hospital | NCT02395250 NCT03146234 | GLP-3 | 2G: CD28 | HCC | 13 | Cy alone or Flu/Cy | 7-40.77x108 CAR+ cells administered over 2-9 cycles | 15% PR | 8% CRS (case proved fatal)  0% ICANS | OS at 3y 10.5% |
| (152) | 2020 | UCL/ Cancer Research UK | [NCT02761915](http://clinicaltrials.gov/show/NCT02761915) | GD2 | 2G: CD28  (AUTO6) | Neurobl-astoma | 12 | Nil  Cy  Flu/Cy | 1x107-1x109 CAR+ T-cells/m2 | No responses but disease regression noted in 3 patients | 8% CRS | Patients with disease regression died on d50 and within 5m (n=2) |
| (153) | 2020 | MSKCC | NCT02498912 | MUC16 | 2G: CD28 + IL-12 | Ovarian cancer | 16 | Nil or Flu/Cy | 3x105-1x107/Kg | No responses (best response stable disease) | 2/3 developed macrophage activation-like syndrome in Flu/Cy cohort | N/A |
| ***Allogeneic CAR T-cells and NK cells*** | | | | | | | | | | | | |
| (154) | 2013 | Baylor | NCT00840853 | CD19 | 2G: CD28 | B-ALL  B-CLL | 8 treated  6 evaluable | 3m-13y post allo HSCT  No conditioning | 1.5x107/m2  4.5x107/m2  1.2x108/m2  donor-derived virus-specific T-cells | 38% CR (2/3 patients in CR at time of treatment)  12% PR | 0% CRS  0% ICANS  0% GvHD | Follow-up still ongoing in 2 CR patients at 2 and 8 months. Third CR lasted 3m |
| (155) (156) | 2013  2016 | NCI | NCT01087294 | CD19 | 2G: CD28 | B-cell malignancy relapsed post allo HSCT | 20 | No conditioning | 1x106 to  10x106/Kg  donor derived T-cells | 30% CR  10% PR | 50% CRS (inferred from information provided)  0% ICANS  0% GvHD | CR sustained for 3-30m at time of writing |
| (16) | 2016 | MDACC | NCT01497184 | CD19 | 2G: CD28 | B-ALL  B-NHL | 19 | Allogeneic HSCT | 106 to 108/m2  Sleeping beauty transposon | 58% CR | 0% CRS  0% ICANS  No exacerbation of GvHD | 53% PFS at 12 mo |
| (157) | 2017 | Multicentre UK & Germany | NCT01195480 | CD19 | 1G | B-ALL (paediatric) relapsed post HSCT or at high risk of relapse post second allo HSCT | 6 | Fludarabine | 4x107-2x108/m2  donor-derived EBV-specific T-cells | 33% CR (2/2 were in CR at time of infusion)  16% PR | 0% CRS  0% ICANS  0% GvHD | One survivor at 3y |
| (157) | 2017 | Multicentre UK & Germany | NCT01195480 | CD19 | 1G | B-ALL (paediatric) relapsed post HSCT or at high risk of relapse post second allo HSCT | 6 | Fludarabine + vaccination with EBV transformed lympho-blastoid cell line | 2x108/m2  donor-derived EBV-specific T-cells | 50% CR (2/3 were in CR at time of infusion) | 0% CRS  0% ICANS  0% GvHD | All patients relapsed |
| (158)  (159) | 2019 | Celyad Oncology | NCT03692429  ALLOSHRINK | NKG2D ligands | 1G plus endog. DAP10  (CYAD-101, also comprising truncated CD3z to reduce  ­­­activation via endog. TCR) | CRC | 15 | Concurrent FOLFOX chemotherapy x 3 cycles | 1x108  3x108  1x109 cells  x 3 infusions with concurrent FOLFOX | 13% PR  60% SD | 0% CRS  0% ICANS  0% GvHD | Med OS 10.6m  Med PFS 3.9m |
| (160)  (161) | 2020 | Allogene  Therapeutics | NCT03939026  (ALPHA) | CD19 | 2G: 41BB  (ALLO-501) | B-NHL | 22 treated  19 evaluable (efficacy) | Flu/Cy/ Allo-647 (two dose levels Allo-647) | 40x106  160x106  360x106 cells  TALEN disruption of TRAC and CD52 | 63% ORR  37% CR  26% PR | 5% CRS  0% ICANS  0% GvHD | 9 of 12 patients remain in response at med follow up of 3.8m |
| (162) (163) | 2020 | Allogene  Therapeutics | NCT04093596  (UNIVERSAL) | BCMA | 2G: 41BB  (ALLO-715) | MM | 31 treated  26 evaluable (efficacy) | Flu/Cy/ Allo-647 (two dose levels Allo-647) or Cy/Allo-647 | 40x106  160x106  320x106  480x106 cells  TALEN disruption of TRAC and CD52 | At dose level 3  60% ORR  40% CR or VGPR | 0% CRS  0% ICANS  0% GvHD | Med follow-up 3.2m  6 /9 treated at DL3 or DL4 still in response |
| (164) | 2020 | CRISPR Therapeutics | NCT04035434  (CARBON) | CD19 | 2G: CD28  (CTX110) | B-NHL | 11 | Flu/Cy | 30x106  100x106  300x106  600x106 cells  CRISPR knock-in at TRAC locus with b2M knockout | 36% CR | 30% CRS  10% ICANS  0% GvHD | Death of only patient treated at highest dose level  (herpes viral reactivation)  CR still ongoing at 1 month |
| (165) | 2020 | MDACC | NCT03056339 | CD19 | 2G: CD28  + IL-15 + inducible caspase 9 suicide gene | B-NHL  B-CLL | 11 | Flu/Cy | 1x105 to  1x107/Kg  Umbilical cord blood derived NK cells | 64% CR  9% PR | 0% CRS  0% ICANS  0% GvHD | Other therapies administered >30d after CAR-NK |
| (166) | 2020 | Multicentre | NCT02808442 &  NCT02746952  (UCART19) | CD19 | 2G: 41BB | B-ALL  (7 pediatric,  14 adults) | 21 | Flu/Cy with or without alemtuzumab | 1·1-2·3 × 106 kg (paediatrics)  6×106, 6-8×107 or 1·8-2·4×108 cells dose-escalation (adults)  TALEN knockout of TRAC and CD52 | 67% CR or CRi | 14% CRS  0% ICANS | 55% OS  27% PFS at 6m |

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